County Council Meeting
Beaufort County, SC

This meeting will be held in Council Chambers, Administration Building Beaufort County Government Robert Smalls Complex 100 Ribaut Road, Beaufort and virtually through Zoom

Monday, November 08, 2021
6:00 PM

AGENDA

1. CALL TO ORDER
2. PLEDGE OF ALLEGIANCE AND INVOCATION - Council Member Alice Howard
3. PUBLIC NOTIFICATION OF THIS MEETING HAS BEEN PUBLISHED, POSTED, AND DISTRIBUTED IN COMPLIANCE WITH THE SOUTH CAROLINA FREEDOM OF INFORMATION ACT
4. APPROVAL OF AGENDA
5. APPROVAL OF MINUTES
6. ADMINISTRATOR'S REPORT

CITIZEN COMMENTS

7. **CITIZEN COMMENTS - (ANYONE who wishes to speak during the Citizen Comment portion of the meeting will limit their comments to no longer than three (3) minutes (a total of 15 minutes) and will address Council in a respectful manner appropriate to the decorum of the meeting, refraining from the use of profane, abusive, or obscene language)**

COMMITTEE REPORTS

8. LIASION AND COMMITTEE REPORTS

PUBLIC HEARINGS AND ACTION ITEMS

9. APPROVAL OF CONSENT AGENDA
10. MATTERS ARISING OUT OF THE CAUCUS EXECUTIVE SESSION
11. PUBLIC HEARING AND THIRD READING OF AN ORDINANCE ADOPTING THE “ENVISION BEAUFORT COUNTY 2040 COMPREHENSIVE PLAN” AND “BEAUFORT COUNTY CONNECTS BICYCLE AND PEDESTRIAN PLAN 2021” AS AN APPENDIX TO THE PLAN.
12. PUBLIC HEARING AND THIRD READING OF AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE A MODIFICATION OF DRAINAGE EASEMENT ASSOCIATED WITH PARCEL #R112-031-000-0628-0000

13. PUBLIC HEARING AND SECOND READING OF AN ORDINANCE AUTHORIZING THE EXECUTION AND DELIVERY OF AN ACCESS AND UTILITY EASEMENT FOR A PORTION OF A RIGHT OF WAY OWNED BY BEAUFORT COUNTY KNOWN AS CASSIDY DRIVE OFF BUCKWALTER PARKWAY IN BULFFTON TOWNSHIP SOUTH CAROLINA

14. PUBLIC HEARING AND SECOND READING OF AN ORDINANCE DECLARING CERTAIN COUNTY OWNED REAL PROPERTY AS SURPLUS PROPERTY AND AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE ANY AND ALL NECESSARY DOCUMENTS TO SELL REAL PROPERTY IDENTIFIED AS TMS NO. R700 036 000 13J 0000, R700 036 000 0112 0000, R700 036 000 0109 0000, R700 036 000 002C 0000 AND R600 036 000 001B 0000

15. PUBLIC HEARING AND SECOND READING OF AN ORDINANCE regarding a TEXT AMENDMENT TO BEAUFORT COUNTY CODE OF ORDINANCES: ARTICLE VII, DIVISION 4, SECTION 2-508; SECTION 2-509; SECTION 2-513; SECTION 2-517; AND SECTION 2-541 TO UPDATE ADMINISTRATIVE CHANGES, TO PROVIDE NECESSARY CONTRACT DOLLAR THRESHOLD CHANGES AND TO UPDATE EXEMPTION PROVISIONS AND PROCEDURES.

16. FIRST READING OF AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE THE NECESSARY DOCUMENTS TO CONVEY A PORTION OF, ACCEPT A DEED FOR, AND CONVEY A PERPETUAL EASEMENT ON A PORTION OF PROPERTY OWNED BY BEAUFORT COUNTY WITH TMS NO. R600 021 000 0673 0000; EXECUTE AN AMENDMENT TO A DEED OF PERPETUAL EASEMENT ON A PORTION OF THE PROPERTY WITH TMS NO. R600 021 000 0007 0000; AND ACCEPT A DONATION TO THE RURAL AND CRITICAL LANDS PROGRAM

17. FIRST READING OF AN ORDINANCE TO AMEND THE STORMWATER MANAGEMENT UTILITY ORDINANCE AS ADOPTED SEPTEMBER 26, 2016 TO PROVIDE FOR THE ADOPTION OF STORMWATER MANAGEMENT STANDARDS SET FORTH IN THE SOUTHERN LOWCOUNTRY DESIGN MANUAL TO MEET THE MUNICIPAL SEPARATE STORMSEWER SYSTEM (MS4) PERMIT REQUIREMENTS

18. FIRST READING OF AN ORDINANCE FOR A TEXT AMENDMENT TO THE STORMWATER MANAGEMENT UTILITY ORDINANCE AS ADOPTED SEPTEMBER 26TH, 2016 TO ADDRESS THE ADOPTION OF THE SOUTHERN LOWCOUNTRY DESIGN MANUAL

19. FIRST READING OF AN ORDINANCE FOR A TEXT AMENDMENT TO THE COMMUNITY DEVELOPMENT CODE (CDC): SECTION A.3.40 (PERMITTED ACTIVITIES) TO REVISE THE LADY'S ISLAND EXPANDED HOME BUSINESS DISTRICT TO INCLUDE SHORT-TERM RENTALS AS A SPECIAL USE.

20. A RESOLUTION ESTABLISHING THE CRITERIA TO BE USED FOR THE REAPPORTIONMENT OF ALL COUNTY COUNCIL DISTRICTS AS TO POPULATION FOLLOWING THE ADOPTION BY THE STATE OF THE FEDERAL DECENNIAL CENSUS AS REQUIRED BY S.C. CODE ANN. SEC. 4-9-90

21. APPROVAL OF MONDAY, DECEMBER 27, 2021, AS AN ADDITIONAL CHRISTMAS HOLIDAY FOR THE BEAUFORT COUNTY EMPLOYEES.

CITIZEN COMMENTS

22. CITIZEN COMMENTS - (ANYONE who wishes to speak during the Citizen Comment portion of the meeting will limit their comments to no longer than three (3) minutes (a total of 15 minutes) and will address Council in a respectful manner appropriate to the decorum of the meeting, refraining from the use of profane, abusive, or obscene language)

23. ADJOURNMENT

CONSENT AGENDA

Items Originating from the Executive Committee

1. RESOLUTION TO ACCEPT OPERATION MARIPOSA GRANT IN THE AMOUNT OF $260,311

2. AUTHORIZATION FOR THE ALCOHOL AND DRUG ABUSE DEPARTMENT TO APPLY FOR THE RURAL OPIOID IMPLEMENTATION RFP- 2022

Items Originating from the Natural Resources Committee

3. APPOINTMENT OF GAIL MURRAY TO THE PLANNING COMMISSION FOR A PARTIAL 1st TERM WITH AN EXPIRATION DATE OF 2024

4. APPOINTMENT OF JANE FREDERICK TO THE ZONING BOARD WITH AN EXPIRATION DATE OF 2024

5. APPOINTMENT OF WILLIAM BEDINGFIELD TO THE SOUTHERN BEAUFORT COUNTY CORRIDOR BEAUTIFICATION BOARD WITH AN EXPIRATION DATE OF 2024

END OF CONSENT AGENDA

Caucus

Beaufort County, SC

This meeting was held both in person at County Council Chambers, 100 Ribaut Road, Beaufort, and also virtually through Zoom.

Monday, August 23, 2021
5:00 PM

MINUTES

1. **CALL TO ORDER**

Council Chairman Passiment called the meeting to order at 5:00 PM

PRESENT
Chairman Joseph F. Passiment
Vice-Chairman D. Paul Sommerville
Council Member Logan Cunningham
Council Member Gerald Dawson
Council Member Brian Flewelling
Council Member York Glover
Council Member Stu Rodman
Council Member Chris Hervochon
Council Member Alice Howard
Council Member Mark Lawson
Council Member Lawrence McElynn

2. **PLEDGE OF ALLEGIANCE**

Chairman Passiment led the Pledge of Allegiance.

3. **FOIA**

Chairman Passiment noted that the Public Notification of this meeting has been published, posted, and distributed in compliance with the South Carolina Freedom of Information Act.

4. **APPROVAL OF THE AGENDA**

Motion: It was moved by Council Member Cunningham, seconded by Council Member Glover to approve the Caucus agenda. The motion was approved without objection.

5. **AGENDA REVIEW**

Chairman Passiment stated that on the County Council Consent Agenda item#16 has a typo and the figure should be $1,500,000, not $500,000.

Vice-Chairman Sommerville stated Item #10 and Item #11 need to be discussed instead of being on the consent agenda.

6. **COUNCIL MEMBER DISCUSSION**

None

7. **EXECUTIVE SESSION**

Motion: It was moved by Vice-Chairman Sommerville, Seconded by Council Member Howard to go into Executive Session to discuss negotiations incident to proposed contractual arrangements and proposed sale or purchase of property and to receive legal advice where the advice relates to matters covered by the attorney-client privilege. The motion was approved without objection.

8. **ADJOURNMENT**

The meeting was adjourned at 6:00 PM

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ______________________________________
Joseph F. Passiment, Jr., Chairman

ATTEST:

____
Sarah W. Brock, Clerk to Council
Ratified:

County Council Meeting

Beaufort County, SC

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Monday, August 23, 2021
6:00 PM

MINUTES

1. **CALL TO ORDER**

Chairman Passiment called the meeting to order at 6:00 PM.

PRESENT

Chairman Joseph F. Passiment
Vice-Chairman D. Paul Sommerville
Council Member York Glover
Council Member Chris Hervochon
Council Member Stu Rodman
Council Member Alice Howard
Council Member Mark Lawson
Council Member Lawrence McElynn
Council Member Gerald Dawson
Council Member Brian Flewelling
Council Member Logan Cunningham

2. **PLEDGE OF ALLEGIANCE AND INVOCATION**

Council Member Stu Rodman led the Pledge of Allegiance and gave the invocation.

3. **FOIA**

Chairman Passiment noted that the Public Notification of this meeting has been published, posted, and distributed in compliance with the South Carolina Freedom of Information Act.

4. **APPROVAL OF AGENDA**

Motion to Amend: It was moved by Council Member Dawson, seconded by Council Member Howard to amend the agenda by removing items 4, 10, and 11 from the consent agenda so they can vote on separately. The motion was approved without objection.

Motion: It was moved by Vice-Chairman Sommerville, seconded by Council Member Glover to approve the agenda as amended. The motion was approved without objection.

5. **ADMINISTRATOR'S REPORT**

To see County Administrator, Eric Greenway's report please click the link below.

https://beaufortcountysc.new.swagit.com/videos/135905

6. **CITIZEN COMMENTS**

Tony Cristello spoke in favor of an environmental education center at Bindon Plantation.

Morris Campbell, Beaufort County Retiree, encouraged County Council to make sure employees, retired or not, are all treated fairly and receive the benefits they deserve.

Gerald Cramer encouraged County Council to come up with a more fair and equal finding for Beaufort County Schools.

Jocelyn Steiger with the Hilton Head Island Assoc. of Realtors stated they are opposed to the proposed coastal resilience overlay zone standards ordinance.

Janet Gresham, CEO of the Beaufort Jasper Realtors Association, spoke against the proposed coastal resilience overlay zone standards ordinance.

Miriam Mitchell, Beaufort County Retiree, urged County Council to reconsider actions taken against Beaufort County Retirees regarding their benefits and correct their mistake.

To see the full comments please click the link below:
https://beaufortcountysc.new.swagit.com/videos/135905

7. **LIASION AND COMMITTEE REPORTS**

Council Member McElynn, Chair of the Community Services/Public Safety Committee encouraged all citizens to get vaccinated.

Council Member Lawson, Chair of the Finance Committee, provided summary of the items that were coming forward from the Finance Committee for consideration for approval on the consent agenda.

Council Member Howard, Chair of the Natural Resources Committee, provided summary of the items that were coming forward from the Natural Resources Committee for consideration for approval on the consent agenda.

Council Member Rodman, Chair of Public Facilities, provided summary of the items that were coming forward from the Public Facilities Committee for consideration for approval on the consent agenda.

8. **APPROVAL OF CONSENT AGENDA**

Motion: It was moved by Council Member Howard, seconded by Council Member Dawson to approve Consent Agenda excluding agenda items#4, item#10, and item#11. The motion was approved without objection.

Discussion: To see the full discussion click the link below
https://beaufortcountysc.new.swagit.com/videos/135905

9. **MATTERS ARISING OUT OF EXECUTIVE SESSION DURING CAUCUS MEETING**

4. **OFFER OF PAYMENT TO RETIREES FOR LOSS OF POST-RETIREMENT HEALTH INSURANCE BENEFITS**

Motion: It was moved by made by Council Member Rodman, seconded by Vice-Chairman Sommerville to approve offer of payment to retirees for loss of Post-Retirement Health Insurance Benefits. The motion was approved.

Discussion: To see the full discussion click the link below:

https://beaufortcountysc.new.swagit.com/videos/135905

The Vote - Voting Yea: Chairman Passiment, Vice Chairman Sommerville, Council Member Glover, Council Member Hervochon, Council Member Rodman, Council Member Howard, Council Member Lawson, Council Member McElynn, Council Member Flewelling, Council Member Cunningham. **Voting Abstaining**: Council Member Dawson. Motion approved 10:0:1

CONSENT AGENDA ITEMS PULLED OFF

10. **FIRST READING OF AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE THE DOCUMENTS NECESSARY TO CONVEY A PORTION OF PROPERTY OWNED BY BEAUFORT COUNTY KNOWN AS OKATIE RIVER PARK WITH TMS NO. R600 021 000 0673 0000**

11. **FIRST READING OF AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE AN AMENDMENT TO A DEED OF PERPETUAL EASEMENT TO ALLOW FOR PUBLIC VEHICULAR ACCESS AND TO PROVIDE ADDITIONAL TERMS ON A PORTION OF THE PROPERTY WITH TMS NO. R600 021 000 0007 0000**

Discussion: To see the full discussion click the link below:

https://beaufortcountysc.new.swagit.com/videos/135905

Motion: It was moved by Council Member Cunningham, seconded by Council Member Rodman to approve item#10 first reading of an ordinance authorizing the county administrator to execute the documents necessary to convey a portion of property owned by Beaufort County known As Okatie River Park with TMS NO. R600 021 000 0673 0000 and item#11 first reading of an ordinance authorizing the county administrator to execute an amendment to a deed of perpetual easement to allow for public vehicular access and to provide additional terms on a portion of the property with TMS NO. R600 021 000 0007 0000.

Discussion: To see the full discussion click the link below:

https://beaufortcountysc.new.swagit.com/videos/135905

Motion to Amend: It was moved by Vice-Chairman Sommerville, seconded by Council Member Howard to postpone both item#10 and item#11 until there is a clear understanding from the legal department of all the issues associated with these parcels and ask staff to do the research and bring a report back to Natural Resources next committee meeting. The amended motion was approved without objection.

10. **THIRD READING AND PUBLIC HEARING OF AN ORDINANCE FOR A ZONING MAP AMENDMENT/REZONING REQUEST FOR 5.23 ACRES (R100 027 000 042B 0000) AT 335 JOE FRAZIER RD FROM T2 RURAL TO T2 RURAL CENTER**

Motion: It was moved by Vice-Chairman Sommerville, seconded by Council Member Flewelling to approve an ordinance for A Zoning map Amendment/Rezoning request for 5.23 acres (R100 027 000 042B 0000) at 335 Joe Frazier Rd from T2 Rural to T2 Rural Center.

The Chairman opened the floor for a public hearing

Billy Player commented on the property at 335 Joe Frazier.

The Chairman closed public hearing

The Vote - Voting Yea: Chairman Passiment, Vice Chairman Sommerville, Council Member Hervochon, Council Member Rodman, Council Member Lawson, Council Member McElynn, Council Member Dawson, Council Member Flewelling, Council Member Cunningham. Voting Nay: Council Member Glover, Council Member Howard. The motion passed 9:2.

Extend past 8 o'clock.

Motion: It was moved by Council Member Rodman, seconded by Council Member Cunningham to extend past 8 O'Clock.

The Vote - Voting Yea: Chairman Passiment, Vice Chairman Sommerville, Council Member Hervochon, Council Member Rodman, Council Member Howard, Council Member Lawson, Council Member Flewelling, Council Member Cunningham. Voting Nay: Council Member Glover, Council Member Dawson. The motion passed 9:2.

11. **FIRST READING OF AN ORDINANCE FOR A TEXT AMENDMENT TO SECTION 3.4.90 OF THE COMMUNITY DEVELOPMENT CODE TO ADD A COASTAL RESILIENCE OVERLAY DISTRICT TO REQUIRE REAL ESTATE DISCLOSURE WHEN PROPERTY IS TRANSFERRED IN ZONE X (SHADED).**

Motion: It was moved by Council Member Howard, seconded by Council Member Glover to approve first reading of an ordinance for A text amendment to Section 3.4.90 of the Community Development Code to add a Coastal Resilience Overlay District to require real estate disclosure when property is transferred in Zone X (shaded).

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/135905

Voting Yea: Chairman Passiment, Vice Chairman Sommerville, Council Member Glover, Council Member Howard, Council Member McElynn, Council Member Dawson. Voting Nay: Council Member Hervochon, Council Member Rodman, Council Member Lawson, Council Member Flewelling, Council Member Cunningham. The motion passed 6:5.

12. **A RESOLUTION TO EXPRESS BEAUFORT COUNTY COUNCIL'S REQUEST THAT THE SC GENERAL ASSEMBLY TAKE THE NECESSARY ACTIONS TO CONTINUE TO ALLOW LOCAL GOVERNMENTS TO COLLECT USER FEES THAT FUND CRITICAL NEEDS SUCH AS PUBLIC SAFETY AND INFRASTRUCTURE**

Motion: It was moved by Council Member Hervochon, seconded by Council Member Glover to approve a resolution to express Beaufort County Council's request that the SC General Assembly take the necessary actions to continue to allow local governments to collect user fees that fund critical needs such as Public Safety and Infrastructure. The motion was approved with objection.

13. CITIZEN COMMENTS

Mr. Tony Criscitiello commented on Botanical Garden on Bindon Plantation.

14. **ADJOURNMENT**

The meeting adjourned at 8:04 PM.

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ______________________________________

Joseph F. Passiment, Jr., Chairman

ATTEST:

____

Sarah W. Brock, Clerk to Council

Ratified:

Caucus

Beaufort County, SC

This meeting was held both in person in Council Chambers at 100 Ribaut Road, Beaufort, and virtually through Zoom.

Monday, September 13, 2021
5:00 PM

MINUTES

1. **CALL TO ORDER**

Council Chairman Passiment called the meeting to order at 5:00 PM

PRESENT
Chairman Joseph F. Passiment
Vice Chairman D. Paul Sommerville
Council Member Logan Cunningham
Council Member Gerald Dawson
Council Member Brian Flewelling
Council Member Stu Rodman
Council Member Alice Howard
Council Member Mark Lawson
Council Member Lawrence McElynn

ABSENT
Council Member York Glover
Council Member Chris Hervochon

2. **PLEDGE OF ALLEGIANCE**

Council Member Dawson led the Pledge of Allegiance.

3. **FOIA**

Chairman Passiment noted that the Public Notification of this meeting has been published, posted, and distributed in compliance with the South Carolina Freedom of Information Act.

4. **APPROVAL OF THE AGENDA**

Motion to Amend: It was moved by Council Member Cunningham, seconded by Council Member Flewelling to add a Citizens Comment to the Caucus agenda. The motion was approved without objection.

Motion: It was moved by Council Member Flewelling, seconded by Council Member Cunningham to approve the amended agenda. The motion was approved without objection.

Citizens Comment

Eddy Gugino spoke regarding censorship

Barbara States spoke regarding censorship

5. **AGENDA REVIEW**

Chairman Passiment stated item # 18 will be done in two parts. There will be a motion for the statement and the second part of the motion is to move the matter to Natural Resources Committee.

6. **COUNCIL MEMBER DISCUSSION**

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139412

7. **EXECUTIVE SESSION**

Motion: It was moved by Council Member Rodman, seconded by Council Member Howard to go into Executive Session. The motion was approved without objection.

8. **ADJOURNMENT**

The meeting adjourned at 5:43 PM.

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ______________________________________

Joseph F. Passiment, Jr., Chairman

ATTEST:

____

Sarah W. Brock, Clerk to Council
Ratified:

County Council Meeting
Beaufort County, SC

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Monday, September 13, 2021
6:00 PM

MINUTES

1. **CALL TO ORDER**

Chairman Passiment called the meeting to order at 6:00 PM.

PRESENT
Chairman Joseph F. Passiment
Vice Chairman D. Paul Sommerville
Council Member York Glover
Council Member Stu Rodman
Council Member Alice Howard
Council Member Mark Lawson
Council Member Lawrence McElynn
Council Member Gerald Dawson
Council Member Brian Flewelling
Council Member Logan Cunningham

ABSENT
Council Member Chris Hervochon

2. **PLEDGE OF ALLEGIANCE AND INVOCATION**

Council Member Gerald Dawson led the Pledge of Allegiance and gave the invocation.

3. **FOIA**

Chairman Passiment stated public notice of this meeting had been published, posted, and distributed in compliance with the SC FOIA Act.

4. **APPROVAL OF AGENDA**

Motion: It was moved by Council Member Rodman, seconded by Council Member Flewelling to approve the agenda. The motion was approved without objection.

5. **ADMINISTRATOR'S REPORT**

To see County Administrator, Eric Greenway's report please click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

6. **PROCLAMATION PRESENTED TO BEAUFORT COUNTY ALCOHOL AND DRUG ABUSE DEPARTMENT-RECOVERY MONTH - Presented by Council Member Larry McElynn**

Council Member Larry McElynn presented a proclamation honoring the Beaufort County Alcohol and Drug Abuse Department.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

7. **PROCLAMATION HONORING GRACE DENNIS FOR HER YEARS OF SERVICE ON THE BEAUFORT COUNTY DISABILITY AND SPECIAL NEEDS BOARD - Presented by Council Member York Glover**

Council Member Alice Howard presented a proclamation honoring Grace Dennis for her years of service on the Disabilities and Special Needs Board.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

8. **CITIZEN COMMENTS**

Mary Ann Rolands, Friends of Fort Freemont, commented on Fort Freemont
Anthony Criscitiello commented on a botanical garden at Bindon Plantation.
Lisa Laking commented on social media outlets and COVID rules and regulations.
Scott Anderson commented on transparency and mask mandates.
Henry Mice commented on the mask ordinance.
Edwin Cagina commented on the mask ordinance.
Cheryl Norris commented on transparency.

9. **MATTERS ARISING OUT OF EXECUTIVE SESSION**

No matters arising out of executive session.

10. **LIASION AND COMMITTEE REPORTS**

Council Member McElynn reviewed consent agenda items in the Community Services and Public Safety Committee.

Vice-Chairman Sommerville reviewed consent agenda items in the Executive Committee.

Council Member Howard reviewed consent agenda items in the Natural Resources Committee.

Council Member Lawson reviewed consent agenda items in the Finance Committee.

Council Member Rodman reviewed consent agenda items in the Public Facilities.

11. **APPROVAL OF CONSENT AGENDA**

Motion: It was moved by Council Member Howard, seconded by Council Member Rodman to approve the consent agenda. The motion was approved without objection.

12. **ADOPTION OF RECOMMENDATIONS OF THE COVID-19 AD HOC COMMITTEE**

Motion: It was moved by Council Member McElynn, seconded by Council Member Glover to recommend to County Administrator for his consideration and adoption and/or implementation as he believes appropriate and that the County Council Chairman instruct all Boards and Commissions and the County Council to adhere to those implemented measures for 90 days from the effective date of September 14th, 2021.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

Motion to Amend: It was moved by Council Member Flewelling, seconded by Council Member Cunningham to remove " the use of masks from employees and visitors" from the recommendation.

The Vote - Voting Yea: Council Member Lawson, Council Member Flewelling, Council Member Cunningham. Voting Nay: Chairman Passiment, Vice Chairman Sommerville, Council Member Glover, Council Member Rodman, Council Member Howard, Council Member McElynn, Council Member Dawson. The motion failed 3:7.

Back to Main Motion - The Vote - Voting Yea: Chairman Passiment, Vice Chairman Sommerville, Council Member Glover, Council Member Rodman, Council Member Howard, Council Member McElynn, Council Member Dawson. Voting Nay: Council Member Lawson, Council Member Flewelling, Council Member Cunningham. The Motion passed 7:3.

13. **CONSIDERATION OF AN AUTHORIZATION TO ALLOW THE COUNTY ADMINISTRATOR TO SIGN A CDBG GRANT CERTIFICATION AND ENTER INTO AN IGA WITH TOWN OF RIDGELAND FOR A CDBG GRANT.**

Motion: It was moved by Council Member Flewelling, seconded by Council Member Howard to approve an authorization to allow the County Administrator to sign a CDBG Grant Certification and enter into an IGA with Town of Ridgeland for a CDBG Grant. The motion was approved without objection.

14. **A RESOLUTION RECOGNIZING THE POLICY SUPPORTING FAIR HOUSING FOR ALL NOT ONLY DURING FAIR HOUSING MONTH, BUT THROUGHOUT THE YEAR**

Motion: It was moved by Council Member Howard, seconded by Council Member Dawson to approve a resolution recognizing the policy supporting Fair Housing for all not only during Fair Housing Month but throughout the year. The motion was approved without objection.

15. **FIRST READING OF A TEXT AMENDMENT TO BEAUFORT COUNTY CODE OF ORDINANCES, CHAPTER 42, ARTICLE II, DIVISION 3, SECTION 42.-81 TO UPDATE BOUNDARIES (SHELDON FIRE DISTRICT)**

Motion: It was moved by Council Member Dawson, seconded by Council Member Flewelling to approve a text amendment to Beaufort County Code of Ordinances, Chapter 42, Article II, Division 3, Section 42.-81 to update Boundaries (Sheldon Fire District). the motion was approved without objection.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

16. **FIRST READING OF AN ORDINANCE REGARDING A TEXT AMENDMENT TO THE COMMUNITY DEVELOPMENT CODE (CDC): SECTION 3.1.60 (CONSOLIDATED USE TABLE) AND SECTION 4.1.190 (RECREATION FACILITY: CAMPGROUNDS) TO REVISE THE CAMPGROUND STANDARDS**

Motion: It was moved by Council Member Flewelling, seconded by Council Member Howard to approve an ordinance regarding a Text Amendment to the Community Development Code (CDC): Section 3.1.60 (Consolidated Use Table) and Section 4.1.190 (Recreation Facility: Campgrounds) to revise the Campground Standards. The motion was approved without objection.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

17. **PUBLIC HEARING CONCERNING APPLICATIONS TO BE SUBMITTED TO THE SOUTH CAROLINA DEPARTMENT OF COMMERCE**

Motion: It was moved by Council Member Flewelling, seconded by Council Member Dawson to approve applications to be submitted to the South Carolina Department of Commerce.

The Chairman opened the floor for a public hearing.

No one came forward.

The Chairman closed the public hearing.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

The Vote - The motion was approved without objection

18. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE FOR A TEXT AMENDMENT TO SECTION 3.4.90 OF THE COMMUNITY DEVELOPMENT CODE TO ADD A COASTAL RESILIENCE OVERLAY DISTRICT TO REQUIRE REAL ESTATE DISCLOSURE WHEN PROPERTY IN TRANSFERRED IN ZONE X (SHADED)**

Motion: It was moved by Vice-Chairman Sommerville, seconded by Council Member Howard to move back to Natural Resources to have staff review and revise.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

The Vote - The motion was approved without objection.

19. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE TO AMEND BEAUFORT COUNTY ORDINANCE 2020/_30__ FOR FISCAL YEAR 2021-22 BEAUFORT COUNTY BUDGET TO PROVIDE FOR THE CARRYOVER OF CERTAIN EXPENDITURES FROM FY 2020-21.**

Motion: It was moved by Council Member Rodman, seconded by Council Member Cunningham to approve second reading of an ordinance to amend Beaufort County Ordinance 2020/30 for the fiscal year 2021-22 Beaufort County Budget to provide for the carryover of certain expenditures from FY 2020-21.

The Chairman opened the floor for a public hearing.

No one came forward.

The Chairman closed the public hearing.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

The Vote - The motion was approved without objection.

20. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE AUTHORIZING THE RE-DIRECTION AND EXPENDITURE OF A PORTION OF THE PROCEEDS OF THE BEAUFORT COUNTY, GENERAL OBLIGATION BONDS, SERIES 2020; AND OTHER MATTERS RELATING THERETO**

Motion: It was moved by Council Member Lawson, seconded by Council Member Rodman to approve the second reading of an ordinance authorizing the re-direction and expenditure of a portion of the proceeds of the Beaufort County, General Obligation Bonds, Series 2020; and other matters relating thereto.

The Chairman opened the floor for a public hearing.

No one came forward.

The Chairman closed the public hearing.

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

The Vote - The motion was approved without objection.

21. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE FOR A TEXT AMENDMENT TO THE COMMUNITY DEVELOPMENT CODE (CDC): SECTION 5.5.30.B.1 (GENERAL PARKING STANDARDS, OFF-SITE/PREMISES PARKING) TO PROVIDE ADDITIONAL FLEXIBILITY**

Motion: It was moved by Council Member Howard, seconded by Council Member Glover to approve second reading of an ordinance for a text amendment to the Community Development Code (CDC): Section 5.5.30.b.1 (general parking standards, off-site/premises parking) to provide additional flexibility.

The Chairman opened the floor for a public hearing.

No one came forward.

The Chairman closed the public hearing.

The Vote - The motion was approved without objection.

22. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE FOR A ZONING MAP AMENDMENT/REZONING REQUEST FOR 3.09 ACRES OF PROPERTY IDENTIFIED AS R100 024 000 0423 0000 LOCATED AT 24 ZEHM LANE, FROM S1 INDUSTRIAL TO C3 NEIGHBORHOOD MIXED USE DISTRICT**

Motion: It was moved by Council Member Howard, seconded by Council Member Dawson to approve second reading of an ordinance for a zoning map amendment/rezoning request for 3.09 acres of property identified as R100 024 000 0423 0000 located at 24 Zehm Lane, from S1 Industrial to C3 neighborhood mixed use district.

The Chairman opened the floor for a public hearing.

No one came forward.

The Chairman closed the public hearing.

The Vote - The motion was approved without objection.

23. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE AUTHORIZING THE ABANDONMENT OF AN EASEMENT ENCUMBERING PROPERTY IDENTIFIED AS TMS NO. R100 016 000 0199 0000**

Motion: It was moved by Council Member McElynn, seconded by Council Member Lawson to approve second reading of an ordinance authorizing the abandonment of an easement encumbering property identified as TMS no. R100 016 000 0199 0000.

The Chairman opened the floor for a public hearing.

No one came forward.

The Chairman closed the public hearing.

The Vote - The motion was approved without objection.

24. **PUBLIC HEARING AND SECOND READING OF AN ORDINANCE FOR A TEXT AMENDEMENT TO ARTICLE 5 ADDING A NEW DIVISION 5.13 TITLED "FILL STANDARDS" TO LIMIT THE AMOUNT OF FILL ON LOW-LYING AREAS**

Motion: It was moved by Council Member Howard, seconded by Council Member Glover to approve public hearing and second reading of an ordinance for a text amendment to Article 5 adding a new division 5.13 titled "Fill Standards" to limit the amount of fill on low-lying areas.

Public Comment:

Chuck Newton commented on fill standards

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

The Vote - The motion was approved without objection.

25. **TEXT AMENDMENT TO THE BEAUFORT COUNTY COMPREHENSIVE PLAN TO AMEND CHAPTER 12 (PRIORITY INVESTMENT) TO INCLUDE AN ENVIRONMENTAL EDUCATION CENTER AT BINDON PLANTATION IN THE 10-YEAR CAPITAL IMPROVEMENTS PLAN (CIP)**

Robert Merchant stated Bindon Plantation is a 1,317-acre parcel located on US 17 in northern Beaufort County approximately 2 miles from Points South. The property is preserved by a conservation easement purchased by the Rural and Critical Lands Preservation Program (RCLPP) in 2012. The proposal calls for the RCLPP to purchase 50 acres to develop a passive park. This park was originally intended to be a future phase of the preservation of Bindon Plantation. The park is also referenced in the Bindon Plantation Conservation Easement addendum that outlined the Beaufort County Open Land Trust's plans for the property. The County does not own the property or have an identified funding source to cover land acquisition or park improvements. The proposal is to amend the 10-year Capital Improvements Plan in the Priority Investment Chapter to include an Environmental Education Center at Bindon Plantation. This item went before the Beaufort County Planning Commission at their June 7 meeting where they voted to support the amendment. The Natural Resources Committee unanimously rejected the proposed amendment at their September 7 meeting.

Motion: It was moved by Council Member Flewelling, seconded by Council Member Rodman to approve Text amendment to the Beaufort County Comprehensive Plan to Amend Chapter 12 (Priority Investment) to include an Environmental Education Center at Bindon Plantation in the 10-year Capital Improvements Plan (CIP).

Discussion: To see the full discussion click the link below.

https://beaufortcountysc.new.swagit.com/videos/139407

The Vote - Voting Nae: Chairman Passiment, Vice Chairman Sommerville, Council Member Glover, Council

Member Rodman, Council Member Howard, Council Member Lawson, Council Member McElynn, Council Member Dawson, Council Member Flewelling, Council Member Cunningham. The motion failed 0:10

Motion to Extend:

Motion: It was moved by Council Member Rodman, seconded by Council Member Flewelling to extend past 8 pm. The motion was approved without objection.

26. **CITIZEN COMMENTS**

Steven Shultz commented on the covid ad-hoc committee.
Debbie Barton spoke against Mask and for Logan Cunningham.
Ms. Gilbert spoke against Mask.
Erik Lawson spoke against vaccines.

27. **ADJOURNMENT**

The meeting adjourned at 8:10 PM

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ______________________________________

Joseph F. Passiment, Jr., Chairman

ATTEST:

____

Sarah W. Brock, Clerk to Council
Ratified:

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

Adoption of "Envision Beaufort County 2040 Comprehensive Plan" and "Beaufort County Connects Bicycle and Pedestrian Plan 2021" as an appendix to the Plan.

MEETING NAME AND DATE:

Beaufort County Council Meeting, October 11, 2021

PRESENTER INFORMATION:

Robert Merchant, AICP, Director, Beaufort County Planning and Zoning (30 min. needed for item discussion)

ITEM BACKGROUND:

State law [Section 6-29-510 (E)] requires that local government comprehensive plans be updated every ten years. The County's current comprehensive plan was prepared in 2010. The Comprehensive Plan is the foundational policy document for the county and provides the legal underpinning that legitimizes local government development regulations. Preparation of the 2040 plan began in January 2020. The Planning Commission unanimously approved the plan at their September 9, 2021 meeting. The plan can be accessed at this link: https://www.envisionbeaufortcounty.com/. At the October 4 meeting, the Natural Resources Committee unanimously approved the plan.

PROJECT / ITEM NARRATIVE:

"Envision Beaufort County" is the result of an 18+-month planning process that involved numerous public input opportunities including three on-line surveys, stakeholder meetings, in-person public workshops, public open houses, as well as public hearings. For ease of use, the plan is divided into three documents—the Beaufort County Atlas (background data), the Comprehensive Plan (core values, strategies, and actions), and the Action Plan Playbook (implementation plan and capital improvement plan). The Greenprint plan, which was updated in conjunction with the comprehensive plan, provides the basis for the land use recommendations and development strategies in the plan.

The plan contains the traditional planning elements required by state law—Natural Environment, Culture, Economy, Mobility, Housing, Community Facilities, and Built Environment—and weaves themes for Resilience, Equity, and Unique to Place throughout the document. The plan continues existing policies and programs while addressing emerging issues including climate change and sea level rise, housing affordability, multimodal transportation including bus rapid transit, and regional cooperation and planning. "Beaufort County Connects: Bicycle and Pedestrian Plan 2021" is a multijurisdictional effort that identifies a comprehensive network of pathways to make walking and cycling a viable option for County residents. Beaufort County Connects will be incorporated into the Comprehensive Plan as Appendix A.

FISCAL IMPACT:

Not applicable.

STAFF RECOMMENDATIONS TO COUNCIL:

Staff recommends approval.

OPTIONS FOR COUNCIL MOTION:

To approve or deny adoption of "Envision Beaufort County 2040 Comprehensive Plan."

ORDINANCE 2021/_____

ADOPTION OF *ENVISION BEAUFORT COUNTY 2040 COMPREHENSIVE PLAN* AND *BEAUFORT COUNTY CONNECTS BICYCLE AND PEDESTRIAN PLAN 2021* AS AN APPENDIX TO THE PLAN

WHEREAS, the comprehensive plan is the foundational policy document for Beaufort County, guiding decisions about land use, mobility, housing, economic development, natural and cultural resources, and resiliency; and

WHEREAS, state law requires that local government comprehensive plans to be reviewed and updated every ten years; and

WHEREAS, Beaufort County's current comprehensive plan was adopted in January 2011; and

WHEREAS, in the winter of 2020, Beaufort County began the process of updating the 2010 comprehensive plan with a series of public workshops, on-line surveys, and stakeholder meetings; and

WHEREAS, in an effort to prepare an easily accessible and usable product, the comprehensive plan was divided into three documents--the Comprehensive Plan, the Beaufort County Atlas, and the Action Plan Playbook; and

WHEREAS, the County, guided by a task force comprised of citizens and staff from all participating local jurisdictions produced *Beaufort County Connects Bicycle and Pedestrian Plan 2021*, designed to be an appendix of the comprehensive plan; and

WHEREAS, the Planning Commission held a public hearing on September 9, 2021 where they unanimously recommended approval of *Envision Beaufort County 2040 Comprehensive Plan* and *Beaufort County Connects Bicycle and Pedestrian Plan 2021*;

NOW, THEREFORE, BE IT ORDAINED that the County Council of Beaufort County, South Carolina hereby adopts the following documents comprising Beaufort County's comprehensive plan:

- *Envision Beaufort County 2040 Comprehensive Plan;*
- *Beaufort County Atlas;*
- *2040 Action Plan Playbook;* and
- *Beaufort County Connects Bicycle and Pedestrian Plan 2021* as Appendix A of *Envision Beaufort County*.

Adopted this ____ day of ____________, 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ________________________________

Joseph Passiment, Chairman

ATTEST:

____

Sarah W. Brock, Clerk to Council

BEAUFORT COUNTY CONNECTS

Bicycle and Pedestrian Plan 2021

ACKNOWLEDGMENTS

BEAUFORT COUNTY BICYCLE AND PEDESTRIAN TASK FORCE

Juliana Smith | *Beaufort County*
Noah Krepps | *Beaufort County*
Robert Merchant, AICP | *Beaufort County*
Alan Seifert, AICP | *Town of Bluffton*
Bill Partington | *Bluffton Resident*
Brent Buice | *East Coast Greenway*
C. William Brewer, P.E. | *Palmetto Cycling Coalition and Hilton Head Cycling, Inc.*
Carol Crutchfield | *Beaufort County School District*
Christian Dammel | *Lowcountry Council of Governments*
David Kimball | *Sun City Cyclers*
David Prichard, AICP | *City of Beaufort*
Dean Moss | *Executive Director, Friends of the Spanish Moss Trail*
Frank Babel | *Bike Walk HHI*
Heather Spade | *City of Beaufort*
Jennifer Ray | *Town of Hilton Head Island*
Jessie White | *South Coast Office Director, Coastal Conservation League*
John Feeser | *Owner, Lowcountry Bicycles*
Karen Heitman | *Sun City Cyclers*
Linda Bridges | *Town of Port Royal*
Missy Luick | *Town of Hilton Head Island*
Stephanie Rossi | *Lowcountry Council of Governments*

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Beaufort County and its municipalities have seen exponential growth in recent decades and trends indicate growth will not slow down over the next ten years. This means the area will see more housing, more infrastructure, more jobs, and more traffic.

As communities and roadways grow increasingly congested and concerns over the environmental impacts of driving increase, interest in walking and bicycling as a mode of transportation will grow. With it, the need for transportation options that help reduce traffic congestion while improving access to economic hubs, community amenities, natural resources, and schools for all communities increases. And because development to accommodate growth is happening quickly, pathway corridors need to be identified and secured as soon as possible.

As the County and its municipalities prepare for future growth, it is imperative that coordinated planning for bicycle and pedestrian infrastructure happens now.

The *Beaufort County Connects: Bicycle and Pedestrian Plan 2021* is a proactive planning tool that supports improved access to bicycle and pedestrian infrastructure throughout the County and its municipalities. It is the result of a year-long, collaborative effort of a Bicycle/Pedestrian Taskforce made up of members from Beaufort County, the City of Beaufort, the Town of Port Royal, the Town of Bluffton, the Town of Hilton Head Island, the City of Hardeeville, Jasper County, the Lowcountry Council of Governments, community and advocacy groups, and bike and pedestrian citizen advocates. Because of the regional collaboration that went into building the plan, it identifies bicycle and pedestrian infrastructure gaps and needs, recommends proactive policies, provides an implementation plan, and offers funding sources that apply to each jurisdiction and will improve the bicycle and pedestrian network throughout the county.

Several initiatives went into building the plan, including a public surveying exercise, public mapping exercise, and input collection from each participating municipality. Nearly 2,000 members of the public responded to the survey and mapping exercises. Over 60% of the respondents indicated access to bicycle and pedestrian facilities is an important factor in deciding where to live and work. Yet, almost half of them reported that though they have an interest in cycling or walking, they often don't because of concerns about the lack of safe facilities and wayfinding. This same group reported wanting walking or biking to be their primary mode of transportation. Clearly, there is a need and desire for a better, more interconnected network of bicycling and pedestrian infrastructure throughout Beaufort County. The objective of this plan is to provide Beaufort County residents with a connected, safe network that meets the needs of all of its diverse users.

During the mapping exercise, the needs of the community were identified. The top six areas reported as needing safe bicycle and pedestrian routes or improvements are:

1. Downtown Beaufort to the Spanish Moss Trail (Beaufort)
2. May River Road (Bluffton)
3. Sams Point Road/Brickyard Road/ Middle Road (Lady's Island)
4. Buck Island Road between Bluffton Parkway and US 278 (Bluffton)
5. SC 170 connecting the Northern and Southern halves of Beaufort County
6. Main Street (Hilton Head Island)

Input gathered from the public and collaborative feedback between local jurisdictions developed three major themes that the plan seeks to address. Creating more connections between neighborhoods, economic hubs, civic areas, and existing bicycle and pedestrian trails. Developing a Spine and Spur framework for building a network where a primary spine route connects northern and southern Beaufort County and smaller spur routes connect the spine to destinations. And targeting the "interested but concerned" group of riders and walkers for outreach efforts and education to promote bicycle and pedestrian transportation.

In total, 139 miles of trails and sidewalks, costing approximately $84 million to build, were identified and included in the plan. The completed network will include four types of bicycle and pedestrian facilities:

- On-road facilities, like protected bike lanes
- Road-separated multi-use paths, like the Spanish Moss Trail
- Low volume/low speed bike-friendly streets
- Sidewalks

In order to successfully build the network, the plan recommends important policies that will ensure the primary themes are addressed and all residents and visitors in Beaufort County have access to safe bicycle and pedestrian paths.

Critical policies that will support successful implementation include:

1. Adoption of *Beaufort County Connects: Bicycle and Pedestrian Plan 2021* by resolution within each jurisdiction and incorporation into their respective Comprehensive Plans.
2. Creation of a staff position within Beaufort County government whose primary responsibility is to oversee the implementation of *Beaufort County Connects 2021* and collaborate with jurisdictions and local, state, and federal agencies to secure funding for and manage development of paths.
3. Consideration of a 2022 ballot initiative to re-impose the 1% capital project sales tax to continue to fund transportation improvements including complete streets and multi-use paths. Additionally, establishment of a regular schedule for future referendums to continue funding these initiatives.

4. Coordination with the Lowcounty Area Transportation Study (LATS) during the update to the Long Range Transportation Plan to incorporate the projects listed in *Beaufort County Connects 2021* and advocate for a target percentage of funding to be devoted to bike and pedestrian facilities.

Additionally, the plan calls for the creation of a Bicycle and Pedestrian Advisory Committee to assist the County and County's bicycle and pedestrian coordinator in planning, funding, development, and implementation of the facilities and programs included in *Beaufort County Connects 2021* to result in increased safety and use of bicycle and pedestrian transportation and recreation.

Important funding sources have been identified to provide a firm financial foundation for the plan, including, but not limited to, federal discretionary grants, community development block grants, capital project sales tax, LATS, foundation grants, and local accommodations taxes. It is imperative that diverse sources of funding are sought and maintained to ensure a consistent revenue stream for developing the projects included in this plan.

Ultimately, *Beaufort County Connects 2021* is a bold, aggressive plan designed to provide a safe, interconnected, and efficient bicycle and pedestrian network for Beaufort County. It will require ongoing collaboration between all jurisdictions, advocacy groups, advisory committees, and a coordinator to be successfully implemented. Fortunately, *Beaufort County Connects 2021* provides the routes, policies, programs, and funding sources to achieve the desired outcome – an enhanced quality of life, improved public health, economic access and opportunity, and equity for people of all races, genders, ages, abilities, and economic statuses throughout Beaufort County.

CHAPTER 1:
INTRODUCTION

WHY PLAN FOR PEDESTRIANS AND BICYCLISTS?

There are things that immediately come to mind when one imagines the unique natural and built environments of Beaufort County – **sprawling salt marshes, rich local culture and history, canopy roads, and small-but-bustling downtowns**. In recent years, the beginnings of a connected multi-use pathway network have found a place on the list of amenities that make the County a highly sought after place to live and visit. The crowds of people that use the Spanish Moss Trail and the extensive pathway network on Hilton Head Island stand as proof that **people, residents and visitors alike, want access to a safe and connected bicycle and pedestrian network.**

"[Cycling] is by far my favorite activity [on] Hilton Head. I've never seen anything so remarkable…" "...The trails are beautiful, diverse and functional. They're also safe and well-marked. **This is what it should be like in every community.**"

-Trip Advisor Review, September 2020

The benefits of bicycle and pedestrian infrastructure extend to all aspects of a community. From physical/ mental health and social bonding, to tourism dollars, job creation, and emissions reductions, we can vastly improve the state of the region and the quality of life of its residents by taking bold, consistent steps to provide pathway access to all.

TRANSFORMING TRANSPORTATION

Bicycle and pedestrian facilities are a vital component of Beaufort County's regional transportation network. A connected network of multi-use paths promotes healthier lifestyles, improves real estate values, attracts knowledge based-industries, and **provides an alternative mode of transportation for all residents.**

This is a critical time to implement bike and pedestrian facilities:

- Traffic volumes on Lady's Island are increasing at a rate of 1.6% annually based on data from the last 10 years.
- On Sea Island Parkway near Meridian Road, traffic increased by 12% between 2009 and 2019; just east of the Lady's Island Drive intersection, traffic increased by 24%.
- On US 21 south of Laurel Bay Road, average daily traffic increased 16%.
- In Port Royal on the Russell Bell Bridge, average daily traffic increased 33%.
- In Bluffton, traffic increased by 20% on May River Road and by 35% on US 278.

It is now commonly understood that new or widened roads attract more traffic. This is a concept known as **"induced demand"** and is often summarized with a quote usually attributed to the great American urbanist Lewis Mumford: **"Building more roads to prevent congestion is like a fat man loosening his belt to prevent obesity."** There has to be another way and fortunately, there is - focusing on multi-modal transportation in order to include transit, cycling, and walking. We need to change and broaden our focus from traffic management to mobility. And, it is important to remember that as we implement capital projects, **we need to build communities through transportation, not transportation through communities.**

THE NEED TO MOVE

Not-for-profit hospitals are required to conduct a Community Health Needs Assessment (CHNA) every three years. Beaufort Memorial Hospital (BMH) prepared a CHNA in 2016 and 2019. These documents provide important information on the current well-being of the community and health needs going forward.

South Carolina ranks number 12 in the nation for the rate of adult obesity. Not surprisingly then, obesity is a problem here in Beaufort County. Morbidity data collected for the County in 2013 indicated that 21% of the adult population was obese. By 2019, that number had increased to 23%--almost one in four adults. Excessive weight has been identified as a causal factor in the development of heart disease, diabetes, hypertension, and stroke. Obesity is even more common in children. A 2018-2019 study at a Beaufort County middle school shows 34%, 44% and 43% of 3rd, 5th, and 8th graders respectively are overweight or obese.

According to the Center for Disease Control (CDC), getting enough physical activity could **prevent 1 in 10 premature deaths.**

The problems associated with excessive weight are not going unnoticed. In 2016, BMH conducted a survey and asked respondents (542) what the five most significant health problems in their community were. Obesity or being overweight was the most frequently cited problem, with 64% of respondents indicating this as a significant health issue. Coming in second and third, 52% of respondents ranked diabetes as a major problem, and 51% said high blood pressure was a significant concern. Obesity is a contributing factor to both these serious health conditions.

The Hospital's 2019 CHNA asked a similar question regarding the community's top ("most pressing") health problems. Of the 1,683 respondents, 43% identified obesity as one of the top health issues in the County. Only the cost of health care was listed by more participants as a concern.

As noted in the Executive Summary of the 2019 report, while Beaufort County ranks much better than many counties in the state (i.e., the state that is 12th in the rate of adult obesity!), ". . .there are very definite areas of concern where intervention is needed to circumvent continued increases in morbidity and potential increases in mortality, especially from preventable causes."

The need for movement couldn't be clearer. It's time to get out the bike and ride!

HOW WALKING AND BIKING CAN IMPROVE OUR HEALTH

Benefits for Children

- Reduces risk of depression
- Improves aerobic fitness
- Improves muscular fitness
- Improves bone health
- Promotes healthy development and growth
- Improves attention and some measures of academic performance

Benefits for Adults

- Lowers risk of high blood pressure
- Lowers risk of stroke
- Improves aerobic fitness
- Improves mental health
- Improves cognitive function
- Reduces arthritis symptoms
- Prevents weight gain

Benefits for Healthy Aging

- Improves sleep
- Reduces risk of falling
- Improves balance
- Improves joint mobility
- Extends years of active life
- Helps prevent weak bones and muscle loss
- Delays onset of cognitive decline

Access Benefits

A connected bicycle and pedestrian network provides **safer, shorter trips to key destinations** for people who are unable or unwilling to drive. Increasing access to the network increases access to employment opportunities and daily necessities.

"Nearly **one-third of the U.S. population**—including children, older adults, people with disabilities, low income people, women, and rural residents—**are transportation disadvantaged** (e.g., they are unable to transport themselves or purchase transportation). "
-American Public Health Association

Economic Benefits

A 2017 study found that cyclists spent $83 billion on trip-related sales and $97 billion in retail sales nationally. The study also found that tourism spending contributed to the creation of 848,000 jobs.

In 2018, the Bureau of Economic Analysis estimated the economic output of outdoor tourism to be $734 billion, of which $96 billion can be attributed to bicycling retail sales.

In Beaufort, the Spanish Moss Trail attracts **40,000 annual visitors**, and **24% of those live beyond a 50-mile radius** of Beaufort, stimulating tourism and recreation-related spending.

Community Benefits

When we provide cyclists and pedestrians access to a trail network, we open up greater opportunities for access to history, culture, and nature and **improve quality of life** and sense of place for residents and visitors. Giving residents the ability to walk to work and stores can bolster employment opportunities and lessen financial constraints. Connected networks don't just link people to destinations, **they allow people to connect with each other.**

Environmental Benefits

A study by the Rails-to-Trails Conservancy stated greenhouse gas emissions in the U.S. are expected to rise to 9.7 billion tons in 2030 from 7.2 billion tons in 2005. Scientists suggest annual emissions must be reduced by 1.2 million, the same amount attributed to personal transportation each year, to address the effects of greenhouse gases. Connected bicycle and pedestrian facilities provide residents and visitors the ability to choose their mode of transportation for short trips, **reducing carbon emissions**.

A SAFER ROUTE

BICYCLE INFRASTRUCTURE MAKES CYCLING SAFER

The design of streets greatly influences the overall safety of cycling. The safest streets are those with cycling-specific infrastructure.

PROTECTED BIKE LANES POSE **90% LESS CHANCE OF INJURY** AS RIDING ON MAJOR STREETS WITH PARKING!

2016 data from the National Highway Traffic Safety Administration confirms that walkers and bikers make up 18.2% of all traffic fatalities. **Proactive policies**, **infrastructure planning**, and **education** are imperative to improving safety conditions for bicyclists and pedestrians. For example, by implementing those elements, the state of Oregon experienced a 31% decrease in bicyclist fatalities and a 47% increase in bicyclist commuters from 2012-2016.

Improving safety conditions for pedestrians and bicyclists will be critical to promoting walking and bicycling in Beaufort County. Concerns over safety are justified. According to the 2019 South Carolina Traffic Collison Fact Book, one pedestrian is killed in the state every 2.2 days and one bicyclist every 13.5 days. In Beaufort County, during the three-year period between 2018 and 2020, nine pedestrians were killed and four cyclists died in crashes.

In 2021, South Carolina was ranked as the 7th most dangerous state in the United States for pedestrians as outlined in the report “Dangerous by Design” published by The National Complete Streets Coalition and Smart Growth America. This is a worsening of the state’s already poor rating in the 2019 report, when the state was ranked 10th. South Carolina’s continued place on the top ten list underscores the profound lack of pedestrian infrastructure in the state.

Between 2009 and 2017, South Carolina experienced over 9,000 crashes involving pedestrians and 1,112 pedestrian fatalities. Accidents did not affect the population equally. Although the state was approximately 27% African American at the time, 47% of those involved in pedestrian crashes were African American.

With regard to bicyclists, the report, "South Carolina Pedestrian and Bicycle Crash Analysis 2009-2017" noted there were 146 bicycle fatalities statewide between 2009 and 2017. In the "Bike Friendly State Report Card" prepared by the League of American Bicyclists, South Carolina ranked low, at 42 out of the 50 states and with regard to fatalities for bike commuters, ranked 46 out of 50, where 50 is the worst. Locally, Beaufort County ranked third among all 46 counties in the state for most bicycle crashes per 1,000 people. Again, the impacts were not experienced evenly across the population. While African Americans made up only 27% of the population, they were involved in nearly 40% of the bicycle crashes over the nine-year period.

Pedestrian and bicycle crashes and fatalities have gone up considerably in recent years. Pedestrian fatalities alone have increased by 45% between 2010 and 2019, and 2019 saw the highest numbers of pedestrian deaths since 1990. Action will be needed at all levels of government--with participation from nonprofit and community groups--to address this growing safety concern. From building "complete streets," making signalized intersection improvements, implementing a Vision Zero program to educate the public on safe driving and cycling techniques, to promoting walking and cycling events, much more can and needs to be done to improve the environment for pedestrians and cyclists in the County.

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PROJECT MISSION AND OBJECTIVES

The mission of the Bicycle and Pedestrian Task Force is to **identify routes, recommend facility types, and suggest policies and ordinances** that will foster **safer, more accessible walking and bicycling** in Beaufort County for residents and visitors.

Objectives

- Establish walking and biking as **routine**, **efficient**, **safe**, and **equitable** options for both transportation and recreation.
- Expand the integrated network of sidewalks, multi-use paths, and on-street bicycle **connections** linking people to destinations like jobs, schools, parks, monuments, and adjacent communities.
- Enhance **quality of life**, **public health**, **economic opportunity**, and **equity** for people of all economic statuses, races, genders, ages, and abilities.

OVERVIEW OF EXISTING TRAIL NETWORK

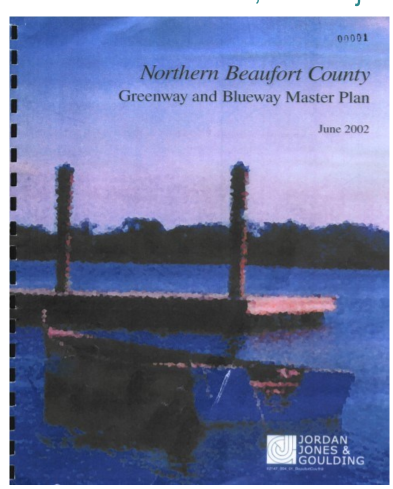
Beaufort County, with its flat terrain and warm climate, has great potential to increase and improve opportunities for walking and cycling. While the county's historic communities of Beaufort, Bluffton, and Port Royal were compactly built with the pedestrian in mind, much of the growth in the last 50 years has been automobile centric, with low-density development and separated land uses. Yet, progress has recently been made to construct safe pedestrian and cycling routes to residential and retail areas and employment destinations.

Previous and Ongoing Regional Pathway Efforts

Hilton Head Island: Since the 1970s, the Town of Hilton Head Island has been a regional leader in developing off-road multi-use paths, with over 60 miles of public paths and another 50 miles in gated communities. The paths connect the island's residential, commercial, and resort destinations and are a top amenity for residents and visitors.

Southern Beaufort County: In the Bluffton area, over 22 miles of multi-use paths have been developed as part of the construction of the Buckwalter, Bluffton, and New Riverside Parkways, and the widening of SC-170, US-278 and SC-46. This network connects many residential areas with businesses, schools, and employment centers. In addition, the Town of Bluffton has improved sidewalks to advance the walkability of Old Town Bluffton and to provide safe routes to area schools (Simmonsville, Buck Island, and Red Cedar streets).

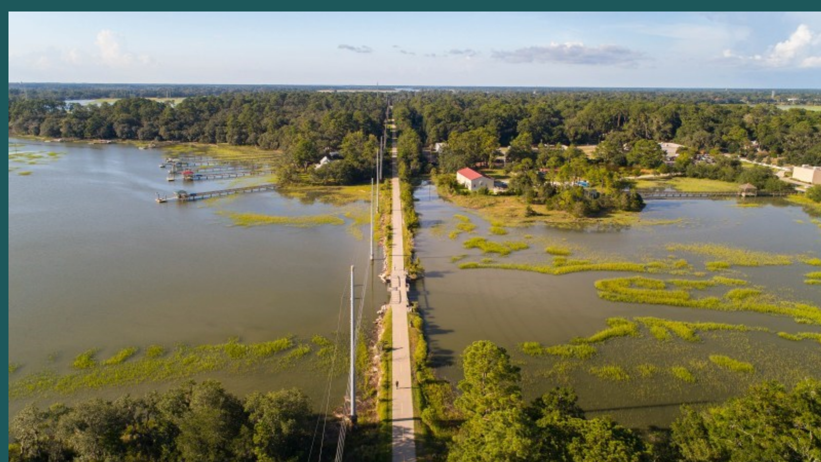
Northern Beaufort County: In northern Beaufort County, approximately 10 miles of the Spanish Moss Trail have been constructed primarily on the right-of-way of the former Port Royal Railroad. Along with serving an important regional recreational need, the Spanish Moss Trail connects residential areas with businesses, retail and tourist destinations, and major employers, like the Marine Corps Air Station and Beaufort Memorial Hospital. Additional improvements include walkways over the Woods Memorial and McTeer Bridges and multi-use paths along Boundary Street.



Existing Network: A Great Start

SPOTLIGHT:
SPANISH MOSS TRAIL

You'll find history and nature everywhere in Beaufort County, even out on the trail. Beaufort County's Spanish Moss Trail follows the path of the historic Magnolia Line, chartered in 1856. Starting at the historic Kinghorn Warehouse (ca 1915) at the Depot trailhead, the Trail passes along marsh, over tidal creeks, and through hardwood forests. During a ride along its 10-mile length, you are as likely to see some of the area's abundant wildlife--dolphins, wading birds, and bald eagles--as you are other walkers and cyclists.



AJPierro Photography

The Magnolia Line, constructed in 1870, ran south from Yemassee to Port Royal on the Beaufort River. The extension to Augusta, Georgia opened in 1873. The ownership of the railroad changed hands several times over the decades until 1985 when the South Carolina State Ports Authority purchased the track and established a new Port Royal Railroad. Business along the line was minimal however, and operations ended in November 2003.

In November 2009, Beaufort-Jasper Water & Sewer Authority acquired the right-of-way to use as a utility corridor. In a visionary move in January 2011, the Authority granted a surface easement to Beaufort County to develop 16 miles of the corridor as a recreational trail to be named the Spanish Moss Trail.

In 2012, the Friends of the Spanish Moss Trail was founded by community leaders as a private non-profit corporation to advocate for the development of the Spanish Moss Trail. The Friends partnered with the PATH Foundation of Atlanta to develop a master plan for a 16-mile trail. PATH, an organization with 25 years of experience building over 300 miles of trails, outlined a phased plan to build a 12-foot wide concrete trail designed for the enjoyment of bikers, runners, walkers, and nature enthusiasts of all stages of life. The inaugural project, a one-mile section of trail between the Depot trailhead and Allison Road, was completed in November 2012.

After that, and with strong public support, it was "full steam ahead." Today, ten miles of the Trail are open and used by over 50,000 residents and visitors a year. The trail provides a trip through a variety of Lowcountry habitats, from salt marsh, tidal creek, bottomland swamp, to hardwood forest. The trail traverses a variety of human habitats as well, from suburban residential neighborhoods, small industrial enclaves, to protected land around the Marine Corps Air Station.

The Trail is known for its views of the marsh, the bridges over tidal creeks, and glimpses of wildlife like mink, winter ducks, roseate spoonbills, osprey, and of course, deer. The quirky, abandoned "Pickle Factory" provides a reminder of the area's agricultural past.

The next phase of construction is the much-anticipated extension of the Trail to the Sands Beach in Port Royal and then from Clarendon Road to the Whale Branch River--bringing the Lowcountry a connected 16-mile Trail. A spur to historic Downtown Beaufort is currently being designed. As with so much of trail implementation, the downtown connector is a partnership effort between Beaufort County, the City of Beaufort, and The Friends.

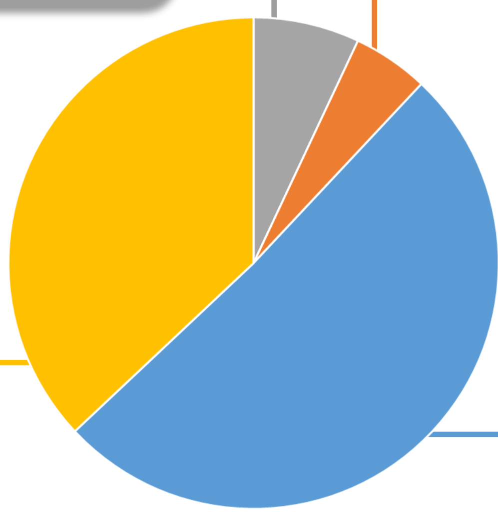
> *Beautiful trail in excellent condition ... this has been one of the most enjoyable rides my wife and have made in the US. Highly recommend it and suggest you take your time....*
>
> -Review from TrailLink

Recognizing the gem that is the Spanish Moss Trail, in 2020, *Outside Magazine* named the Trail one of the ten best walking trails in America. Truly, the Spanish Moss Trail has become one of the County's greatest assets.

USER TYPES

Cycling is increasing nationally as a transportation and recreation choice. **From 2000 to 2019, bicycle commuting rates increased 58% nationally and 88% in communities that have invested heavily in bicycle infrastructure.** When considering bicycle facilities, it is important to understand what types of investments have the greatest potential to promote cycling. To better understand the needs of cyclists, we relied on four commonly used cyclist categories based on comfort level and willingness to consider cycling a viable transportation mode.

Understanding user types provides a more efficient and comprehensive network to address the most bicycle and pedestrian needs. The "Interested but Concerned" group represents about half of all cyclists nationwide. **According to a 2016 study, they are the ones most likely to change their habits when there are safe bicycle and pedestrian facilities available to them.**

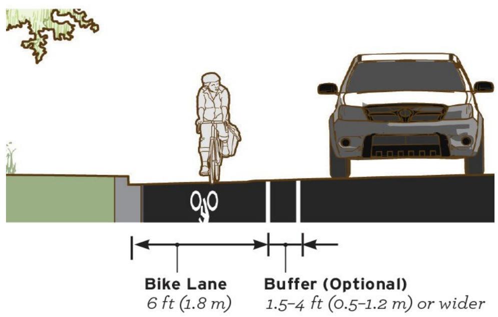


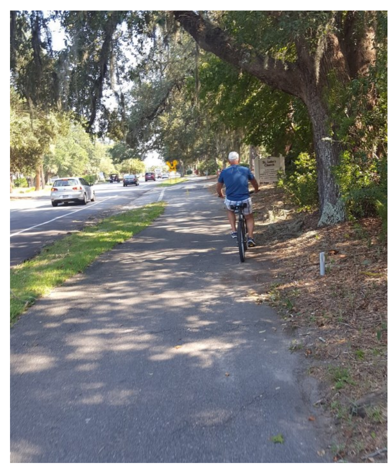
Percentages in chart are based on a national survey of the 50 largest metropolitan areas in the U.S.

FACILITY TYPES

In order to meet the mission and objectives of this plan, emphasis must be placed on serving the needs of the "Interested but Concerned" group with a comprehensive network of multi-use paths and bike friendly streets. For the purposes of this plan, there are four general types of bicycle and pedestrian facilities:

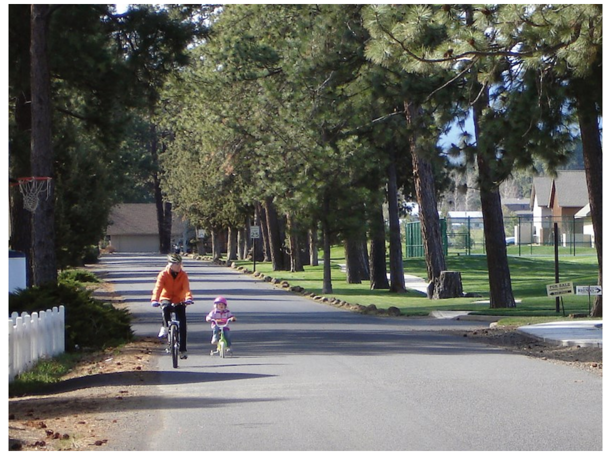
On-Road Facilities: On-road facilities, including shared lanes, paved shoulders, bike lanes, and protected bike lanes ("cycle tracks"), are primarily used by the "strong and fearless" and "enthused and confident" types of cyclists. While paved shoulders greatly improve safety, especially where there are higher speeds or traffic volumes, inadequate shoulder width and presence of rumble strips frequently stand in the way for even the most fearless cyclists. Adequate, paved on-road facilities should be targeted for rural and suburban areas. On lower speed urban streets, designated bike lanes have the potential to increase the number of "interested but concerned" cyclists.





Multi-Use Paths: Multi-use paths are pedestrian/bikeways that are typically separated from motorized traffic by an open space or barrier and are either within the highway right-of-way or within an independent right-of-way. When designed correctly, multi-use paths provide the greatest level of comfort and safety for cyclists and pedestrians and have the greatest potential to increase ridership among "interested but concerned" cyclists, including children and the elderly. They also provide safe facilities for cyclists and pedestrians with no other transportation choices.

Bike-Friendly Streets: Bike-friendly streets are low volume/low speed streets that provide a safe environment for bicyclists. Included in this category is the “Bicycle Boulevard”, which is optimized for bicycle travel with treatments such as traffic calming and traffic reduction, signage and pavement markings, and intersection crossings. These treatments allow through movements for cyclists while discouraging similar through trips by nonlocal motorized traffic. Maximum traffic speeds should not exceed 25 MPH.



Sidewalks: The primary purpose of sidewalks is to provide a safe path for pedestrians that is separated from vehicular traffic by on-street parking or a planting strip. Width of sidewalks should be a minimum of 5 feet in low density residential areas and increase in width in areas of high pedestrian traffic. Sidewalks should be prioritized where they provide safe and convenient access for pedestrians to schools, parks, retail, and services.

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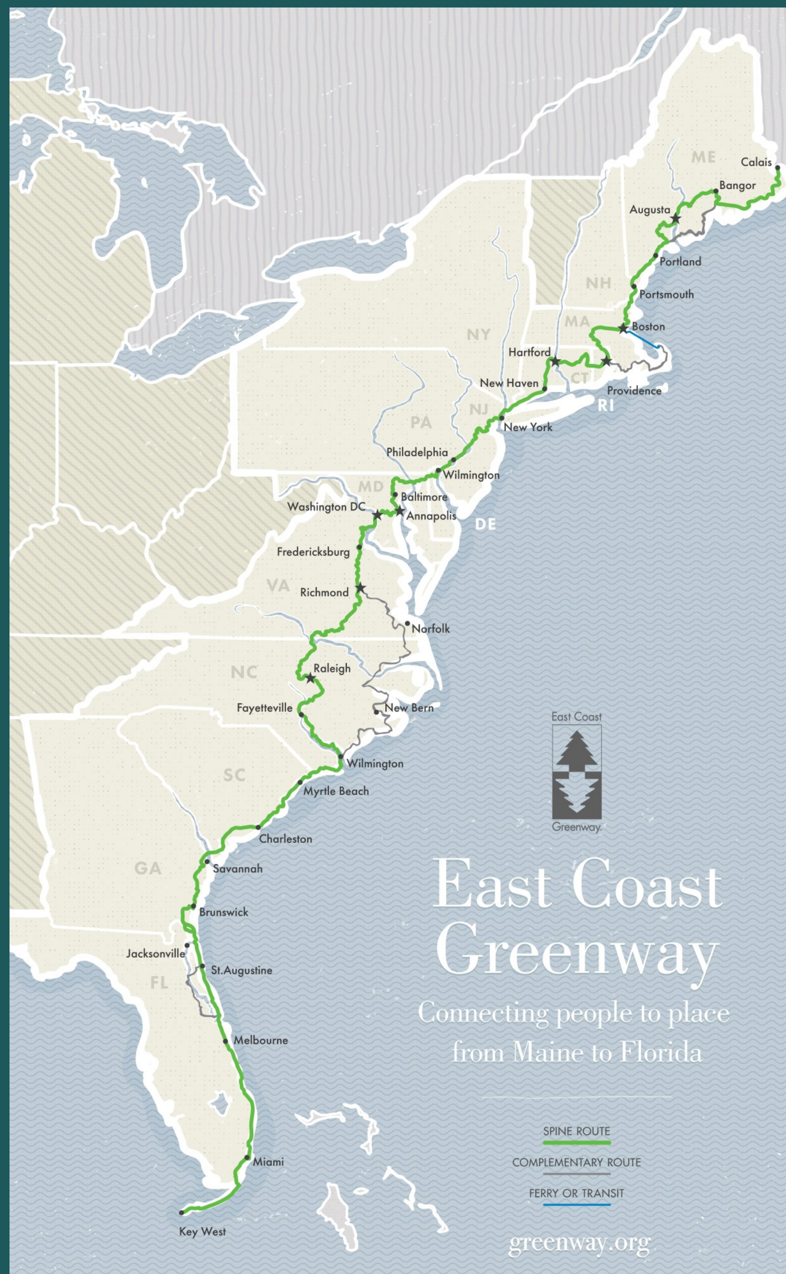
SPOTLIGHT: EAST COAST GREENWAY

In coastal South Carolina, 20% of the spine route of the East Coast Greenway (ECG) has been completed as a paved, traffic-separated, multi-use path. Beaufort County features three completed segments of the ECG spine route: the Gardens Corner Greenway, the Spanish Moss Trail, and the SC-170 side path. Completed segments are those that meet the requirements described in the *Greenway Guide* (www.greenway.org/design-guide) and are typically 10-12' wide paved trails, also known as greenways, sidepaths, and multi-use paths.



The East Coast Greenway (ECG) is an envisioned 3,000-mile, non-motorized trail system connecting cities, towns, and natural areas from Maine to Florida. The non-profit East Coast Greenway Alliance coordinates efforts to complete and promote the ECG. When completed, the ECG will consist of a network of locally developed multi-use paths, rail-trails, and similarly non-motorized facilities, linked to form a continuous spine trail passing through more than 450 communities in fifteen coastal states and Washington DC.

Above: The multi-use path along SC 170 in Okatie is an approximately 4.5 mile segment of the ECG stretching from US 278 to SC 46.

Left: The Spanish Moss Trail makes up 10 miles of the ECG spine route through Beaufort County and will account for a total of 16 miles when fully developed.

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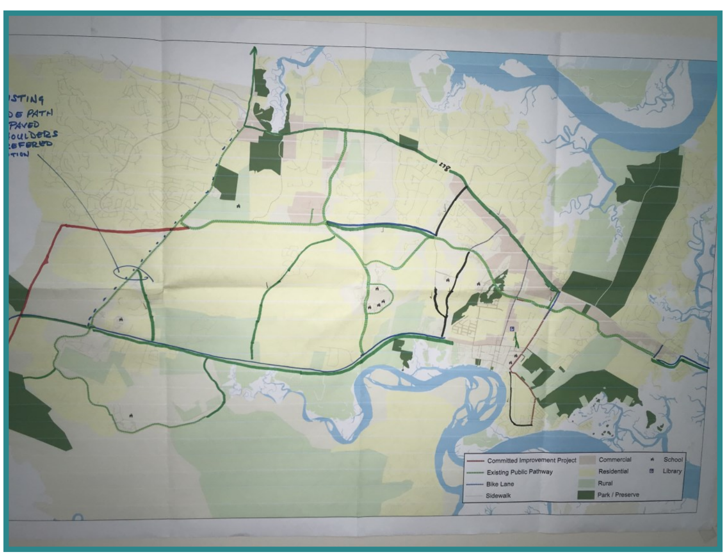
CHAPTER 2:

PROCESS AND PUBLIC INPUT

TASK FORCE PROCESS OVERVIEW

In the fall of 2019, Beaufort County Planning staff assembled a Bicycle and Pedestrian Task Force comprised of local and regional planners representing various municipalities and organizations, as well as pathway and cycling advocates from across the County. The initial goal of this group was to **identify the most urgent needs for facilities in the existing bicycle and pedestrian network, recommend future projects to address those needs, and develop consistent policies for what types of bicycle and pedestrian facilities are appropriate for urban, suburban, and rural areas of the County.** The group soon decided this effort was critical enough to result in a stand-alone Bicycle and Pedestrian Plan.

The task force worked to identify the areas of greatest need in the existing network using maps of existing pathways, committed future pathways, and landmarks such as schools, parks, libraries, and major employers. The group then performed a mapping exercise and created a list of potential pathway projects to meet its objectives. Over the course of several months, the initial project list was reworked to address additional gaps and ensure efficiency of the proposed network.



Proposed facilities ranged from multi-use paths, to sidewalks, to protected bike lanes based on the needs of the community. Once the task force had an established list of projects, focus shifted to engaging the public.

PUBLIC INPUT SURVEY

In the summer of 2020, the County released an online survey to gain public input regarding citizens' walking and cycling habits and desires. The survey was available from the first week of July until the first week of August on the County website and was advertised by the participating municipalities and by advocacy groups including the Coastal Conservation League, the Sea Island Coalition, and Bike Walk Hilton Head Island. The survey consisted of two parts:

- A multiple-choice question and answer section; and
- A mapping exercise in which respondents were asked to indicate improvements or new facilities they would like to see.

A total of 1,946 people responded to the survey. Of the almost 2,000 respondents, 57% identified as female, 42% as male, with the remainder choosing not to identify as a particular gender. Over 70% of the respondents were adults over 55. Almost 42% were over 65.

In general, people feel safe walking in their neighborhood. When asked if they felt safe walking in their community, almost 80% of all participants responded yes. The areas where people did not feel safe walking were on Lady's Island, where almost 30% stated they did not feel safe walking, and in Burton, zip code 29906, where approximately 24% indicated they did not feel safe walking. Okatie and City of Beaufort respondents felt the most comfortable walking, with 89% in Okatie and 88% in Beaufort stating they felt safe walking in their neighborhood.

Residents feel a little less comfortable when on a bike, but in general, still feel safe. Slightly over 75% of those responding indicated they felt safe cycling in their community, while one in four people stated the opposite. Lady's Island was again the area where the highest percentage of respondents indicated they did not feel safe cycling (45.5%). The Burton area (zip code 29906) also had a higher than average percentage of residents feeling uncomfortable riding (33%). In contrast, The Town of Hilton Head Island had the highest percent of respondents that felt safe riding (80%). This reflects the extensive investments the Town has made in bike paths and promoting Hilton Head as a Bike Friendly Community.

To encourage people to walk more, it is important to identify what impediments there might be to traveling on foot. Respondents were given a list of eight items and asked to identify which of these stopped them from walking as much as they'd like. The top three issues identified were:

- not enough sidewalks;
- motorists don't exercise caution; and
- the places they need to go are beyond walking distance.

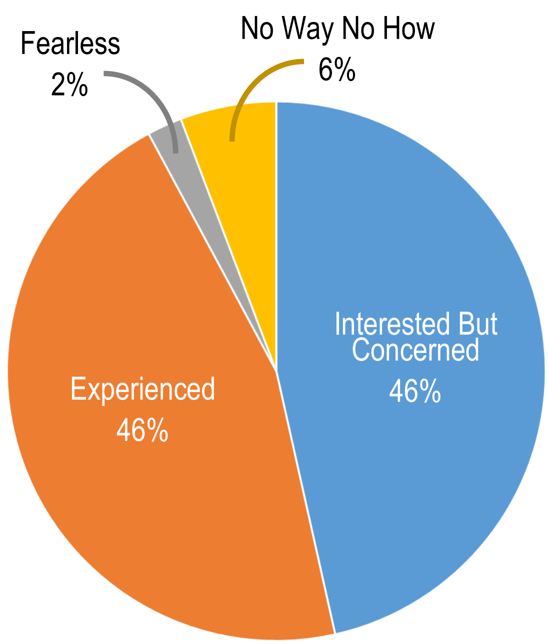
These findings have important implications for the County's comprehensive land use planning effort. Promoting a policy of "complete streets" at the state and local level will help ensure that new roads and road improvements provide safe, convenient places for pedestrians to walk. Making the design of streets "context sensitive" will help control vehicle speeds. Promoting mixed-use, walkable developments will put people close to shopping and services, and provide safe means of access for pedestrians and cyclists.

Issues that were not major impediments were inadequate accommodations for people with disabilities, lack of enforcement of traffic laws, and safety/security concerns.

Survey results indicate that investments in cycling infrastructure and cycling programs could have major payoffs. Only 6% of participants stated they had no interest in cycling. When asked to rate their experience and interest in cycling, 46% of participants stated they were interested in cycling but had concerns with safety, routes, and wayfinding. Expanding cycling infrastructure and targeting education and promotional events at this large segment of the population could greatly expand the cycling community

ADDITIONAL SURVEY FINDINGS

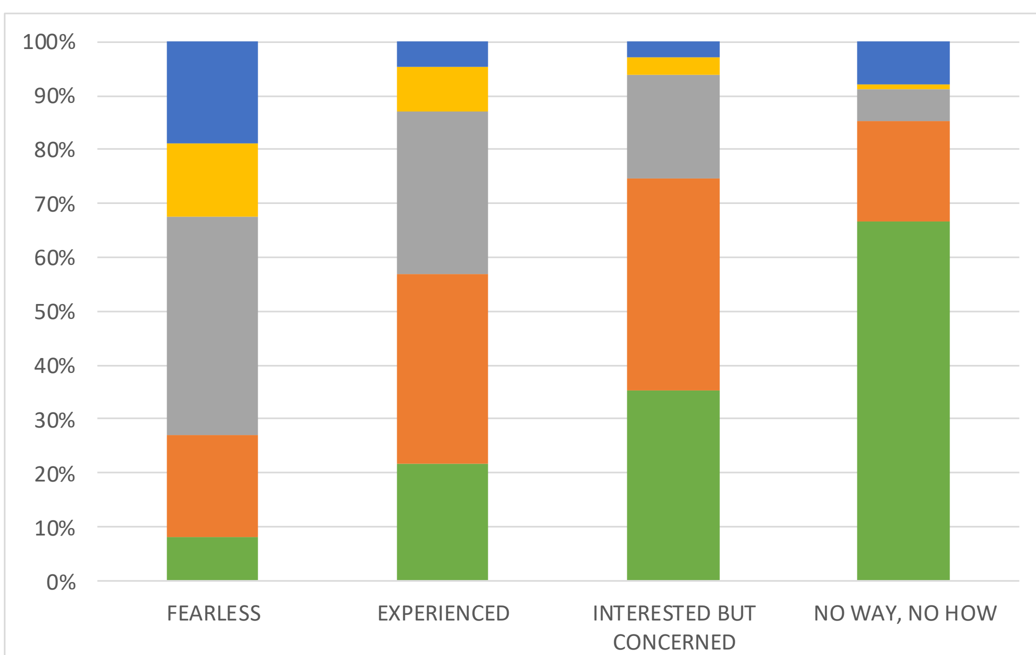
All survey respondents were asked questions about safety, comfort, and existing facilities:

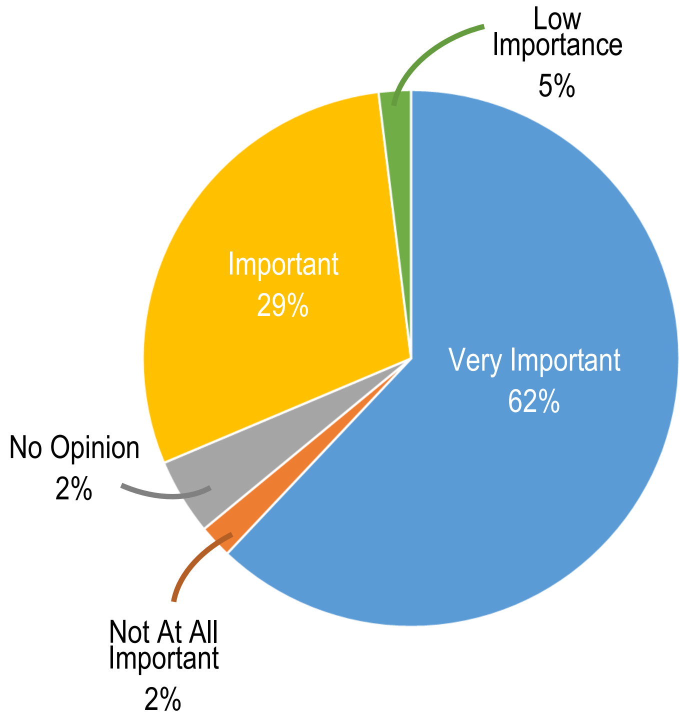


When asked to identify the type of cyclist closest to their own comfort level, over 46% of respondents self-identified as “Interested but Concerned.” **Almost 50% of that group would like walking or biking to be their primary mode of transportation.**

At what traffic speed do you feel unsafe riding a bicycle in mixed traffic (by cyclist type)?

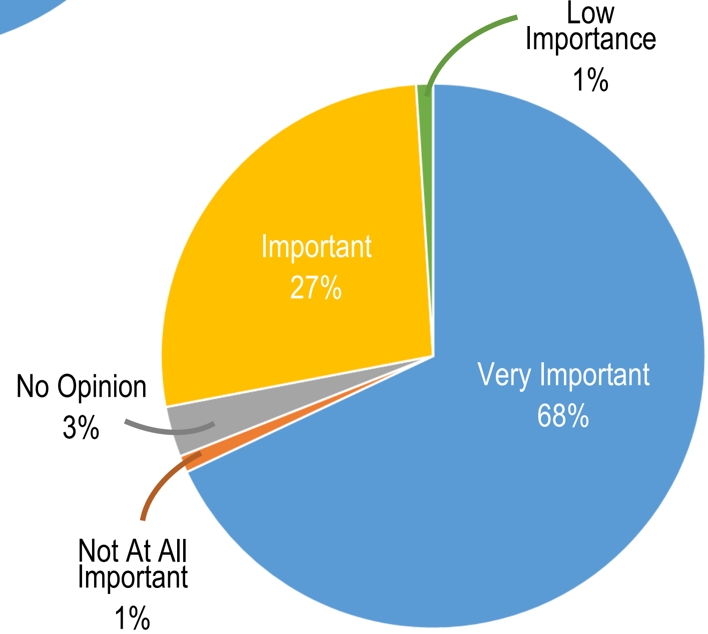
Never Uncomfortable
55 MPH or higher
45 MPH or higher
35 MPH or higher
25 MPH or higher

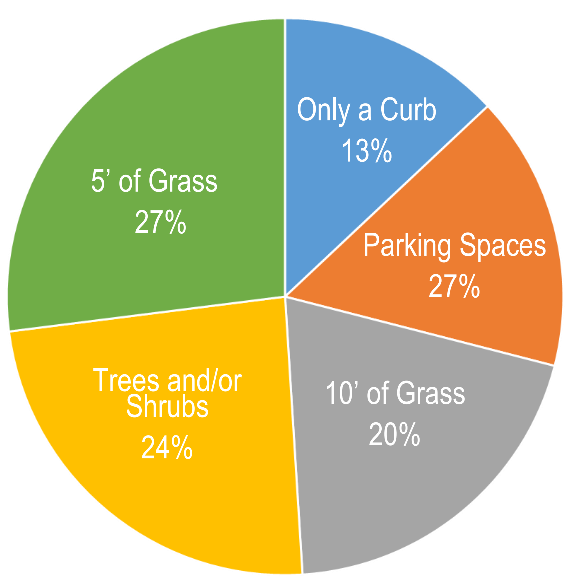




How important are bikeability and/or walkability in your choice of where to live or work?

How important is it for county and local governments to invest in bicycle and pedestrian systems?





I feel safe when

"insert option here"

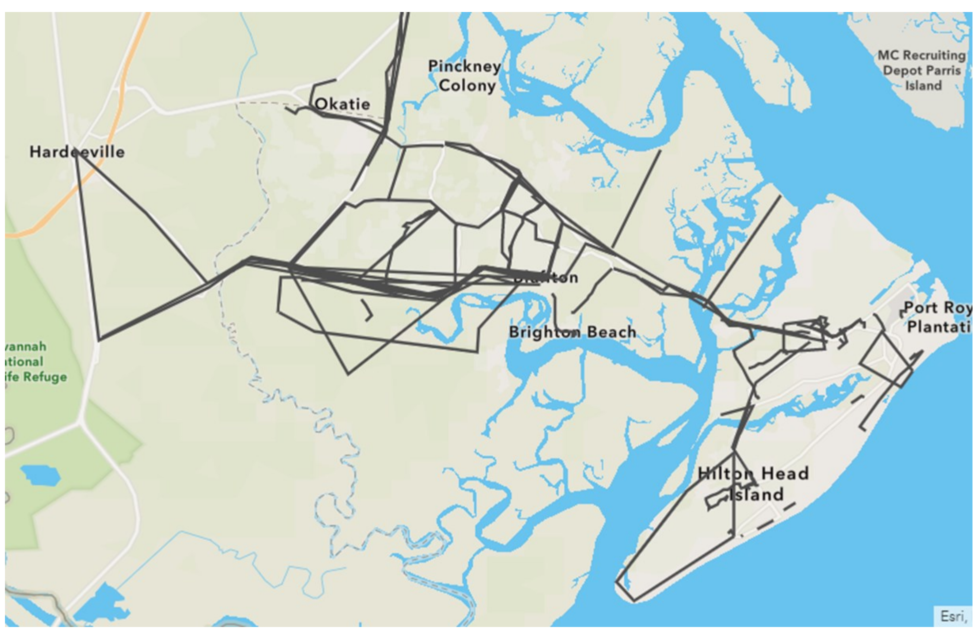
separates the sidewalk from the road.

MAPPING EXERCISE FINDINGS

Next, respondents were asked to identify bicycle and pedestrian routes most in need of facilities and/or existing infrastructure in need of improvements. Respondents were also able to give written descriptions of their recommendations.

Responses in Northern Beaufort County focused on major corridors and connections between downtown Beaufort, the Town of Port Royal, and Lady's Island/St. Helena Island out to Hunting Island.

Similarly, Southern Beaufort County respondents frequently identified routes between established residential areas and newer commercial development, between Bluffton and Hilton Head Island, and heading north on SC-170.



MAJOR THEMES

MAKING CONNECTIONS:

Respondents frequently mentioned connecting neighborhoods, commercial locations, civic areas, and existing bicycle and pedestrian trails.

SPINE AND SPUR:

Many responses suggested using certain portions of existing trails and planning efforts as a "backbone" or "spine" to the regional network. Several others mentioned creating "spurs" or "loops" from the spine out to destinations.

Other important themes included:

- Safety improvements.
- Wayfinding and signage for bicycle and pedestrian access.
- Education initiatives including a phone app with route-making capabilities, safety resources, and updates on regional bicycle and pedestrian planning efforts.

TOP MENTIONED ROUTES / IMPROVEMENTS

1. Connection from Spanish Moss Trail to Downtown Beaufort

2. May River Road

3. Sams Point Road / Brickyard Point Road / Middle Road

4. Buck Island Road between Bluffton Parkway and US 278

5. SC 170 connecting Northern and Southern Beaufort County

6. Main Street (Hilton Head Island)

CHAPTER 3:

PROJECT PRIORITIZATION

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PRIORITIZATION METHODOLOGY

After collecting public input, the Task Force developed a process for prioritizing the proposed recommendations using the “Making Connections” and “Spine and Spur” themes resulting from the public input survey. Several precise criteria were also used in the decision-making process. Project prioritization does not preclude implementing projects on an opportunistic basis, where cost-efficiencies or new project partnerships become available.

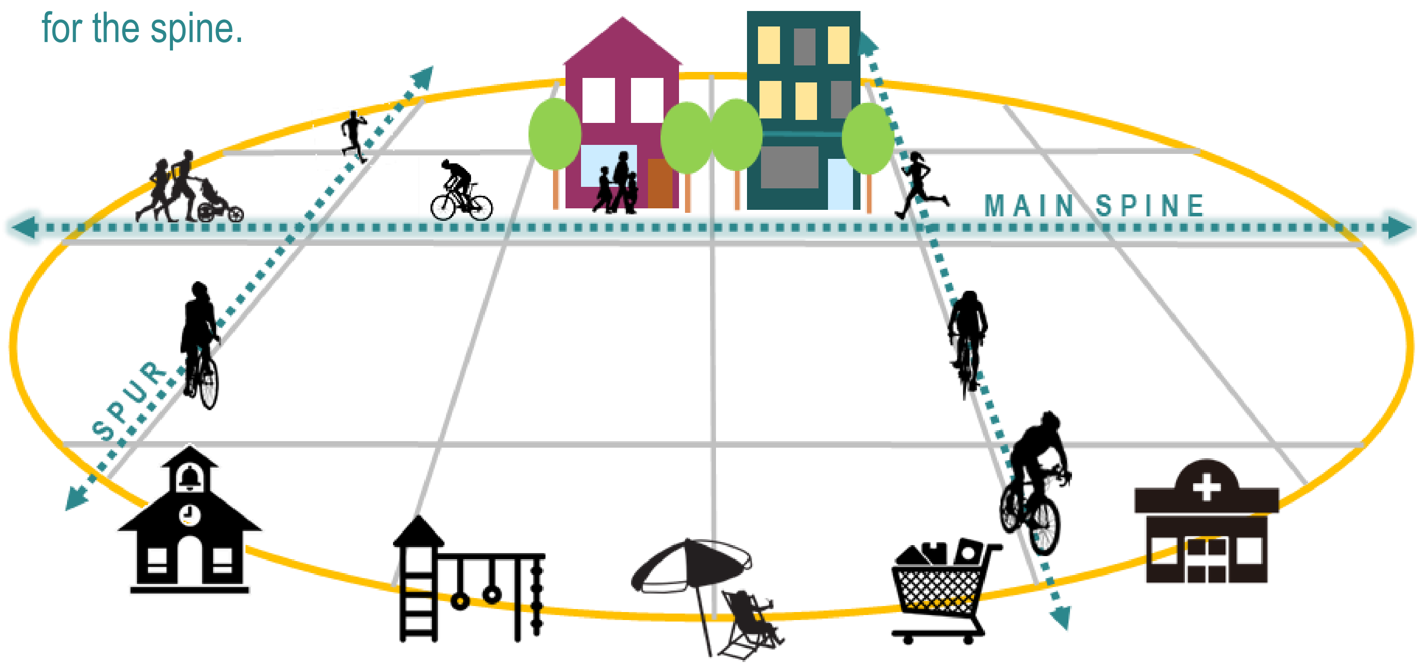
Therefore, the results of the prioritization process are intended as a flexible framework for seeking funds to design and engineer the highest priority projects.

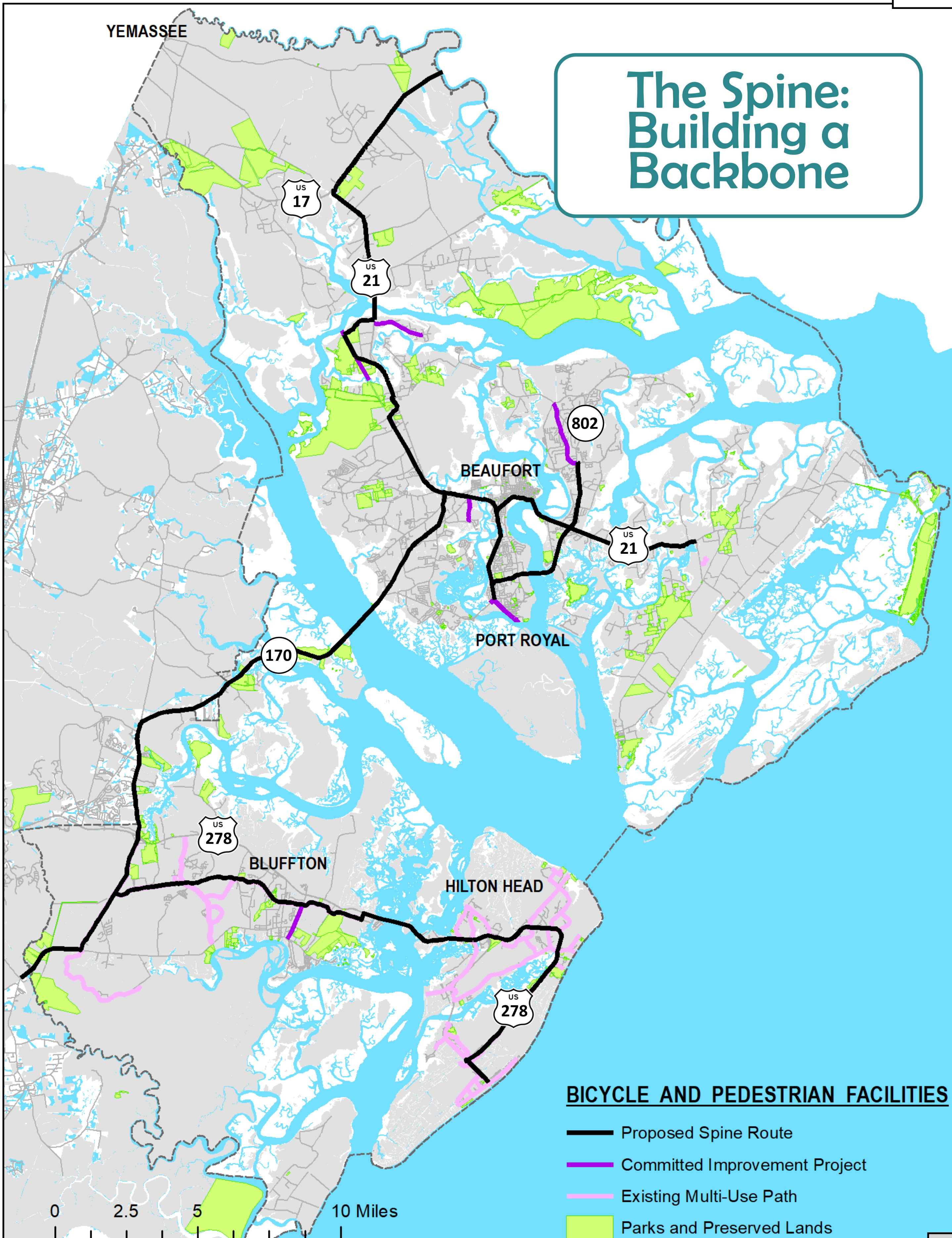
GUIDING PRINCIPLES

Making Connections:
This plan aims to connect residents and visitors to jobs, schools, parks, shopping, nature, and other destinations in the region. Recommended projects have been prioritized on their merit in relation to this goal.

Target the "Interested but Concerned":
46% of users in Beaufort County are "Interested but Concerned" and most likely to change their habits. Multi-use paths, signage, and educational opportunities through schools programs, pamphlets, or other publications are critical pieces of the puzzle in making more people feel "Enthused and Confident."

Spine and Spur Approach:
This approach identifies a central "spine" of the network and strives to add connected "spurs" that reach into communities and provide safe, efficient access to the existing network. Beaufort County has an existing pathway network in the Spanish Moss Trail, Bluffton Parkway, and throughout Hilton Head Island that should be used as the basis for the spine.





The Spine: Building a Backbone
YEMASSEE
US 17
US 21
802
BEAUFORT
US 21
PORT ROYAL
170
US 278
BLUFFTON
HILTON HEAD
US 278
0
2.5
5
10 Miles
BICYCLE AND PEDESTRIAN FACILITIES
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Parks and Preserved Lands

POLICY AND PROGRAM RECOMMENDATIONS

Policies supporting non-motorized travel are as important to improving walking and bicycling conditions as are engineering projects. Policies and programs are crucial in developing a culture where walking and bicycling are every day activities, and support for these transportation alternatives is institutionalized. Non-infrastructure recommendations fall into two categories---policy recommendations that are implemented by County leadership and staff; and program recommendations, implemented by a variety of governmental and nonprofit partners.

These recommendations have been developed using the nationally recognized five "E's" strategy for better walking and bicycling accommodation. This is a holistic approach to pedestrian and bicycle planning that considers engineering, encouragement, education, and evaluation/planning activities implemented in an equitable fashion.

The Five "E's" are:

Equity: A bicycle and walk-friendly community for everyone;

Engineering: Creating safe and comfortable pedestrian and bicycle facilities;

Education: Educating pedestrians, bicyclists, and motorists to ride and drive;

Encouragement: Creating a strong mutli-modal culture that welcomes and celebrates walking and biking; and

Evaluation & Planning: Planning for walking and bicycling as safe and viable transportation options.

POLICY RECOMMENDATIONS

1 Encourage each jurisdiction on the Bicycle and Pedestrian Task Force to adopt Beaufort County Connects 2021 by resolution and incorporate the document into their respective comprehensive plans. ***(Evaluation & Planning)***

2 Adopt the Immediate, Mid-, and Long Term project list in this plan. ***(Engineering)***

3 Use the Prioritization Matrix in this plan to further evaluate each proposed project, ensuring that the implementation process focuses on projects of most merit to the connectivity of the regional bicycle and pedestrian network. ***(Engineering)***

4 Develop a funding strategy and anticipated annual revenue stream for bicycle and pedestrian projects that includes Accommodations Tax, Guideshare funds, Capital Project Sales Tax, dedicated local funding, and state and federal grants. ***(Evaluation & Planning)***

5 Create a staff position within the Beaufort County government whose primary responsibility is to oversee the implementation of the Beaufort County Connects 2021. ***(Evaluation & Planning)***

6 Consider a 2022 ballot initiative to re-impose a 1% capital project sales tax to fund transportation improvements that include complete streets and multi-use paths and establish a regular schedule for future referendums. ***(Equity, Evaluation & Planning)***

7 Encourage local jurisdictions to adopt a Complete Streets policy that requires all streets to be planned, designed, operated, and maintained to enable safe access for all users, including pedestrians, bicyclists, and transit riders of all ages and abilities. All future transportation projects should adhere to the Complete Streets policy in an appropriate urban, suburban, or rural context. ***(Equity, Engineering)***

8 Encourage municipalities and SCDOT to make Complete Streets policies mandatory in all new construction and repair projects. ***(Equity, Evaluation & Planning)***

9 Identify streets where Shared Lane Markings ("sharrows") should be added to improve conditions for bicyclists. Work with SCDOT, the County, and municipalities as appropriate to have these added. ***(Equity, Evaluation & Planning)***

10 Work with Lowcountry Area Transportation Study (LATS) during the update of the Long Range Transportation Plan to incorporate bicycle and pedestrian projects in the Beaufort County Connects 2021 and advocate for a target percentage of funding to be devoted to bicycle and pedestrian facilities. ***(Equity, Evaluation & Planning)***

11 Identify rural roads with moderate to high traffic volumes where paved shoulders are needed. Work with SCDOT to include paved shoulders as part of road repaving. ***(Equity, Evaluation & Planning)***

12 Establish an agreement with local utilities for use of utility corridors as walking and bicycling paths. ***(Equity, Evaluation & Planning)***

13 Revise the Community Development Code to require that path corridors are reserved, dedicated, or constructed in new developments where path corridors are shown in an adopted plan or where a property connects to an existing or proposed greenway. ***(Equity, Evaluation & Planning)***

14 Actively engage with the Beaufort County School District for their assistance in planning and implementing sidewalks and pathways so that children can walk or bike to school. ***(Equity, Evaluation & Planning)***

15 Advocate for state funding for the Safe Routes to School Program in concert with the Beaufort County School District. ***(Equity, Evaluation & Planning)***

16 Develop a non-profit organization to advocate for pathway projects in Beaufort County and work to raise private donations. ***(Encouragement, Evaluation & Planning)***

17 Work with the Friends of the Spanish Moss Trail to expand their role to advocate and raise private donations for pathway projects that connect to the trail. ***(Encouragement, Evaluation & Planning)***

18 Endorse the Vision Zero Policy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. ***(Equity)***

19 Install pedestrian facilities such as crosswalks, countdown signals, and curb ramps at all intersections where there is an existing sidewalk or planned sidewalk or trail. ***(Equity, Evaluation & Planning)***

20 Provide raised medians or pedestrian refuge islands, where practical, at crosswalks on streets with more than three lanes, especially on streets with high volumes of traffic. ***(Equity, Evaluation & Planning)***

21 Require bicycle parking in all new commercial, civic, government, and multi-family land uses. Encourage municipalities to have similar requirements. ***(Equity, Evaluation & Planning)***

22 Work with the East Coast Greenway to develop a strategy to complete the East Coast Greenway trail through Beaufort County. ***(Evaluation & Planning)***

23 Encourage the SC Legislature to adopt a Safety Stop bill that allows bicyclists to treat a stop sign as a yield sign if the cyclist has slowed down to a speed that would allow them to stop if needed. Studies have shown that Safety Stops are safer and more efficient for the cyclist. ***(Equity, Evaluation & Planning)***

24 Encourage large employers to provide showers and clothes lockers at work to promote commuting by bike. ***(Equity, Evaluation & Planning)***

PROGRAM RECOMMENDATIONS

1 Establish a Bicycle and Pedestrian Advisory Committee to assist the County in the planning, funding, development, and implementation of facilities and programs that will result in the increased safety and use of bicycle and pedestrian travel as a mode of transportation and recreation. ***(Education, Encouragement, Evaluation & Planning)***

2 Support or partner with municipalities on bike sharing and e-scooter programs in an effort to promote cycling and mobility. ***(Equity, Encouragement)***

3 Sponsor, support, and/or promote national events that promote walking and cycling ***(Education, Encouragement)***:

- **National Bike Month.** National Bike Month is a chance to showcase the many benefits of bicycling and encourage more people to give biking a try.
- **Bike-to-Work Day**. Bike-to-Work Day promotes the bicycle as an option for commuting to work by providing route information and tips for new bicycle commuters.
- **Car-Free Day**. Car Free Day, an international day to celebrate getting around without cars, coincides with the beginning of the school year and is the perfect way to kick-off programs that promote bicycling and raise awareness for environmental issues.
- **Earth Day**. Earth Day can encourage residents to help the environment by bicycling to destinations and staying out of their cars and provides an excellent opportunity to educate people of all ages in the community.

4 Become a designated Walk Friendly Community. This program recognizes communities that have shown a commitment to improving and sustaining walkability and pedestrian safety through comprehensive programs, plans, and policies. ***(Encouragement)***

5 Become a designated Bicycle Friendly Community. This program provides a roadmap to improving conditions for bicycling and guidance to help improve the community by providing safe accommodations for bicycling and encouraging people to bike for transportation and recreation. ***(Encouragement)***

6 Consider participating in the Open Streets Program to temporarily open selected streets to pedestrians by closing them to cars. ***(Education, Encouragement)***

7 Encourage and support events hosted by private non-profit groups that promote walking and cycling such as bike rodeos, weekend walkabouts, lunchtime bicycle rides, cycle the bridges, ride to beach, etc. ***(Education, Encouragement)***

8 Support and partner with private nonprofit groups, such as Eat Smart Move More South Carolina, that focus on helping communities create healthy eating and active living options. ***(Education, Encouragement)***

9 Develop an education program similar to Charleston's **Bike Right, Drive Right Campaign** to educate both bicyclists and motorists on safe and respectful sharing of our roads. ***(Education)***

10 Develop a regional wayfinding program. ***(Encouragement)***

11 Develop an interactive bike map that outlines bike routes and bike parking. ***(Encouragement)***

12 Support the School District in implementing a Walk and Bike to School day. ***(Education, Encouragement)***

13 Conduct county-wide pedestrian and bicycle counts on a regular basis. ***(Evaluation & Planning)***

14 Encourage training courses for law enforcement officers on state and local laws for motorists, bicyclists, and pedestrians to focus enforcement of speeding and failing to yield the right-of-way to pedestrians and bicyclists, as well as bicyclists and pedestrians failing to follow traffic signs and signals and wrong way riding on the road. ***(Education)***

POTENTIAL PARTNERS

The following agencies, institutions, and organizations have been identified as potential partners in implementing the Beaufort County Connects 2021:

Agencies and Institutions: Department of Defense, SC DOT, SC DHEC, Beaufort County PALS, Beaufort County School District, Beaufort County Libraries, City of Beaufort Public Works, Town of Port Royal Public Works, Town of Bluffton Engineering, Town of Hilton Head Island, USCB, TCL, Palmetto Breeze, Beaufort Memorial Hospital, Hilton Head Regional Health Care, Coastal Carolina Hospital

Nonprofits: Eat Smart Move More South Carolina, Coastal Conservation League, Friends of the Spanish Moss Trail, Bike Walk HHI, YMCA, AARP, Diabetes Association, Palmetto Cycling Coalition, Sun City Cycling Club, Hilton Head Island Bicycling Club, EZ Riders Bicycle Club, Kickin' Asphalt Bicycle Club, Chain Gang Bicycle Club

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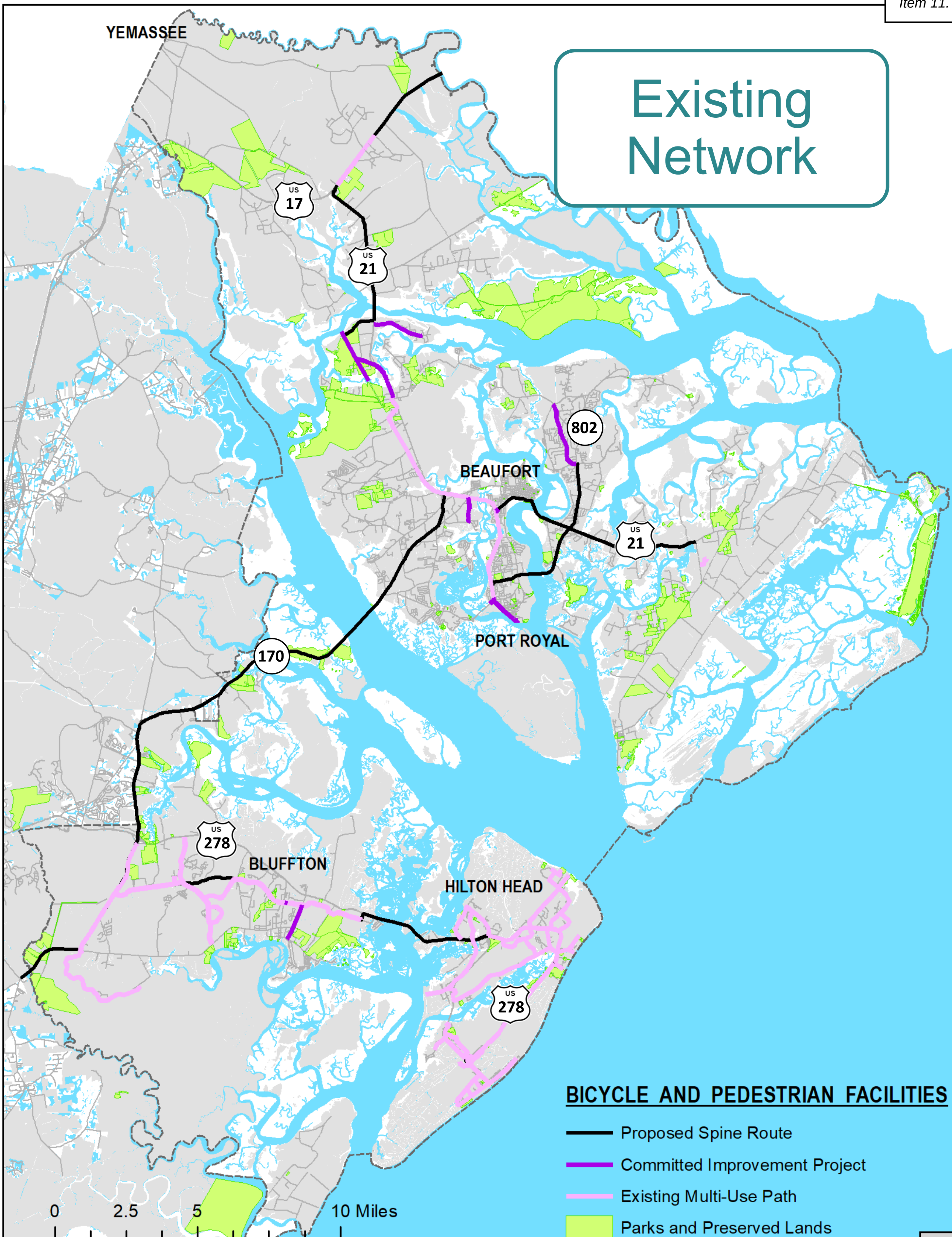
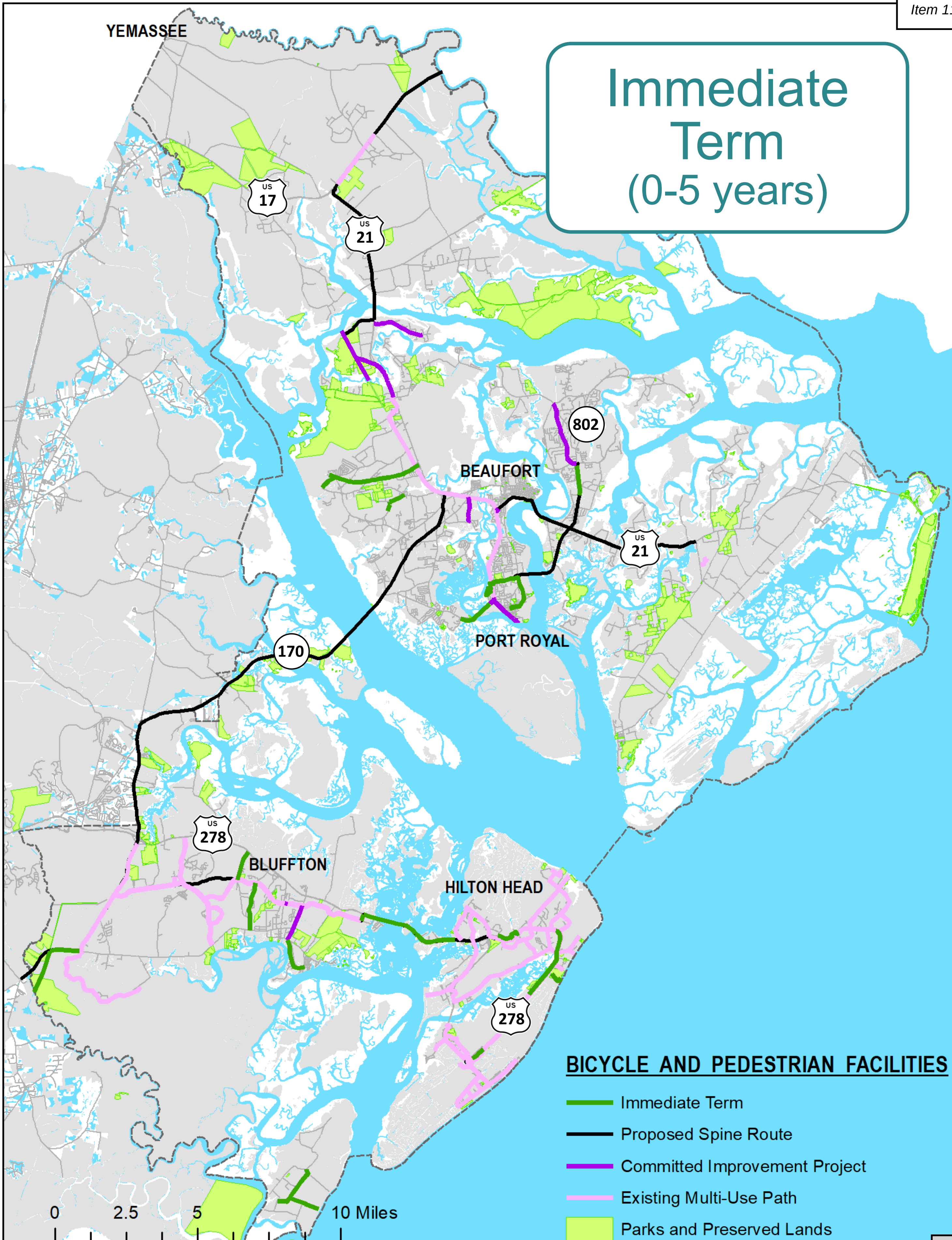
MAPPING A NETWORK

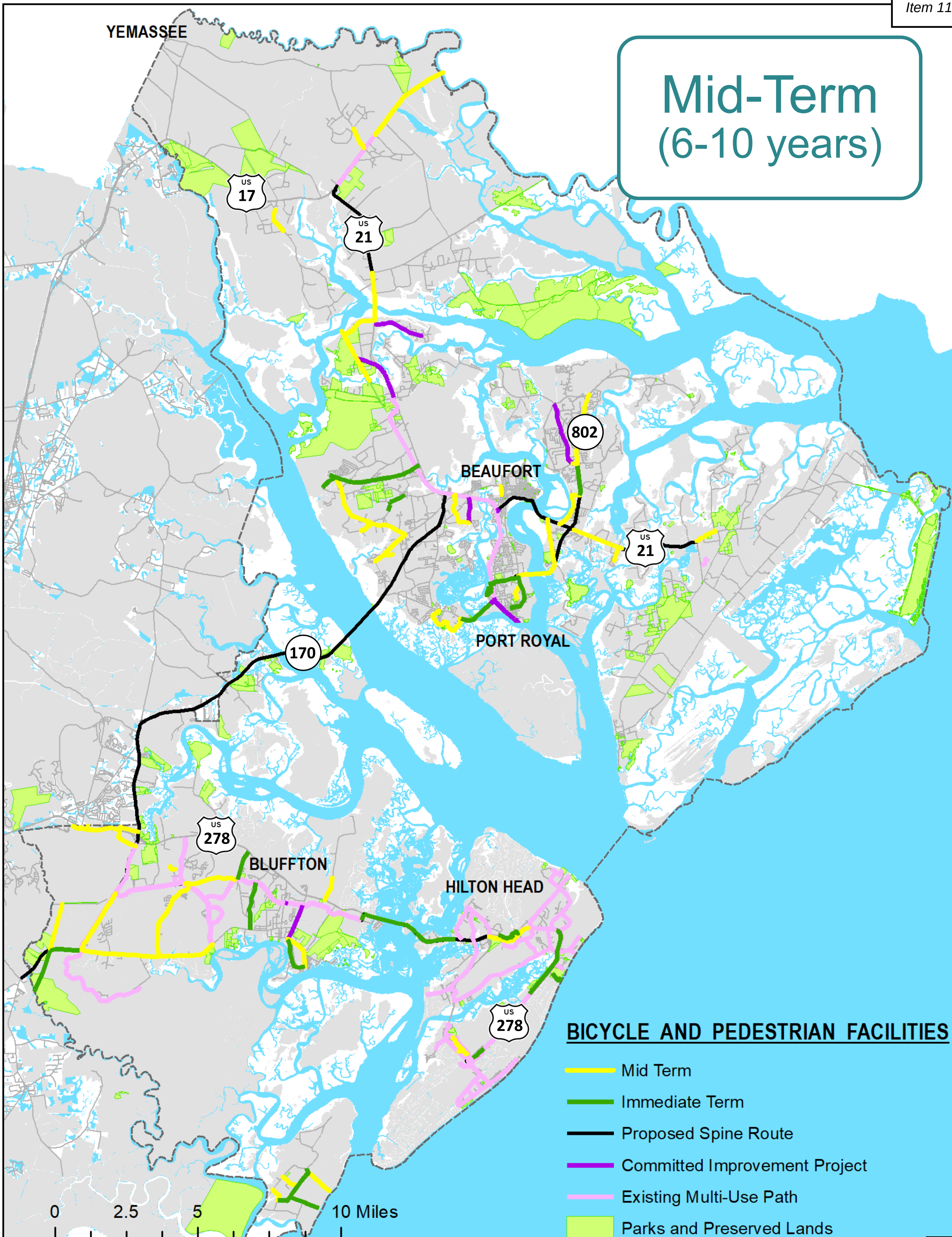
The next pages of this plan tell a story through maps. Beginning with the existing bicycle and pedestrian network in Beaufort County and proposed spine routes, each subsequent map visualizes how infrastructure improvements and new bicycle and pedestrian projects will expand upon the current network. Each project has merit as part of the "Spine" or a connected "Spur" of the network, and each is designated as one of three levels of priority: Immediate Term (0-5 years), Mid-Term (5-10 years), and Long Term (10+ years).


Existing
Network
YEMASSEE
US 17
US 21
802
BEAUFORT
US 21
PORT ROYAL
170
US 278
BLUFFTON
HILTON HEAD
US 278
BICYCLE AND PEDESTRIAN FACILITIES
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Parks and Preserved Lands
0
2.5
5
10 Miles

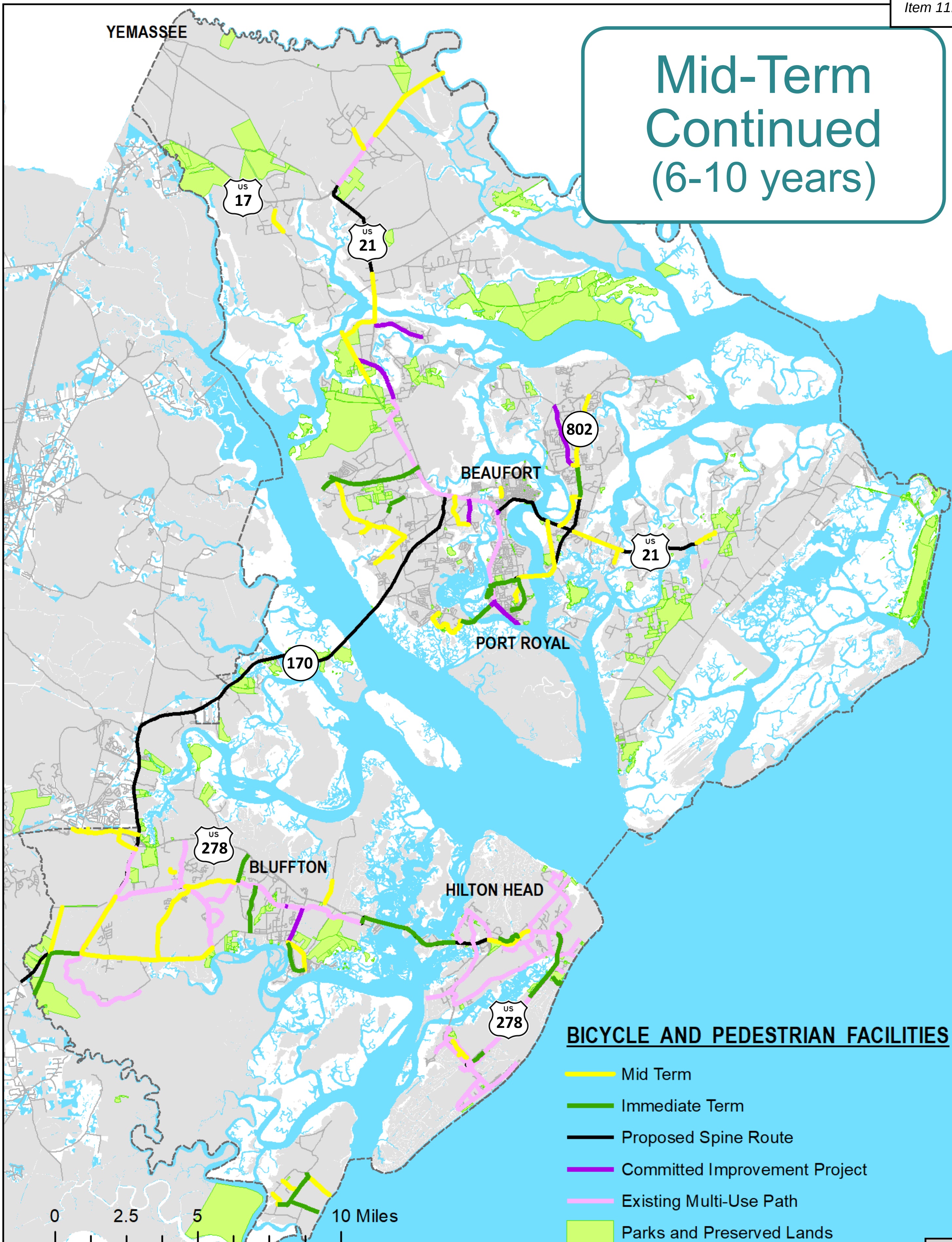

Immediate Term (0-5 years)
YEMASSEE
US 17
US 21
802
BEAUFORT
US 21
PORT ROYAL
170
US 278
BLUFFTON
HILTON HEAD
US 278
BICYCLE AND PEDESTRIAN FACILITIES
Immediate Term
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Parks and Preserved Lands
0
2.5
5
10 Miles

Project	Length (mi)	Approximate Costs	Operation (yearly)	Jurisdiction(s)
Spanish Moss Trail from Clarendon to Whale Branch	3.0	$1,500,000	$19,500	Beaufort County
Laurel Bay Rd	3.4	$3,900,000	$22,100	Beaufort County
Rugrack Rd from Joseph Shanklin Elementary to Laurel Bay Rd (Sidewalk)	0.5	$150,000	$3,250	Beaufort County
Pine Grove Rd / Burton Wells Rd	0.9	$1,000,000	$5,850	Beaufort County
Russell Bell Bridge from Spanish Moss Trail to Broad River Dr	1.3	$650,000	$8,450	Beaufort County, Port Royal
Waddell Rd /Battery Creek Rd / Riverside Dr from Ribaut Rd to Spanish Moss Trail (Bike Lane)	1.0	$750,000	$6,500	City of Beaufort, Town of Port Royal
Sams Point Rd from Wallace Rd to southern terminus of Middle Rd Pathway	1.1	$550,000	$7,150	Beaufort County, City of Beaufort
Lady's Island Dr to Port Royal Elementary / Live Oaks Park via Old Shell Rd / 14th St	1.3	$650,000	$8,450	Beaufort County
New River Liner Trail from Hwy 46 south to New River (Paving)	1.5	$750,000	$9,750	Beaufort County, Town of Bluffton
SC-46 from New River Park to New River Linear Trail	0.6	$300,000	$3,900	Beaufort County, Town of Bluffton
Buck Island Rd from Bluffton Pkwy to US-278	1.0	$500,000	$6,500	Beaufort County, Town of Bluffton
Alljoy Rd	1.6	$750,000	$10,400	Beaufort County, Town of Bluffton
School Rd (Crush and run path)	1.6	$584,000	$10,400	Beaufort County
Beach Rd from School Rd to terminus (Crush and run path)	1.2	$438,000	$7,800	Beaufort County
Main Street from Wilborn Rd to Whooping Crane Way	1.1	$1,200,000	$6,875	Town of Hilton Head Island, Beaufort County
Shelter Cove Lane from US 278 Bus to Shelter Cove Park	0.2	$225,000	$1,250	Town of Hilton Head Island
Woodhaven Drive/Lane, Phase I Boggy Gut Pathway	0.2	$225,000	$1,250	Town of Hilton Head Island
US 278 Bus E from Mathews Dr to Dillon Rd	1.1	$1,200,000	$6,875	Town of Hilton Head Island
Singleton Beach Rd from Chaplin Park to Collier Beach Park	0.4	$300,000	$2,500	Town of Hilton Head Island
US 278 Bus E from Arrow Rd to Village at Wexford	0.4	$400,000	$2,500	Town of Hilton Head Island
US 278 from Squire Pope Rd to Bridges (SCDOT Project)	1.5	N/A*	$9,375	Town of Hilton Head Island, Beaufort County
US 278 from Jenkins Island to Mainland (SCDOT Project)	1.8	N/A*	$11,250	Town of Hilton Head Island, Beaufort County
Chaplin Linear Park	1.2	$2,150,000	$9,825	Town of Hilton Head Island
TOTAL	**27.9**	**$18,172,000**	**$181,700**	

*Final alignment and facility improvements not known at this time


Mid-Term
(6-10 years)
YEMASSEE
US 17
US 21
802
BEAUFORT
US 21
PORT ROYAL
170
US 278
BLUFFTON
HILTON HEAD
US 278
BICYCLE AND PEDESTRIAN FACILITIES
Mid Term
Immediate Term
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Parks and Preserved Lands
0
2.5
5
10 Miles

Project	Length (mi)	Approximate Costs	Operation (yearly)	Jurisdiction(s)
Big Estate Road from Hwy 17 to Big Estate Circle	1.4	$2,000,000	$9,100	Beaufort County
US-17 from Big Estate Rd to Harriet Tubman Bridge	3.0	$1,000,000	$19,500	Beaufort County
Seabrook Rd from US-21 to Spanish Moss Trail	1.3	$1,000,000	$8,450	Beaufort County
US-21 from Seabrook Rd to Keans Neck Rd	1.7	$850,000	$11,050	Beaufort County
US-21 from Detour Rd to Seabrook Rd (Sidewalk)	1.6	$480,000	$10,400	Beaufort County
Broad River Drive	1.7	$2,000,000	$11,050	Beaufort County, Town of Port Royal
Burton Wells Park to Habersham Market	0.5	$250,000	$3,250	Beaufort County
Wallace Rd and Sunset Blvd	1.5	$750,000	$9,750	Beaufort County, City of Beaufort
Joe Frazier Rd from Broad River Blvd to Laurel Bay Rd	3.5	$1,800,000	$22,750	Beaufort County
Sams Point Rd from traffic circle to Springfield Rd	2.5	$1,250,000	$16,250	Beaufort County
Meridian Road	1.6	$1,750,000	$10,400	Beaufort County, City of Beaufort
US-21 from Sams Point Way to Airport Cir	0.8	$400,000	$5,200	Beaufort County, City of Beaufort
Chowan Creek Bluff from US-21 to Lady's Island Elementary (Sidewalk)	0.4	$230,000	$2,600	Beaufort County, City of Beaufort
Marsh Road from Duke St o Boundary St (a portion to be boardwalk for marsh protection)	0.3	$150,000	$1,950	Beaufort County, City of Beaufort
Burton Hill/Old Salem Road	1.4	$2,000,000	$9,100	Beaufort County, City of Beaufort
MLK Jr Blvd to St. Helena Elementary School	0.8	$400,000	$5,200	Beaufort County
Broad River Blvd/Riley Road	1.1	$750,000	$7,150	Beaufort County, Town of Port Royal
McTeer Bridge Protected Bike Lanes	1.0	$300,000	$6,250	Beaufort County
TOTAL	**26.1**	**$17,360,000**	**$169,400**	

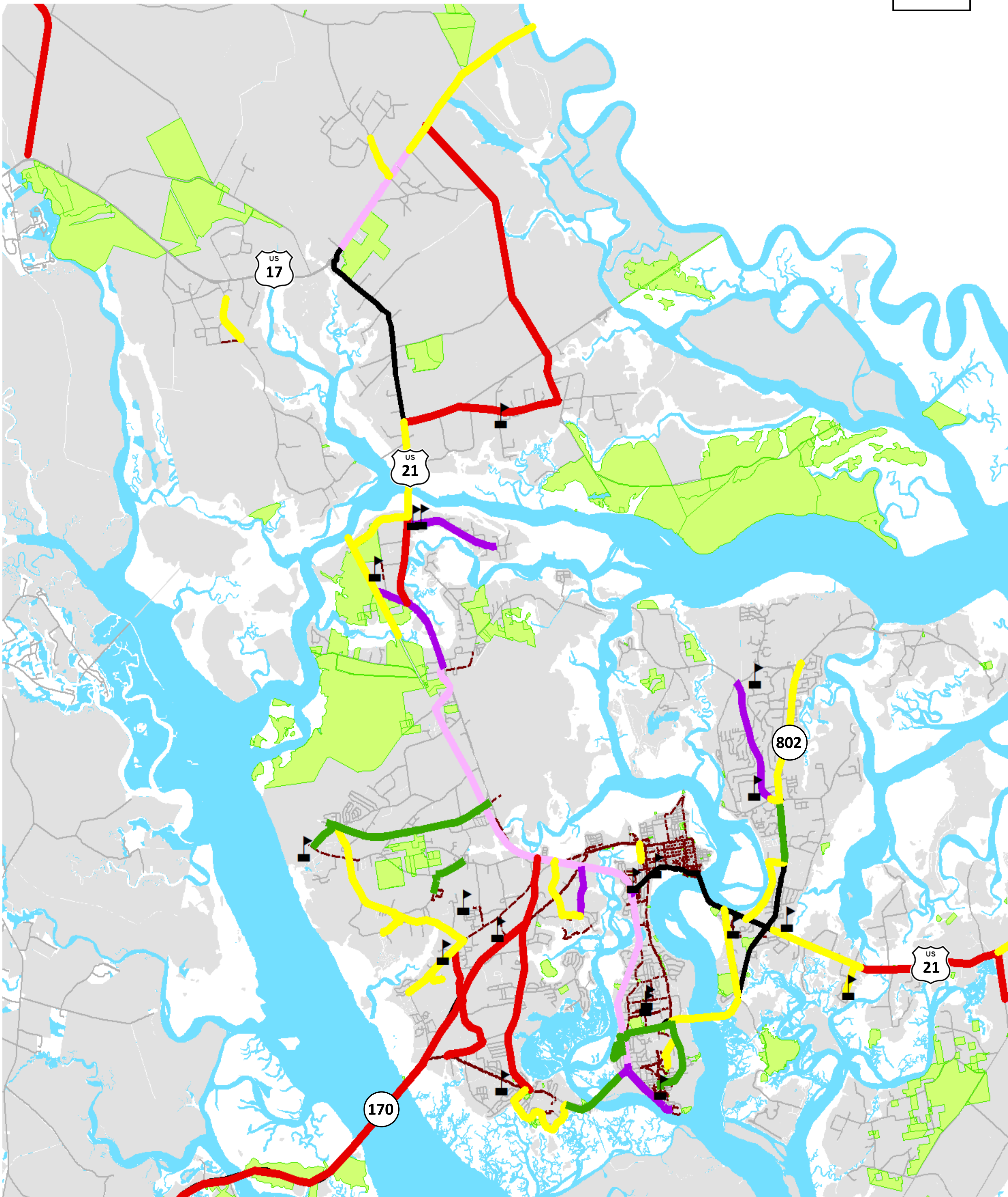

Mid-Term
Continued
(6-10 years)
YEMASSEE
US 17
US 21
802
BEAUFORT
US 21
PORT ROYAL
170
US 278
BLUFFTON
HILTON HEAD
US 278
BICYCLE AND PEDESTRIAN FACILITIES
Mid Term
Immediate Term
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Parks and Preserved Lands
0
2.5
5
10 Miles

Project	Length (mi)	Approximate Costs	Operation (yearly)	Jurisdiction(s)
Naval Park to Cypress Wetlands	0.4	$200,000	$2,600	Town of Port Royal
Shell Point Rd from Broad River Dr to Savannah Hwy	1.6	$800,000	$10,400	Beaufort County, Town of Port Royal
Okatie Center Blvd N & S and US-278 from SC-170 to University Blvd	2.2	$1,100,000	$14,300	Beaufort County
Northbound side of SC-170 from SC-46 to Bluffton Pkwy	2.3	$1,700,000	$14,950	Beaufort County, Town of Bluffton
New River Linear Trail from SC-46 to Del Webb Trailhead (Paving)	1.8	$900,000	$11,700	Beaufort County
Old Miller Rd / Lake Point Dr Connection	0.4	$3,000,000	$2,600	Beaufort County, Town of Bluffton
Sawmill Creek Rd (Sidewalk)	0.7	$350,000	$4,550	Beaufort County
SC-46 from traffic circle to Buckwalter Pkwy	4.8	$2,400,000	$31,200	Beaufort County, Town of Bluffton
Ulmer Road/Shad Road	1.3	$2,000,000	$8,450	Beaufort County, Town of Bluffton
US 278 Bus E from Gardner Dr to Jarvis Park Dr	1.4	$1,800,000	$8,750	Town of Hilton Head Island
Arrow Rd R/W Pathway from Bristol Sports Arena to Target Rd	0.9	$950,000	$5,625	Town of Hilton Head Island
Archer Rd Pathway	0.2	$200,000	$1,250	Town of Hilton Head Island
Lagoon Rd/Ibis St Pathway from Avocet St to North Forest Beach Dr	0.8	$800,000	$4,690	Town of Hilton Head Island
Benjies Point Rd from School Rd to Haig Pt (Crush and run path)	0.5	$182,500	$3,125	Beaufort County
Church Rd (Crush and run path)	0.6	$219,000	$3,900	Beaufort County
Turtle Beach Rd from Oak Ridge Ln to terminus (Crush and run path)	1.0	$365,000	$6,500	Beaufort County
TOTAL	**20.9**	**$16,966,500**	**$134,590**	


Long Term
(10+ years)
YEMASSEE
US 17
US 21
802
BEAUFORT
PORT ROYAL
170
US 278
BLUFFTON
HILTON HEAD
US 278
BICYCLE AND PEDESTRIAN FACILITIES
Long Term
Mid Term
Immediate Term
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Parks and Preserved Lands
0
2.5
5
10 Miles

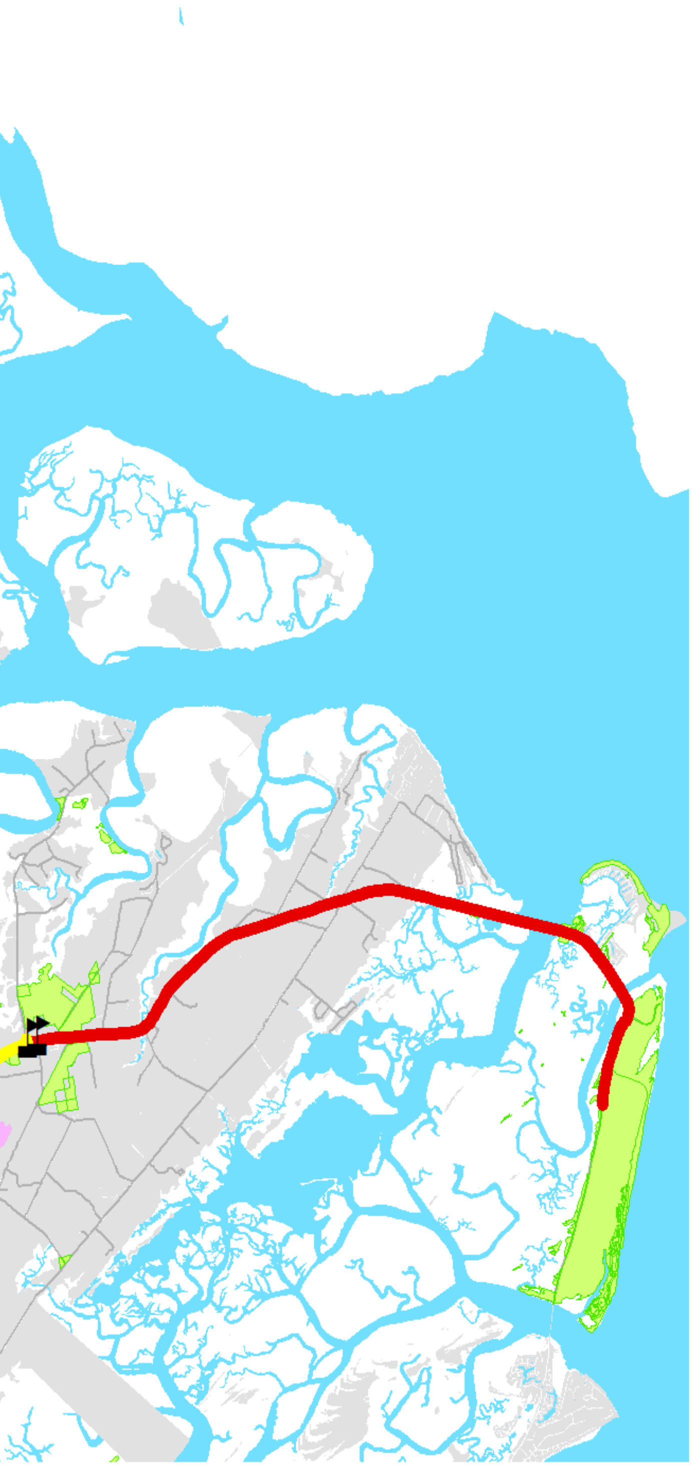
Project	Length (miles)	Approximate Costs	Operation (yearly)	Jurisdiction(s)
Castle Hall Rd from Wall St to US-17	3.5	$1,750,000	$22,750	Town of Yemassee
US-21 from Keans Neck Rd to US-17	3.3	$1,700,000	$21,450	Beaufort County
US-21 from Airport Cir to MLK Jr Blvd	3.7	$1,850,000	$24,050	Beaufort County
US-21 from St. Helena Elementary to Hunting Island Dr	9.5	$4,750,000	$61,750	Beaufort County
Parris Island Gtwy from Savannah Hwy to US-21	4.3	$2,200,000	$27,950	Beaufort County, City of Beaufort, Town of Port Royal
SC-170 from Broad River Bridge to Spanish Moss Trail	5.4	$2,700,000	$35,100	Beaufort County, City of Beaufort, Town of Port Royal
Grober Hill Rd and Castle Rock Rd from Savannah Hwy to Broad River Blvd (Bike Lane)	2.6	$780,000	$16,900	Beaufort County, Town of Port Royal
SC-170 from Callawassie Dr to Broad River Bridge	4.8	$2,400,000	$31,200	Beaufort County, Jasper County
SC-170 from Cecil Reynolds Dr to Oldfield Way	4.0	$2,000,000	$26,000	Beaufort County, Jasper County
SC-170 from Oldfield Way to Callawassie Dr	3.8	$1,900,000	$24,700	Beaufort County, Jasper County
Gibbet Rd	1.3	$650,000	$8,450	Beaufort County, Town of Bluffton
From Old Palmetto Bluff Rd to SC-46	1.0	$500,000	$6,250	Beaufort County, Town of Bluffton
5A (Future Bluffton Pkwy)	1.8	$900,000	$11,700	Beaufort County, Town of Bluffton
Hampton Pkwy from Bluffton Pkwy to US-278	1.7	$850,000	$11,050	Beaufort County, Town of Bluffton
From Bruin Rd to Bluffton Community Library via Hawkes Rd	0.3	$150,000	$1,950	Beaufort County, Town of Bluffton
From Future Bluffton Pkwy to US-278	1.6	$800,000	$10,400	Beaufort County, Town of Bluffton
Sawmill Creek Rd from US-278 to Trask Boat Landing (Bike Lane)	3.5	$262,500	$22,750	Beaufort County
Island West / Buckwalter Place Connector Path	0.3	$150,000	$1,950	Beaufort County, Town of Bluffton
US 278 from Gumtree to Squire Pope Rd	1.0	$1,200,000	$6,250	Town of Hilton Head Island
US 278/US 278 Bus from Sea Pines Circle to Welcome Center	0.3	$150,000	$1,875	Town of Hilton Head Island
Jonesville Rd	1.1	$1,250,000	$6,875	Town of Hilton Head Island
Martinangele Rd Easement to Prospect Rd to Benjies Pt Rd to School Rd (Crush and run path)	1.0	$365,000	$6,250	Beaufort County
Cooper River Landing Rd and Haig Point Rd from Freeport Marina to Daufuskie Island Boat Landing (Bike Lane)	3.5	$1,750,000	$22,750	Beaufort County
TOTAL	**63.3**	**$31,007,500**	**$410,350**	

*Final alignment and facility improvements not known at this time


US 17
US 21
802
170
US 21

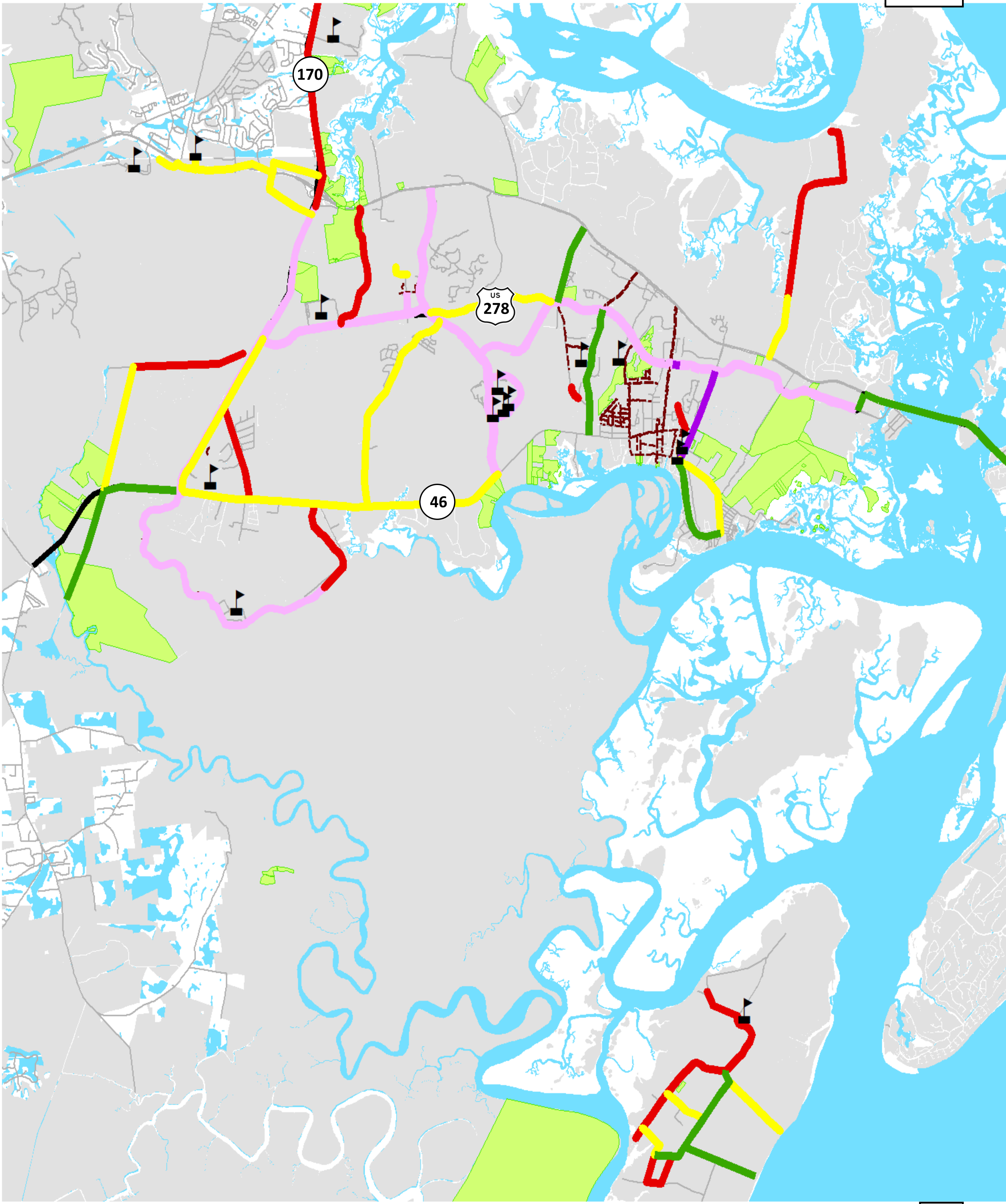
NORTHERN BEAUFORT COUNTY

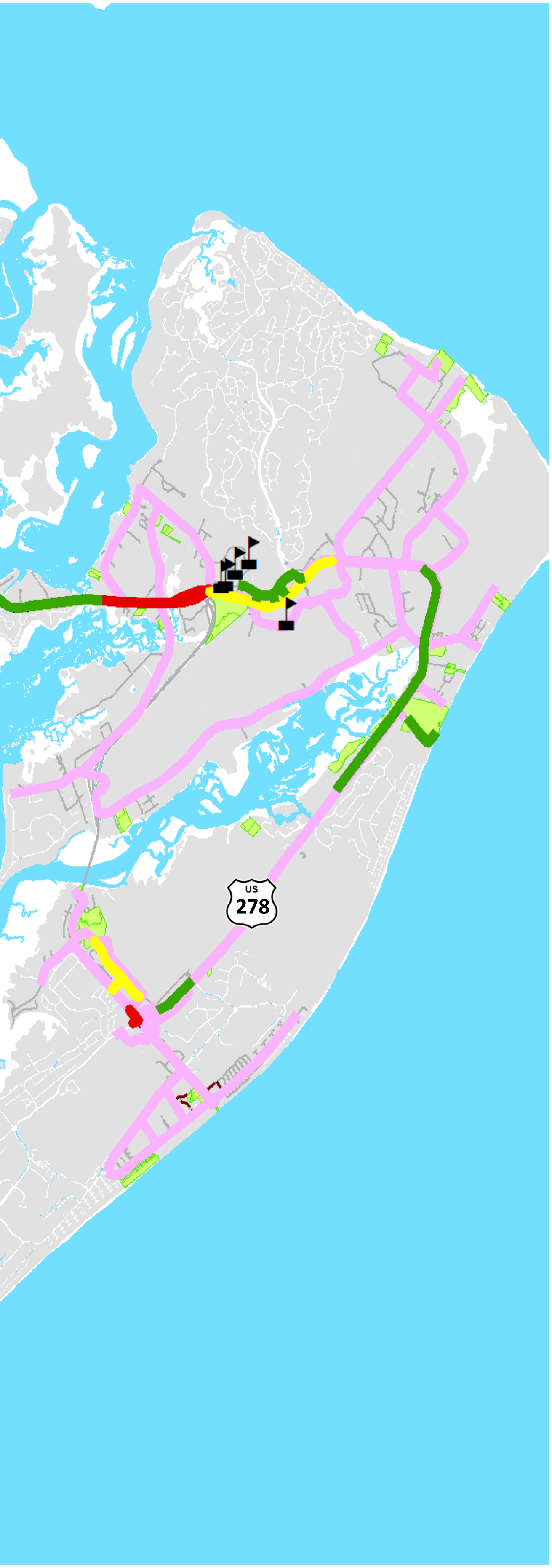
The pathway network in Northern Beaufort County begins at the north end of the County on the Gardens Corner Greenway, which is part of the East Coast Greenway. From there, pedestrians and cyclists will be able to safely travel the US 21 corridor into historic Downtown Beaufort. In town, users can explore the City of Beaufort and the Town of Port Royal on local roads or via the Spanish Moss Trail. The completed pathway network will take residents and visitors from the Waterfront Park in Beaufort, across the Woods Memorial Bridge to the multi-purpose pathways on Lady's Island. Cyclists and pedestrians will then be able to continue across St. Helena Island, and on to Hunting Island State Park. Returning to Beaufort, users can rejoin the East Coast Greenway, now adjoining the SC 170 corridor, and cross the Broad River Bridge into Southern Beaufort County.



BICYCLE AND PEDESTRIAN FACILITIES

Long Term
Mid-Term
Immediate Term
Proposed Spine Route
Committed Improvement Project
Existing Multi-Use Path
Existing Sidewalks
Schools
Parks and Preserved Lands


170
US
278
46

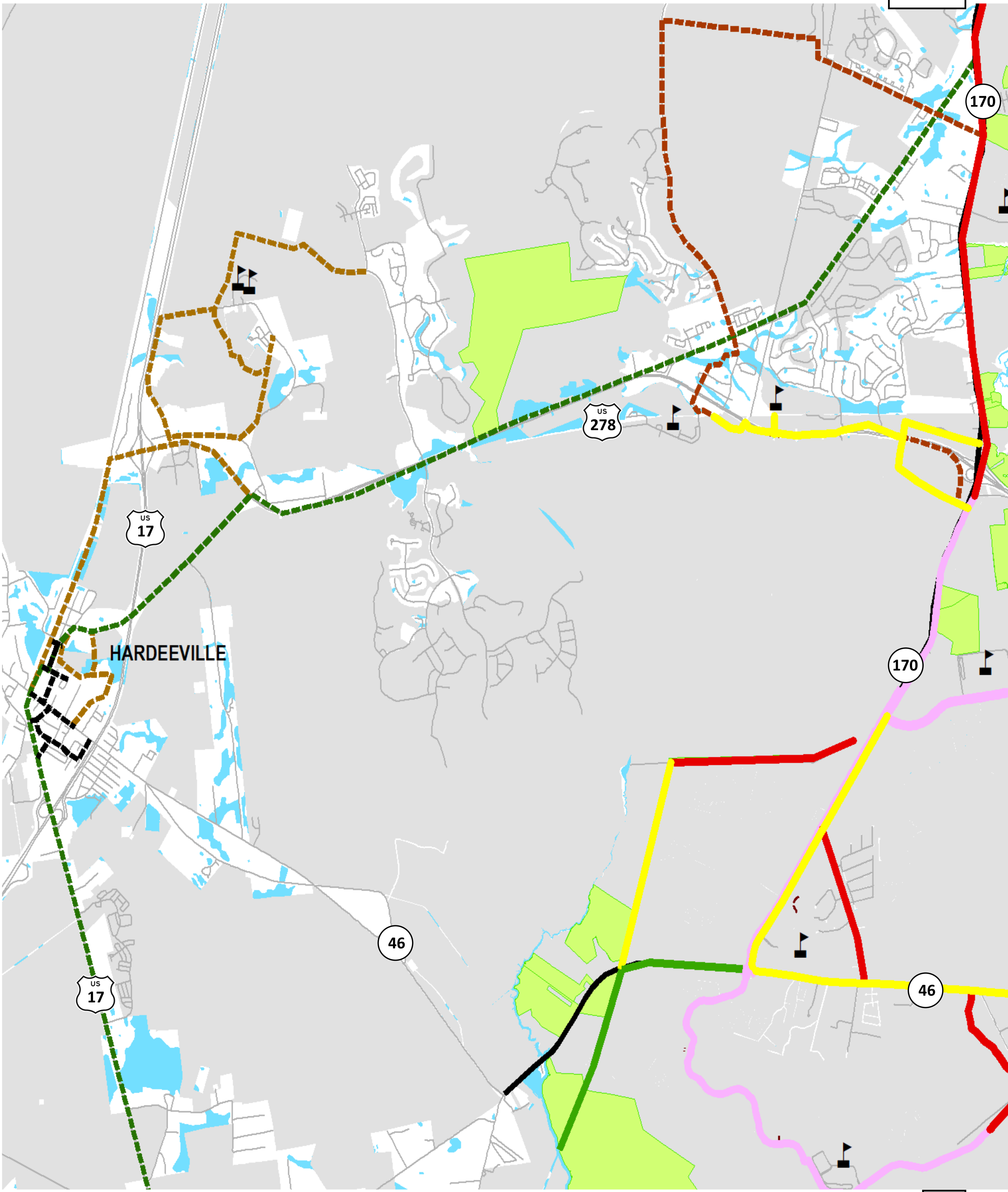


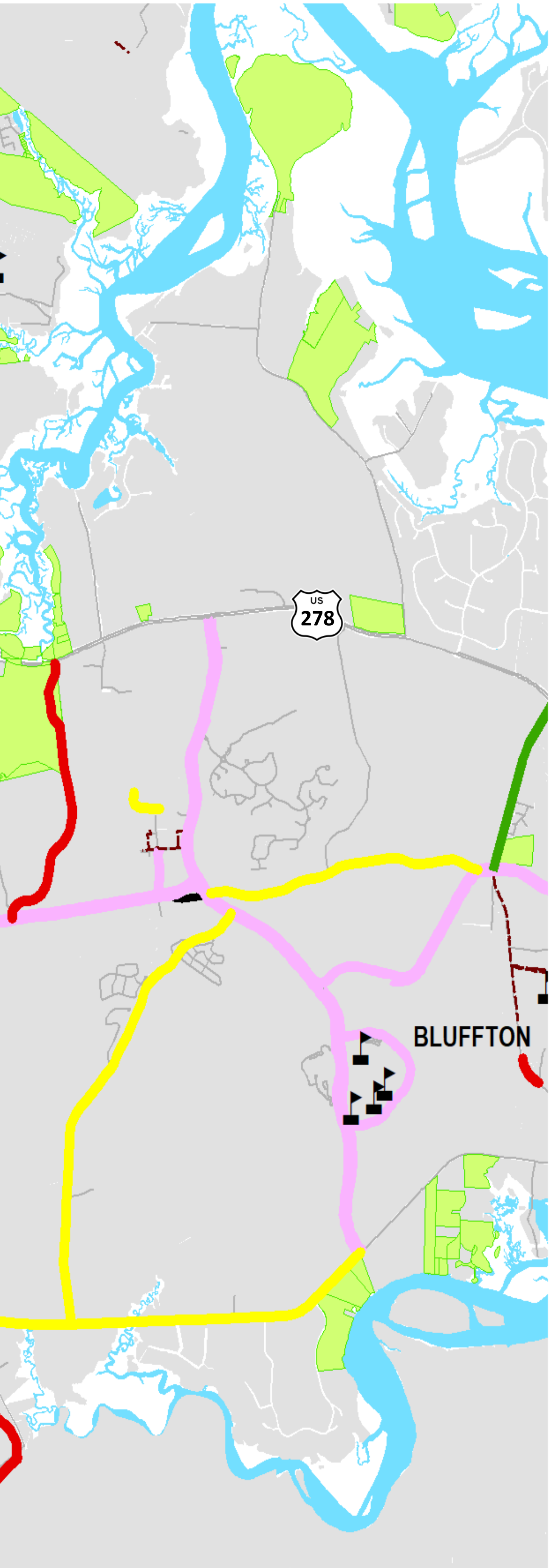
SOUTHERN BEAUFORT COUNTY

The network continues into Southern Beaufort County over the Broad River Bridge on the East Coast Greenway along SC 170. The trail continues through Okatie before crossing US 278. From there, users can continue on the East Coast Greenway to Savannah. Before crossing into Jasper County, users can take a side trip along the New River Linear Trail. Bikers and walkers interested in continuing their Beaufort County explorations will want to turn east onto the Bluffton Parkway multi-use path. Old Town Bluffton will be accessed from the path along Burnt Church Road. While in Old Town, a walk (or ride) through Brighton Beach is a must-do. Back on the Bluffton Parkway Side Path, the Town of Hilton Head is just over the J. Byrnes Bridge. On Hilton Head, over 60 miles of trails crisscrossing the island await pedestrians and bicyclists in this Gold-rated "Bicycle Friendly Community."

BICYCLE AND PEDESTRIAN FACILITIES

- Long Term
- Mid-Term
- Immediate Term
- Proposed Spine Route
- Committed Improvement Project
- Existing Multi-Use Path
- Existing Sidewalks
- Schools
- Parks and Preserved Lands


170
US 278
US 17
HARDEEVILLE
170
46
US 17
46



JASPER COUNTY CONNECTIONS

The success of this plan relies on regional cooperation between Jasper County, Beaufort County, and Hardeeville. Shared facilities begin at Snake Rd and SC 170 along the East Coast Greenway. At Argent Blvd, bikers and walkers can branch off into Jasper County along the proposed Hardeeville extension of the East Coast Greenway. From there, they can visit destinations like Sergent Jasper Park, downtown Hardeeville, and the Hardeeville Recreation Complex before continuing south to Georgia. At Short Cut Rd on SC 170, students and professors living along the corridor can use the proposed Sand Shark Trail to access both the TCL New River and the USC Bluffton campuses. Additional connections to the campuses are north and south of US 278 on Okatie Center Blvd N & S. This same network will tie into the Coastal Carolina Hospital, providing staff, visitors, and patients access to jobs and medical services.

BICYCLE AND PEDESTRIAN FACILITIES

- Hardeeville Proposed Sand Shark Trail
- Hardeeville Proposed East Coast Greenway
- Hardeeville Proposed Sergent Jasper Trail
- Hardeeville Proposed Sidewalks
- Long Term
- Mid Term
- Immediate Term
- Proposed Spine Route
- Committed Improvement Project
- Existing Multi-Use Path
- Schools
- Parks and Preserved Lands

PRIORITIZATION MATRIX

This prioritization matrix should be used by the bicycle and pedestrian coordinator and any future oversight committee to further evaluate each project, ensuring that the implementation process focuses on projects of most merit to the connectivity of the regional bicycle and pedestrian network over the long-term life of this document.

Criteria	Definition	Rank	Measurement
Connectivity	Does the project overcome barriers or fill gaps in the bicycle and pedestrian network?	High	Project closes gap between existing facilities
		Low	Project does not close gap between existing facilities
Safety	Does the project provide an immediate safety improvement where collision data, speed, and/ or street design indicate potential safety concerns?	High	Project location has a significant crash history, high speeds, and a street design that indicates a potential safety concern
		Medium	Project location has two of the following qualities: a significant crash history, high speeds, and a street design that indicates a potential safety concern
		Low	Project location has one of the following qualities: a significant crash history, high speeds, or a street design that indicates a potential safety concern
Accessibility	Does the project modify a completely non-accessible route or enhance accessibility along routes that already have some level of access?	High	Project provides or enhances access along a route with no or limited access
		Low	Project does not provide or enhance access along a route with no or limited access

Criteria	Definition	Rank	Measurement
Demand	Is it likely that walkers and bikers will use the facility? Will the project attract new walking and biking trips for existing destinations?	High	Project will attract new trips, and it is likely walkers and bikers will use the facility
		Low	Project will attract new trips, or it is likely that walkers and bikers will use the facility
Ease of Implementation	Does the project require easements, property acquisition, or additional right of way? Does the project have jurisdictional/ stakeholder support? Is the project a strong contender for grant funding?	High	Project is feasible, has political/ stakeholder support, and is a strong contender for grant funding
		Medium	Project has two of the following qualities: is feasible, has political support, and is a strong contender for grant funding
		Low	Project has one of the following qualities: is feasible, has political support, and is a strong contender for grant funding
Cost	What are the capital, operating, and maintenance costs of the improvement?	High	Construction and operating costs over 10 years are <$750,000
		Medium	Construction and operating costs over 10 years are between $750,000 and $1,250,000
		Low	Construction and operating costs over 10 years are >$1,250,000
Equity	Does the project improve access for underserved populations?	High	Improves access for underserved populations
		Low	Does not improve access for underserved populations

POTENTIAL FUNDING SOURCES

This table outlines sources of funding for pathway projects in Beaufort County. The recommended bicycle and pedestrian coordinator will use Chapter 4 of this plan as a guideline for prioritizing and funding projects. Many projects will require several funding sources from multiple levels of government (federal, state, local) and private sources.

POTENTIAL FUNDING SOURCE	POTENTIAL ANNUAL REVENUE	PROJECT TYPES
Local Accommodations Tax	Up to $500,000	Small projects, local matches for grants
Capital Project Sales Tax	Up to $1 million annually (assume successful referendum every 10 years with $10 million dedicated to bicycle and pedestrian projects)	Large projects, small projects
LATS	Up to $3 million annually (assume small % to fund bicycle and pedestrian projects in County)	Small projects
LCOG Federal Transportation Dollars	Assume small % of annual Guideshare funds for bicycle and pedestrian projects in County	Small projects in Sheldon or St. Helena Island
SCPRT Recreational Trails Program	$50,000 (assume successful $100,000 grant every two years)	Very small projects, trailheads, other enhancements
SCDOT Transportation Alternative Program	$250,000 (assume successful grant every two years)	Small projects
Private Funding	N/A	Matching local grants, maintenance, enhancement
RAISE Discretionary Grants	2019 avg. award: $17.4 million 2020 max.: $25 million/project	Largest projects
AARP Livable Communities Grants	Average in 2018: $10,000	Very small projects
Foundation Grants	N/A	Diverse projects and programs
Community Development Block Grant	$200,000 - $500,000	Medium projects

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CHAPTER 4:

IMPLEMENTATION PLAN

88

IMPLEMENTATION PLAN

RECOMMENDATION	Each jurisdiction represented on the Bicycle and Pedestrian Task Force should be encouraged to adopt the Beaufort County Connects 2021 by resolution and incorporate the document into their respective comprehensive plans.	Adopt the Immediate, Mid-, and Long Term project list in this plan.	Use the Prioritization Matrix in this plan to further evaluate each proposed project, ensuring that the implementation process focuses on projects of most merit to the connectivity of the regional bicycle and pedestrian network.
INVESTMENT	Low	Low	Low
TIME FRAME	Short	Short	Ongoing
PARTNER(S)	County Council, Municipalities, LATS	County Council, Municipalities, LATS, Nonprofits	County Planning & Zoning Department, County Engineering Municipalities, LATS
INITIATED			
COMPLETE			

IMPLEMENTATION PLAN

RECOMMENDATION	Develop a funding strategy and anticipated annual revenue stream for bicycle and pedestrian projects that includes Accommodations Tax, Guideshare funds, Capital Project Sales Tax, dedicated local funding, and state and federal grants.	Create a staff position within the Beaufort County government whose primary responsibility is to oversee the implementation of the Beaufort County Connects 2021.	Consider a 2022 ballot initiative to re-impose a 1% capital project sales tax to fund transportation improvements that include complete streets and multi-use paths and establish a regular schedule for future referendums.
INVESTMENT	Low	Low	Low
TIME FRAME	Short	Short	Short
PARTNER(S)	County Council, Municipalities, LATS	County Council	County Council, Municipalities
INITIATED			
COMPLETE			

RECOMMENDATION	Encourage each local jurisdiction to adopt a Complete Streets policy that requires all streets to be planned, designed, operated, and maintained to enable safe access for all users, including pedestrians, bicyclists, and transit riders of all ages and abilities.	Encourage municipalities and SCDOT to make Complete Streets policies mandatory in all new construction and repair projects.	Identify streets where Shared Lane Markings ("sharrows") should be added to improve conditions for bicyclists. Work with SCDOT, the County, and municipalities as appropriate to have these added.
INVESTMENT	Low	Low	Low
TIME FRAME	Short	Ongoing	Ongoing
PARTNER(S)	County Council, Municipalities, LATS	County Planning & Zoning Department, County Engineering, Municipalities, SCDOT, Nonprofits	County Planning & Zoning Department, County Engineering, Municipalities, SCDOT, Nonprofits
INITIATED			
COMPLETE			

IMPLEMENTATION PLAN

RECOMMENDATION	Work with LATS during the update of the Long Range Transportation Plan to incorporate bicycle and pedestrian projects in Beaufort County Connects 2021 and advocate for a target percentage of funding to be devoted to bicycle and pedestrian facilities.	Identify rural roads with moderate to high traffic volumes where paved shoulders are needed. Work with SCDOT to include paved shoulders as part of road repaving.	Establish an agreement with local utilities for use of utility corridors as walking and bicycling paths.
INVESTMENT	Low	Low	Low
TIME FRAME	Short	Short	Mid-
PARTNER(S)	County Planning & Zoning Department, LATS, Municipalities	Beaufort County Engineering, Beaufort County Planning & Zoning, SCDOT	County Council, Municipalities, SCDOT, Dominion Energy
INITIATED			
COMPLETE			

RECOMMENDATION	Revise the Community Development Code to require that path corridors are reserved, dedicated, or constructed in new developments where path corridors are shown in an adopted plan or where a property connects to an existing or proposed greenway.	Actively engage with the Beaufort County School District for their assistance in planning and implementing sidewalks and pathways so that children can walk or bike to school.	Advocate for state funding for the Safe Routes to School Program in concert with the Beaufort County School District.
INVESTMENT	Low	Low	Low
TIME FRAME	Short	Ongoing	Ongoing
PARTNER(S)	County Planning & Zoning Department, County Council	School District, County Planning & Zoning Department, County Engineering, Municipalities	County Planning & Zoning Department, County Engineering, Municipalities, SCDOT, School District, LATS
INITIATED			
COMPLETE			

IMPLEMENTATION PLAN

RECOMMENDATION	Develop a non-profit organization to advocate for pathway projects in Beaufort County and work to raise private donations.	Work with the Friends of the Spanish Moss Trail to expand their role to advocate and raise private donations for pathway projects that connect to the trail.	Endorse the Vision Zero Policy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all.
INVESTMENT	Low	Medium	Low
TIME FRAME	Mid-	Ongoing	Short
PARTNER(S)	County Planning & Zoning, Municipalities	Friends of the Spanish Moss Trail, County Planning & Zoning, County Engineering	County Council, Mayors, County Planning & Zoning, County Engineering, Local Law Enforcement Agencies
INITIATED			
COMPLETE			

RECOMMENDATION	Install pedestrian facilities such as crosswalks, countdown signals, and curb ramps at all intersections where there is an existing sidewalk or planned sidewalk or trail.	Provide raised medians or pedestrian refuge islands, where practical, at crosswalks on streets with more than three lanes, especially on streets with high volumes of traffic.	Require bicycle parking in all new commercial, civic, government, and multi-family land uses. Encourage municipalities to have similar requirements.
INVESTMENT	Medium	Medium	Low
TIME FRAME	Mid-	Mid-	Short
PARTNER(S)	County Engineering, SCDOT, Municipal Engineering Departments	County Engineering, SCDOT, Municipal Engineering Departments	County Planning & Zoning Department, Municipalities
INITIATED			
COMPLETE			

IMPLEMENTATION PLAN

RECOMMENDATION	Work with the East Coast Greenway to develop a strategy to complete the East Coast Greenway trail through Beaufort County.	Encourage the SC Legislature to adopt a Safety Stop bill that allows bicyclists to treat a stop sign as a yield sign if the cyclist has slowed down to a speed that would allow them to stop if needed.	Encourage large employers to provide showers and clothes lockers at work to promote commuting by bike.
INVESTMENT	Medium	Low	Low
TIME FRAME	Short	Ongoing	Ongoing
PARTNER(S)	County Planning & Zoning, County Engineering, SCDOT, East Coast Greenway Alliance, LATS	Local Delegates, Advocacy Groups	Advocacy Groups
INITIATED			
COMPLETE			

RECOMMENDATION	Establish a Bicycle and Pedestrian Advisory Committee to assist the County in the planning, funding, development, and implementation of facilities and programs that will result in the increased safety and use of bicycle and pedestrian travel as a mode of transportation	Support or partner with municipalities on bike sharing and e-scooter programs in an effort to promote cycling and mobility.	Sponsor, support, and/or promote national events that promote walking and cycling: National Bike Month, Bike-to-Work Day, Car-Free Day, Earth Day
INVESTMENT	Low	Low	Low
TIME FRAME	Short	Ongoing	Ongoing
PARTNER(S)	County Planning & Zoning, County Engineering	County Planning & Zoning, Municipalities	County Planning & Zoning, Municipalities, Nonprofits
INITIATED			
COMPLETE			

IMPLEMENTATION PLAN

RECOMMENDATION	Become a designated Walk Friendly Community.	Become a designated Bicycle Friendly Community.	Consider participating in the Open Streets Program to temporarily open selected streets to pedestrians by closing them to cars.
INVESTMENT	Low	Low	Low
TIME FRAME	Mid-	Mid-	Mid-
PARTNER(S)	County Council, County Planning & Zoning, County Engineering, Nonprofits	County Council, County Planning & Zoning, County Engineering, Nonprofits	County Council, County Planning & Zoning, County Engineering, Nonprofits
INITIATED			
COMPLETE			

RECOMMENDATION	Encourage and support events hosted by private non-profit groups that promote walking and cycling such as bike rodeos, weekend walkabouts, lunchtime bicycle rides, cycle the bridges, ride to beach, etc.	Support and partner with private nonprofit groups, such as Eat Smart Move More South Carolina, that focus on helping communities create healthy eating and active living options.	Develop an education program similar to Charleston's **Bike Right, Drive Right** Campaign to educate both bicyclists and motorists on safe and respectful sharing of our roads.
INVESTMENT	Low	Low	Low
TIME FRAME	Ongoing	Ongoing	Ongoing
PARTNER(S)	County Council, County Planning & Zoning, Municipalities, Nonprofits, School District, Beaufort Memorial Hospital	County Council, County Planning & Zoning, Municipalities, Nonprofits, School District, Beaufort Memorial Hospital	Local Law Enforcement Agencies, Nonprofits, School District
INITIATED			
COMPLETE			

IMPLEMENTATION PLAN

RECOMMENDATION	Develop a regional wayfinding program.	Develop an interactive bike map that outlines bike routes and bike parking.	Support the School District in implementing a Walk and Bike to School day.
INVESTMENT	Medium	Low	Low
TIME FRAME	Mid-	Mid-	Short
PARTNER(S)	County Planning & Zoning, County Engineering, SCDOT,	County Planning & Zoning, County GIS, SCDOT, Municipalities	County Planning & Zoning, School District, Local Law Enforcement
INITIATED			
COMPLETE			

RECOMMENDATION	Conduct county-wide pedestrian and bicycle counts on a regular basis.	Encourage training courses for law enforcement officers on state and local laws for motorists, bicyclists, and pedestrians.	
INVESTMENT	Medium	Low	
TIME FRAME	Ongoing	Short	
PARTNER(S)	County Planning & Zoning, County Engineering	County Planning & Zoning, Local Law Enforcement Agencies	
INITIATED			
COMPLETE			

ENVISION
BEAUFORT COUNTY

2040 COMPREHENSIVE PLAN

September 2021

ACKNOWLEDGMENTS

County Council

Joe Passiment, Jr., Chairman
Paul Sommerville, Vice-Chairman
Chris Hervochon
York Glover, Sr.
Alice Howard
Stu Rodman
Larry McElynn
Brian Flewelling
Logan Cunningham
Gerald Dawson
Mark Lawson

Planning Commission

Ed Pappas, Chairman
Randolph Stewart, Vice-Chairman
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Support from:

Beaufort County, the Rural and Critical Lands Program, and the people of Beaufort County

CONTENTS

INTRODUCTION

BEAUFORT COUNTY'S OPPORTUNITY: RESILIENCE, EQUITY, & PLACE

Beaufort County has the key ingredients that provide for a high quality of life. The unique character of the Lowcountry--the distinctive blend of the natural and built environment--set it apart from other places. The area's character, community, environment, sense of place, and history are cherished by its citizens and should be preserved and protected. At the same time, there is a need to promote economic opportunity and equitable access to jobs, housing, and services for all its residents to enjoy.

This Comprehensive Plan is being created in a time of change that is challenging the status quo. Growth continues to provide opportunities as well as challenges. The COVID-19 pandemic has altered how we live, shop, gather, and conduct business. Storm events are getting stronger and more frequent, which is causing more people and expensive infrastructure to be impacted by higher levels of flooding. Development is pushing into our natural environment, and we are losing our tree canopy. Habitats and the quality of our waterways are being threatened. More and more, our underserved populations are not able to equitably share in the region's opportunities and economy. Fortunately, the citizens and leadership of Beaufort County are determined to address these issues and create the tools needed to overcome current challenges.

Beaufort County has created a vision and the regulatory tools it needs to balance economic development, resource protection, and growth in a form that creates quality places. With the Comprehensive Plan, Greenprint Plan, transect-based zoning, cultural overlays, and various small area and corridor plans, it has a healthy toolbox from which to guide the growth of its built environment.

There remains however, an opportunity to more completely organize the toolbox to help achieve the County's vision for the future. With this Comprehensive Plan, a more direct link is created between planning for prosperity, environmental and economic resilience, equitable community services and infrastructure, and preservation of the unique place that is the Lowcountry.

Balance can be achieved by including goals, strategies, and specific actions that will enable all citizens increased access and choices related to health, safety, quality of life, education, recreation, and jobs. Growth can occur together with resource protection and resilience planning. It does not need to be an either-or decision.

By considering these two concepts in unison, and creating clarity about how to accomplish both, Beaufort County can move forward confident that it is protecting the health, safety, and welfare of its citizens; the assets that support its economy; and the opportunity for a better life for its citizens.

This Comprehensive Plan looks out 20 years and recognizes the impact that growth has on the convenience, sense of place, and character of the region. It describes specific principles, strategies, and actions that enable Beaufort County to act on

With this Comprehensive Plan, a more direct link is created between planning for environmental and economic resilience, the equitable sharing in community services, infrastructure, prosperity and quality of life, and the preservation and promotion of the unique place that is the Lowcountry.

its established principles and values as described in the many visionary plans that it has created.

The Comprehensive Plan acknowledges that growth is desired and inevitable, but must be accomplished in ways that support traditional town planning, environmental protection, and access and equity for its citizens. Balance can be accomplished by guiding development to land that is most suitable based on economic, cultural, social, and environmental principles.

The Plan acknowledges that the County is inextricably linked to its municipalities and adjacent counties, sharing roads, waterways, habitats, and open spaces which do not follow jurisdictional boundaries. This requires that high levels of cooperation and collaboration be maintained within the region so that local identities can be expressed within a framework of shared goals regarding infrastructure, environmental protection, growth, economic development, and affordable housing.

With focus and effort, as well as regional collaboration, Beaufort County can move forward with a clear vision and action plan that honors its principles and values. By investing in new public infrastructure, creating incentives for affordable housing, focusing development on land of the highest suitability, and making hard choices about how to protect the very environmental systems that can help mitigate harm, future generations will be able to enjoy the quality of life and economic prosperity offered by Beaufort County's unique landscape and culture.

THE 2040 COMPREHENSIVE PLAN

The 2040 Comprehensive Plan is a county-wide planning document that outlines goals, policies, and implementation strategies developed with a thorough public engagement process. The purpose of the 2040 Comprehensive Plan is to enable government officials and citizens to anticipate and constructively respond to growth and change; to encourage the development of a vibrant built environment and a healthy natural environment; and to provide equitable opportunities for all citizens to enjoy a high quality of life.

Critical Goals of the Plan

- Integrate existing plans and initiatives into a community-wide vision for the future.
- Create a resource to inform policy decisions.
- Set priorities and responsibilities to be used by Staff and Leadership to initiate tasks and make decisions.
- Outline specific goals and strategies to achieve the vision.
- Align Strategic Plans, Capital Improvement Plans, Budgets, and Department Action Plans.

Why Is It Needed?

A comprehensive plan is required by state law in all jurisdictions that have zoning. The comprehensive plan sets out a vision for the future, establishes goals, and recommends actions to achieve those goals. It links long range vision with local programs and policies.

The comprehensive plan informs County government activities to ensure Beaufort County maintains its high quality of life, unique landscape, access to nature, Lowcountry aesthetic, and expands economic opportunities. When implemented, the comprehensive plan will enable the County to reap the rewards of its ongoing success and to build a community that attracts people to live, work, and play. This plan looks out into the future 10 years. After five years, the plan should be reviewed and revised after 10 years.

What Does It Include?

The Beaufort County Comprehensive Plan 2040 conveys a vision, goals, strategies, and actions derived through a collaborative "community-based" planning process.

It includes Implementation and Action Planning, which provides an opportunity for County staff, leadership, private sector interests, and citizens to hold each other accountable to act on it.

The Comprehensive Plan focuses the capital investment, human capacity, and the shared commitment that is needed for the County to realize its vision and manage its growth toward an even more viable and sustainable future. Consistent with state statute, the Comprehensive Plan consists of elements which analyze growth and guide future development and projects.*

Because of the unique approach undertaken by the County in the adoption of this Comprehensive Plan, the standard elements are woven into integrative Themes that better articulate Beaufort County's priorities for achieving economic, social, and environmental sustainability.

Required Elements For South Carolina Comprehensive Plans*

POPULATION
Consider historic trends, projections, household numbers and sizes, educational levels, and income.

ECONOMIC DEVELOPMENT
Consider labor force characteristics, employment and residence, and analysis of the economic base.

NATURAL RESOURCES
Consider coastal resources, slope, agricultural and forest land, plant and animal habitats, parks and recreation areas, scenic views, wetlands and soils.

CULTURAL RESOURCES
Consider historic buildings, structures, districts, natural/ scenic sites and archaeological resources.

COMMUNITY FACILITIES
Consider water/ sewage system and wastewater treatment; solid waste collection and disposal, fire protection, emergency medical services, government facilities; education and cultural facilities.

HOUSING
Consider location, types, age, condition of housing, owner and renter occupancy, and affordability.

LAND USE
Consider existing and future categories, including residential, commercial, industrial, agricultural, forestry, mining, public and quasi-public, recreation, parks, open space, and vacant or undeveloped.

TRANSPORTATION
Consider facilities including major road improvements, new roads, transit projects, pedestrian and bicycle projects, and other elements of a network in coordination with land use.

PRIORITY INVESTMENT
Analyze the likely federal, state, and local funds available for public infrastructure and facilities during the next ten years, and recommend projects for needed public infrastructure and facilities such as water, sewer, roads, and schools.

RESILIENCE
Consider strategies for the long term viability, maintaining quality of life and health, safety and welfare for future generations.

Look for these icons throughout the document to keep track of how each element is addressed

HOW TO USE THIS DOCUMENT

Each of the core values, strategies, and actions included in this document are important in order for the County to achieve its vision. In that sense, this Comprehensive Plan is a living document that needs to be used and updated regularly. To be effective, the Plan needs to influence the actions of County departments and encourage collaboration and cooperation between them. The Plan is a starting point, where vision is articulated, themes are established, strategies are identified, and action items are defined.

A Tool for Decision Making: First and foremost, the Comprehensive Plan should serve as a reference tool that is referred to regularly, and should be the foundation for the County's internal actions and interactions with its neighboring municipalities and counties. The Core Values and Strategies in each element serve as these tools for decision making.

A Plan for Action: The plan also outlines specific action items in each element and a Capital Improvements Plan that achieve the core values and strategies. These action items are intended to be implemented within a ten year time. While this plan provides specific steps for future action, it purposefully does not resolve all of its core principles, and strategies with specific actions.

The Comprehensive Plan describes actions in terms of immediate activities that begin with adoption of the plan, typically completed within the first year; short-term activities that start within one to three years of the plan's adoption; mid-term activities that begin three to ten years after the plan's adoption; and long-term activities that extend beyond ten years and may overlap into the next Comprehensive Plan Update.

Three **concepts** are woven throughout **Thematic Chapters** that address Beaufort County's greatest opportunities within the 2040 Comprehensive Plan, which are: **Resilient, Equitable, and Unique to Place:**

Resilient — Able to adapt and thrive in a dynamic coastal environment and changing economy.

Equitable — Ensuring all neighbors have fair and equal access to safety, quality of life, health,amenity and opportunity.

Unique to Place — Preserving and promoting a built and natural environment that is of the Lowcountry way of life.

Within the Thematic Chapters, each recommended strategy is highlighted with a capital letter R (Resilient), E (Equitable), or P (Place) to represent each of these concepts.

BEAUFORT COUNTY ATLAS

A living document in a simple template that can be updated over time. The starting reference point for current and future Beaufort County planning projects.

PEOPLE OF BEAUFORT COUNTY

County Comprehensive Plan references County

BEAUFORT COUNTY COMPREHENSIVE PLAN

A simple and visual comprehensive plan update with succinct analysis and concrete recommendations organized by theme.

County Comprehensive Plan and Green Print Plan reference each other.

GREENPRINT PLAN

A simple and visual Green Print Plan update with succinct analysis and concrete recommendations organized by theme.

MUNICIPAL COMP PLANS

PARKS AND RECREATION PLANS

SOUTHERN LOWCOUNTY ORDINANCE AND DESIGN MANUAL

TRANSPORTATION PLANS

PROCESS: CAPTURING COMMUNITY VISIONS & GOALS

The planning process was conducted during the time of social distancing associated with the COVID-19 pandemic, which shaped the way community engagement was conducted with most of the interaction being virtual and web-based.

The process was organized in stages. The initial phase analyzed Beaufort County's existing environment, its role within the region, social and economic conditions, and projected growth.

Initial efforts also included evaluating the action items of existing plans and policies to determine what has been done, what was not relevant anymore, and what still needed to be done to avoid duplication of efforts.

Later stages shaped the strategy and vision for the Plan around a process of extensive community outreach and engagement that had to respond to the realities of being conducted during a pandemic.

Public surveys, in-person and virtual community workshops, focus groups, and planning exercises helped establish goals, strategies, metrics, and implementation steps. In-person workshops occurred around the County and tried to reach as many citizens as possible through outreach and promotion.

The Plan was drafted, expanded, and ultimately finalized through an iterative process of continuous feedback between the consultant team, community, and County staff. Public comments were integrated in response to additional public workshops that asked the public to evaluate and prioritize the Plan's key strategies.

The Comprehensive Plan process was led by the County's Planning Department, with support from all the County's departments. Several stakeholder groups helped shape the plan's focus.

Research, Analysis, & Stakeholder Meetings
Jan. 2020

Public Workshops: Vision, Open Space, Economy, & Growth
June 2020

Plan Development & Public Review
April 2021

Plan Adoption
Sept. 2021

COMMUNITY VOICES OF INPUT

1.4K

STORYMAP & CONTENT VIEWS

2.5K

STAKEHOLDER TOUCHPOINTS

47+

METHODS OF ENGAGEMENT

12

WITH COMMUNITY EMPHASIS ON

PRESERVING ENVIRONMENT & RURAL CHARACTER

RESILIENT CULTURE & ECONOMY

GROWTH MANAGEMENT & COLLABORATION


Beaufort County Comprehensive Plan Public Workshops, 2020

THEMES

Three **concepts** are woven throughout **Thematic Chapters** that address Beaufort County's greatest opportunities within the 2030 Comprehensive Plan, which are: **Resilient, Equitable, and Unique to Place:**

Resilient — Able to adapt and thrive in a dynamic coastal environment and changing economy.

Equitable — Ensuring all neighbors have fair and equal access to safety, quality of life, health,amenity and opportunity.

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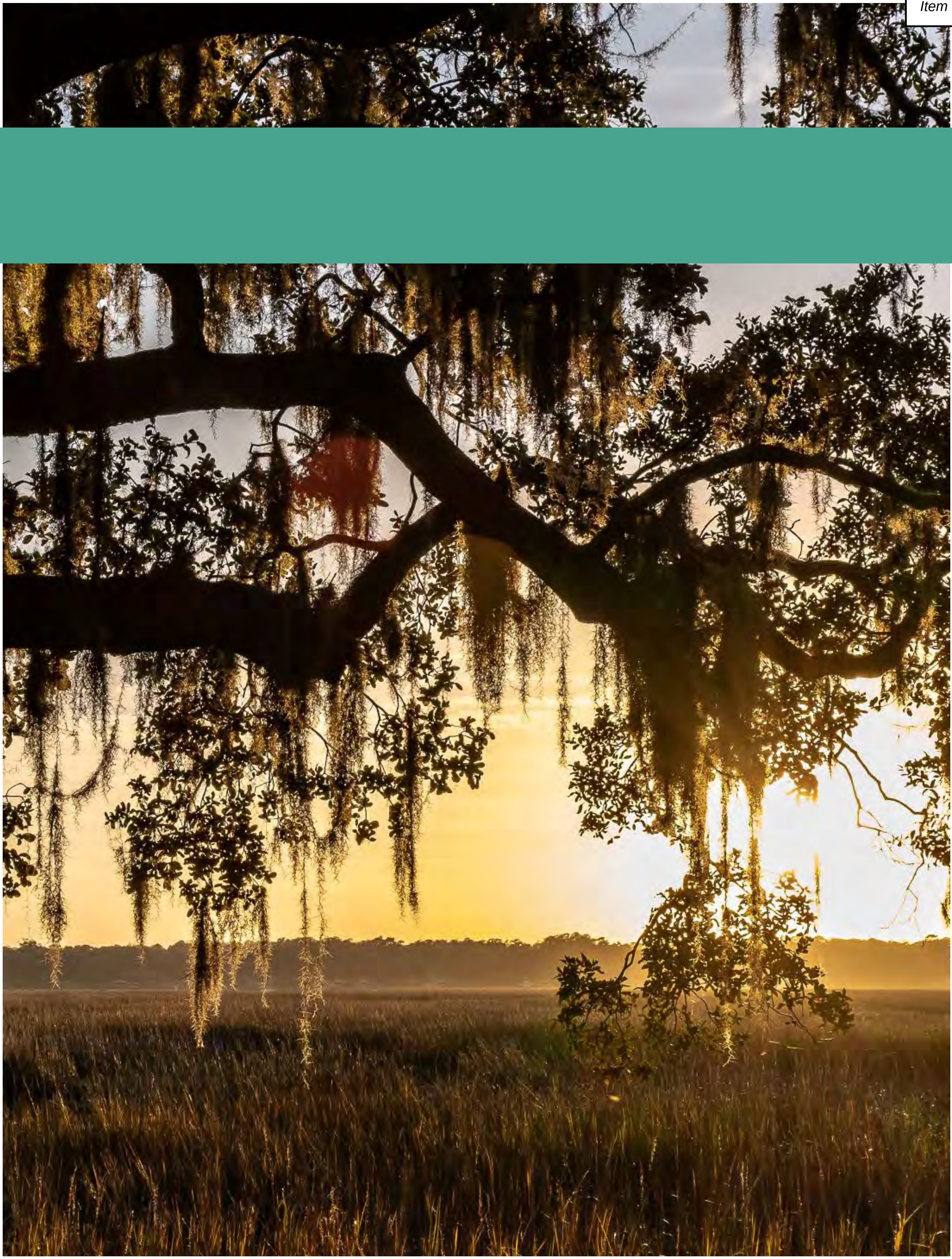


Photo source: Port Roya

NATURAL ENVIRONMENT

Natural resources protected for recreation, rejuvenation, hazard mitigation, and environmental health.

CORE VALUES

1. We value our unique and complex natural environment as a source of life, recreation, economy, culture and sense of place.

2. We make efforts to preserve our critical natural environments to preserve the quality of life for future generations.

3. We balance development with the preservation of our natural systems.

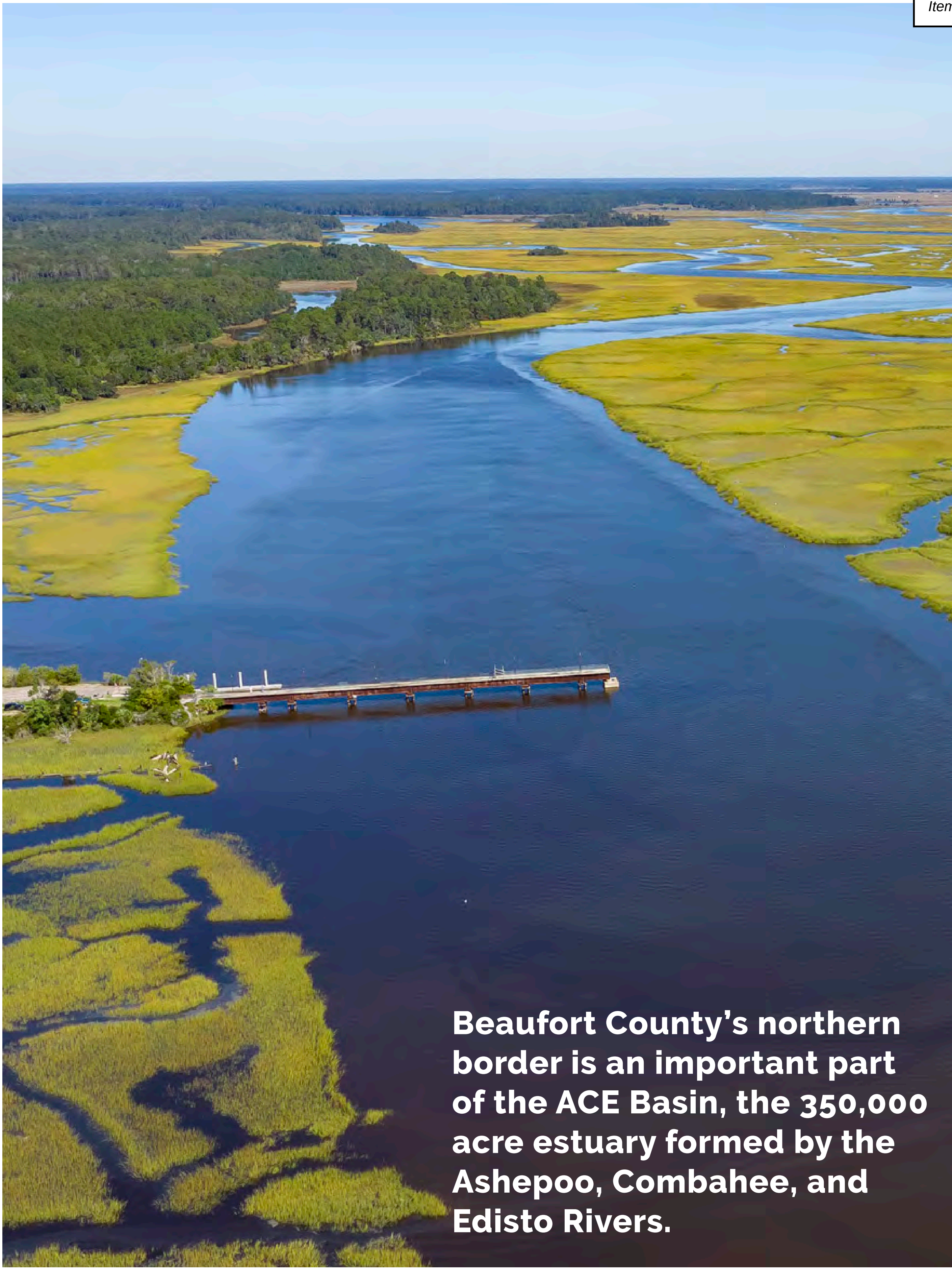
4. We depend on clean water to support our economy and lifestyle.

5. We prepare for environmental changes and meet those challenges head on.

6. We are leaders in the region and pursue environmentally responsible development.

i

Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.



Beaufort County's northern border is an important part of the ACE Basin, the 350,000 acre estuary formed by the Ashepoo, Combahee, and Edisto Rivers.

Photo source: Design Workshop

CONTEXT

Beaufort County has a treasured natural environment, primarily made up of the Port Royal Sound, and including expansive saltmarshes and tidal waters, sub-tropical maritime forests of live oaks and palmettos, towering pines, forested wetlands of cypress and tupelo, and over 30 miles of beaches.

Beaufort County residents and visitors have a great attachment to the local environment and have fought hard to preserve and protect it. The County has developed advanced stormwater standards to prevent flooding and protect water quality. They have developed requirements to protect specimen trees, habitats, beaches and dunes, and endangered species. They have also been very aggressive in securing and preserving open space.

However, there are still many challenges ahead. Development has not slowed and the County will continually need to reevaluate and update its policies and regulations to make sure that its water quality and resource protection goals are met. As growth continues, land becomes more scarce and challenging to develop, reinforcing the importance of prioritizing future acquisitions of open space and the preservation of greenways and wildlife corridors to connect natural areas.

Additionally, the County needs to continue to cooperate with its neighbors on natural resource planning, achieving baseline environmental standards, and retrofitting stormwater management systems in older developments.

Adding to the challenge, Beaufort County is experiencing the effects of stronger storm events and rising sea levels. Impacts include higher levels of flooding, property damage, loss of business and infrastructure, displacement, and significant drain on local and federal budgets.

Sea level rise also affects environmental systems, including erosion of protective beach landforms, marsh migration, loss of wildlife habitat, potential for prolonged flooding, and the salinization of freshwater wetlands and aquifers, which alters their ecological balance and function.

These impacts can be reduced by planning in harmony with the natural environments that are "designed" to accommodate them. Resiliency planning will prevent costly recovery expenditures and lessen fears of devastation or economic ruin from coastal or storm flooding. Locating homes and businesses outside the path of destructive flooding will lead to a safer, economically, and socially sustainable future

Several coastal community comprehensive plans and resiliency plans were studied to determine current best practices, including:

Norfolk, Virginia, Virginia Beach, New Orleans, Broward County Florida, Charleston, South Carolina,Boston, Washington DC,and Miami, Florida.

Given the strides the County has taken to preserve and protect its natural resources, the following strategies are needed to face future challenges:

» Continue to reevaluate and update water quality and natural resource protection standards.

» Work cooperatively with neighboring jurisdictions to protect valuable resources.

» Implement tools to aid the conservation of sensitive environments and landscapes.

» Study and minimize the probable impacts of sea level rise on public assets, infrastructure, operations, and the environment.

» Continue to aggressively conserve and begin to restore critical habitats and their ecosystem services.

Photo source: Design Workshop

STRATEGIES & ACTIONS

R NE 1. STUDY, MONITOR, ADDRESS, AND PROTECT VITAL NATURAL RESOURCES, AND PRIORITIZE CONSERVATION EFFORTS.

- Monitor and study the impacts of rising sea level on salt marshes.
- Identify opportunities to facilitate marsh migration and target vulnerable areas for conservation.
- Establish project standards and regulations for permitting living shorelines as an alternative to bulkheads and revetments as erosion control techniques through collaboration with DHEC/OCRM.
- Collect and compile baseline data on water quality standards on the sub-watershed level, including the Port Royal Sound. Continue to support short- and long-term monitoring of the Sound to identify any changes. Work towards centralizing and standardizing the collection and analysis of water quality to be easily accessible.
- Continue to implement the Stormwater Utility with priority placed on encouraging property owners in older moderate- and high-density developments that predate the adoption of stormwater standards in Beaufort County to retrofit facilities to meet current standards.

- Provide a mechanism to allow high-density developments to reduce the impact of nitrogen pollution by encouraging property owners to retrofit stormwater management devices in older non-conforming developments within the same sub-watershed.
- Continually reevaluate and update the Stormwater BMP manual to increase the use of Low Impact Development (LID) and incentivize preservation of trees and preservation and restoration of natural spaces that serve these functions naturally and at no cost.
- Continually evaluate how stormwater standards can be modified to help reduce FEMA flood insurance rates through the Community Rating System (CRS).
- Continue to fund the Rural and Critical Lands Preservation Program (RCLPP) and use the Greenprint map to assist in prioritizing land purchases and conservation easements.
- Work toward a network of open spaces coordinating RCLPP lands with other preserved lands and open space set asides.
- Protect mature and specimen trees and plant new trees when property is developed or redeveloped.
- Build on the current partnership with Clemson Extension to promote the value of tree protection and proper tree care and promote other Extension public education programs such as Master Naturalist and Master Gardner to help residents restore and protect the area's natural resources.
- Preserve groundwater quality by reducing and eliminating heavy usage of groundwater resources in the County.

NE1. ACTIONS

NE 1.1. Monitor effectiveness of existing ordinances and programs and update as necessary to protect water quality and natural resources.

NE 1.2. Seek referendums on additional funding for the Rural and Critical Lands Preservation Program every four years.

NE 1.3. Require new developments and encourage existing developments to adopt a tree management plan.

NE 1.4. Support Port Royal Sound Foundation's application to the EPA's National Estuary Program to recognize the local and national importance of the Port Royal Sound, drawing support and funding for conservation and research on our vital coastal resources. Seek partnership with Port Royal Sound Foundation to monitor water quality and provide educational opportunities for the community about the importance of keeping our waterways healthy.

NE 1.5 Evaluate the time period that a property owner must wait after clear cutting property before applying for a development permit.

R NE 2. USE THE GREENPRINT PLAN AND GREENPRINT PRIORITY MAPPING TO ENSURE THAT NEW DEVELOPMENT SUPPORTS RESOURCE CONSERVATION.

- Create awareness of potential impacts of development.
- Identify areas critical for flood control and natural resource protection, as well as higher ground that may be more suitable for development.
- Use the Greenprint Overlay in review of proposed development and land use plans, infrastructure plans, parks and recreation plans, and transportation plans.

STRATEGIES & ACTIONS

NE2. ACTIONS

NE 2.1. Provide critical environmental systems maps on the County website.

NE 2.2. Update environmental systems mapping (five-year cycle) to reflect ongoing research and actual conditions of flooding and sea level rise.

R NE3. MONITOR AND STUDY ENVIRONMENTAL HAZARDS TO BEST UNDERSTAND POTENTIAL IMPACTS AND PLAN APPROPRIATELY.

NE3. ACTIONS

NE 3.1. Install and monitor tidal gauges at several locations in Beaufort County, including the Port Royal Sound Foundation's Maritime Center, to provide a thorough representation of tidal activity across the county. Seek partners to assist in funding and managing tidal gauges, including ACE Basin NERR, Palmetto Bluff Conservancy, Lowcountry Institute, S.C.

NE 3.2. Install groundwater monitoring wells at various locations including agricultural areas and low-lying communities that rely on septic systems.

NE 3.3. Adopt comprehensive water plans for vulnerable areas of the County by studying and analyzing how stormwater, sea level rise, and storm surge interact in an area determined by geographic and geological conditions. Understand and quantify to what degree salt marshes reduce local flooding and storm surge impacts, implement planning to incorporate these natural buffers as hazard reduction tool.

NE 3.4. Engage residents in the Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS) program through collaboration with the Office of the State Climatologist and the National Weather Service

R NE 4. BUILD AT HIGHER ELEVATIONS TO AVOID IMPACT OF INCREASED FLOODING.

- Enact ordinances and policies that direct new development to a height or location resilient to coastal flooding caused by increasingly intense storm events, king tides, and rising sea levels.
- Consider increasing low-impact development (LID) standards, increasing buffers, limiting septic systems, and reducing density for low-lying areas and areas identified on the Greenprint Priority Mapping.
- Periodically evaluate freeboard requirements and/or Base Flood Elevations (BFE) to ensure that new structures are built to address existing flood risks and projected future risks due to sea level rise.
- Incentivize land purchases in flood-prone areas for open space preservation.
- Apply for grant funding—DOT, EPA, CDBG, FEMA, etc.—to develop a sustainable, resilient solution to address current and future flooding of the Warsaw Island Causeway.

NE4. ACTIONS

NE 4.1. Adopt a coastal resilience overlay district to require notification prior to real estate closings of the vulnerability of property to coastal flooding in low lying areas.

NE 4.2. Adopt additional feet of freeboard above BFE as well as uniform policies for adjacent properties outside the flood area.

NE 4.3. Review the County's Community Rating Service (CRS) program and makes changes to regulations and programs as appropriate with the goal of improving the County's CRS rating. Every improvement in the CRS rating saves flood policy holders 5% in premiums.

R

NE 5. ASSIST VULNERABLE COMMUNITIES AND CONDUCT HAZARD MITIGATION PLANNING.

- Identify local communities that are at the highest risk to the impacts of coastal flooding and sea level rise. Develop criteria for identifying when the County intervenes, either through policy and/or funding regarding flooding and sea level rise impacts to public, quasi-public, and private infrastructure and individual properties to ensure equitable and proportional responses.
- Fully incorporate and integrate future sea level rise and climate change impacts into emergency management and hazard mitigation plans.

NE5. ACTIONS

NE 5.1. Develop a flood, sea level rise, and climate change roadshow program to connect with community groups, homeowners' associations, professional organizations not already served by existing programs, and other similar organizations for community outreach and education. Partner with public agencies such as Sea Grant and nonprofit groups such as the Port Royal Sound Foundation and the Gullah/Geechee Sustainability Think Tank in development of the program.

NE 5.2. Maintain an ongoing collaborative working group, similar to the Sea Level Rise Task Force, for discussions and feedback involving recommendations and other proactive activities related to sea level rise and resilience.

NE 5.3. Hire a Resilience Officer to oversee hazard mitigation planning in the county, including, but not limited to, assisting vulnerable communities, applying for grants, creating outreach education programs, and continually assessing hazard risks and creating policies to mitigate them.

R

NE 6. EXPAND COMMUNITY-LEVEL CLIMATE CHANGE SCIENCE OUTREACH AND EDUCATION.

- Improve communication and outreach to the public about the science and projected impacts of flooding, sea level rise, and climate change.

NE6. ACTIONS

NE 6.1. Develop a county- level website that houses Beaufort County specific flooding and sea level rise information, including housing reports, outreach materials, the GIS portal that has sea level rise mapping, and other data sources. This website can potentially count as Community Rating System outreach credit if National Flood Insurance Program information is included.

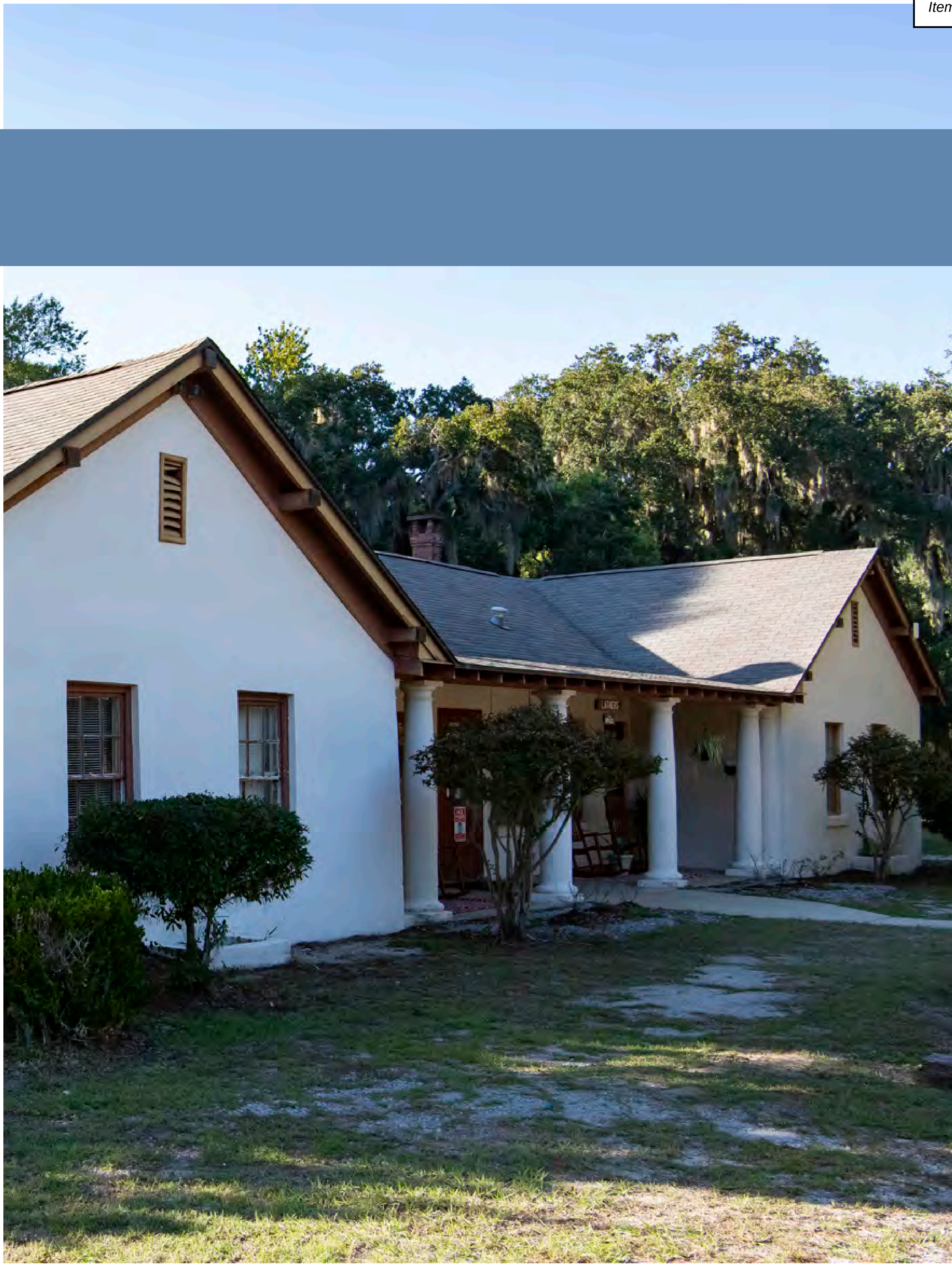


Photo source: Design Workshop

CULTURE

Historic, cultural, and scenic resources protected for future generations.

CORE VALUES

1 We know that cultural diversity is what makes us a strong and healthy community. We believe in protecting culturally significant communities and resources through sensitive place-based planning and community engagement.

2 We understand that the assorted geographies of the County have varied demographic make-ups, needs, and lifestyle preferences.

3 We preserve and promote our cultural, ethnic, and socioeconomic diversity within our approach to planning the built environment.

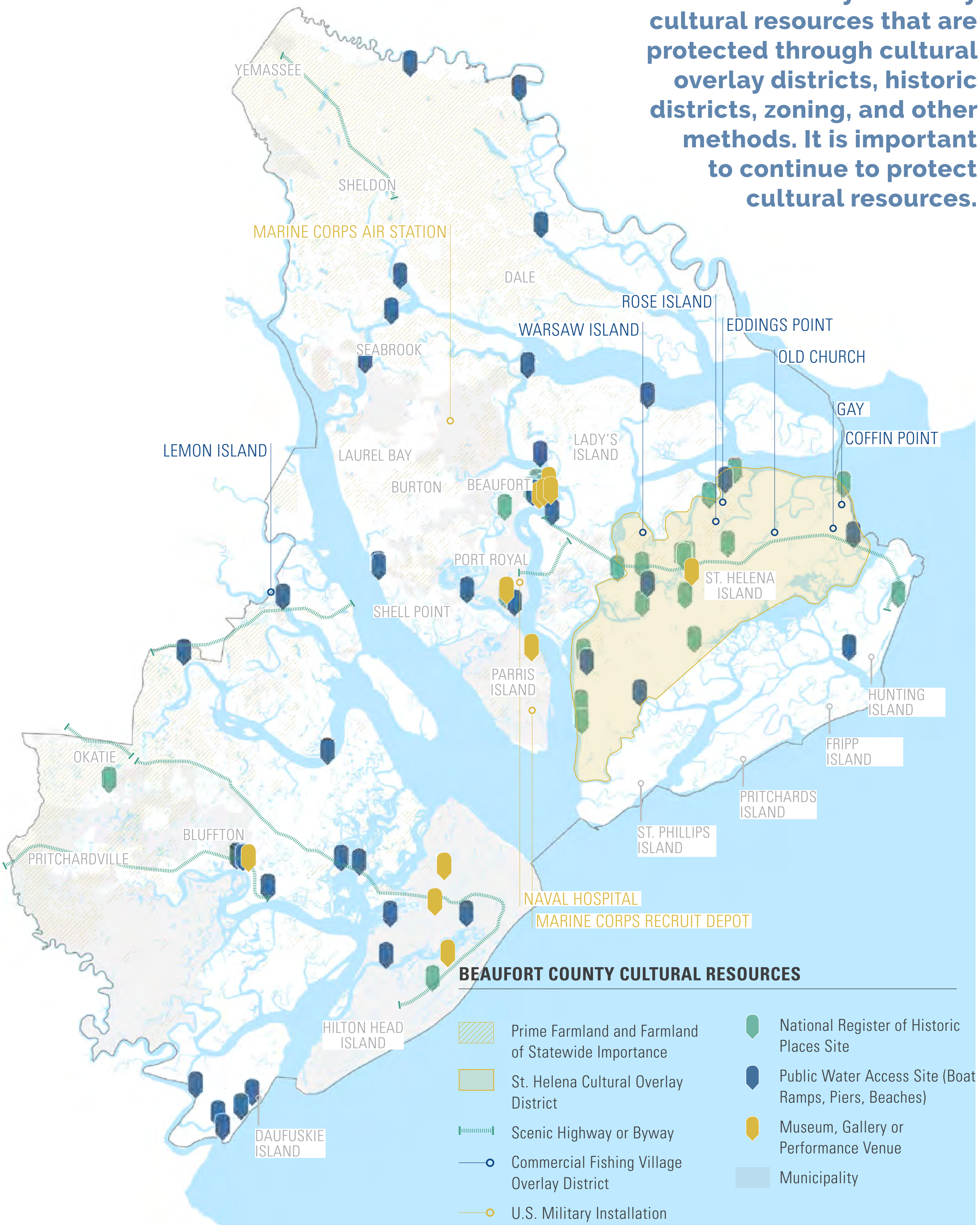
4 We know that the County's attractiveness as a destination to live, work, and vacation, and its consequent economic well-being, are directly related to its historic character and unique quality of life.

5 We want local communities to have a strong voice in their future planning.

6 We believe that our major cultural resource is our people.

Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.

Beaufort County has many cultural resources that are protected through cultural overlay districts, historic districts, zoning, and other methods. It is important to continue to protect cultural resources.



CONTEXT

Beaufort County is one of America's historic and cultural treasures. The County is home to the second oldest city in South Carolina and boasts two of four National Historic Landmark Districts in the state. Beaufort County is the birthplace of the Reconstruction Era.

The County is home to several significant Gullah/Geechee communities. Farming, fishing, and forestry have been an important part of life in the County for generations. The County's abundant resources—land and water—have provided jobs, sustenance, and places to recreate and reflect.

Many residents of Beaufort County, especially the Gullah/Geechee community, have traditionally relied on local waters as a food source. Some residents have used water resources as a source for small-scale commercial fishing enterprises.

We know that the County's attractiveness as a destination to live, work, and vacation, and its consequent economic well-being, are directly related to its historic character and unique quality of life.

These resources include the County's rich agricultural heritage, the people's relationship to the water, the area's scenic roadways, and the County's unique Gullah/Geechee history. Each of these components is vital to the region's identity. They add to the quality of life for residents; drive the local tourism economy; and make the County an attractive place to live or invest.

Beaufort County has grown rapidly over the past 20 years. Growth has brought economic development, educational opportunities, and improvements in public facilities and services. This growth has spread along shorelines and across farmland and forest.

As waterfront property has developed, access to the water for commercial, recreational, and subsistence purposes has diminished. Forested land has been consumed by new subdivisions. Vernacular architecture is being lost to production housing. New residents, bringing suburban lifestyles, have supplanted residents practicing a rural way of life. More people mean more cars. Traffic congestion has become a major public concern. As a result, roads have been widened to four, even six lanes to ease traffic flow. Many two-lane, tree-shaded "canopy" roads, have been replaced by suburban arterials.

Beaufort County bears a great responsibility to be good stewards of its cultural and historic resources. Therefore, this chapter offers the following strategies to protect the County's unique historic, cultural, and scenic resources:

- Enhance access to the water for all users.
- Preserve historic, cultural, and archaeological resources.
- Promote the preservation of agriculture and forestry.
- Protect the County's rural landscape and way of life.

Photo source: Design Workshop

STRATEGIES & ACTIONS

RC 1. PROTECT AND ENHANCE THE TRADITIONAL LOCAL SEAFOOD INDUSTRY BY PROACTIVELY WORKING TO PRESERVE EXISTING WORKING WATERFRONTS AND ALLOWING FOR THE EXPANSION OF COMMERCIAL FISHING OPERATIONS WHERE APPROPRIATE.

- Enhance boat landings and other County-owned waterfront properties to serve the diverse needs of subsistence, commercial, and recreational boaters and fishermen. Such enhancements include providing fishing piers, crabbing docks, and improved boat landing facilities.
- Consider the use of the Rural and Critical Land Preservation Program to protect working waterfronts by purchasing development rights; or, where deemed appropriate, consider the acquisition of working waterfronts with a long-term lease arrangement to continue active private operation of the waterfront.
- Explore the feasibility of using some County waterfront properties to support the traditional seafood industry by allowing

the location of private seafood processing facilities and other supporting services. This should only be considered where sufficient land is available and where such activities would not interfere with public access to the water, or endanger other seafood harvesting.

- Pursue funding sources such as OCRM Coastal Access and BIG Grants, the DNR Water Recreational Resource Fund, and consider local revenue-generating sources such as boat landing user fees at certain landings to fund improvements to water access facilities.
- Work with OCRM and DHEC to form a Commercial Seafood Advisory Committee made up of representatives of the local seafood industry, dock owners, seafood distributors, along with representatives of local governments, the Gullah/Geechee Fishing Association, and SC Sea Grant to continually monitor the status of Beaufort County's local seafood industry.
- Prioritize conservation of the Port Royal Sound to ensure health and sustainability of commercial seafood species (shrimp, shellfish, crab, offshore finfish) that rely on its live oyster reefs and tidal mud flats. Seek partnership with Port Royal Sound Foundation to provide educational opportunities for the community about the importance of our local seafood industry.

C1. ACTIONS

C 1.1. Improve access to the water at Fort Frederick, Jenkins Creek Boat Landing, and Station Creek Boat Landing.

C 1.2. Develop a comprehensive study of Beaufort County's boating needs. Develop a list of improvements necessary to accommodate existing and future requirements and identify partnerships with muncipalities to improve access to the water near jurisdictional boundaries.

C 1.3. Build a kayak launch at Fort Frederick and develop a blueway trail on the Beaufort River and associated creeks

R C 2. PRESERVE AND PROTECT THE COUNTY'S HISTORIC AND CULTURAL LANDSCAPES AND WATERWAYS.

- Develop a heritage tourism plan, in partnership with the Gullah/Geechee Cultural Heritage Corridor and the local Gullah/Geechee community that balances public access with private traditions, and economic development with the protection of cultural landscapes and lifeways. Explore land conservation strategies, development ordinances, and grant programs that can support plan implementation.
- Explore regional and national partnerships to take advantage of National Park Service and other initiatives to protect cultural landscapes against the impacts of climate change. This cultural inventory and vulnerability assessment should be aligned with a St. Helena Island comprehensive water study and plan, and should inform Rural and Critical Land priority purchases.
- Prioritize land conservation strategies and development ordinances that protect the quality of water bodies that are critical to Beaufort County cultural lifeways – including working waterfronts and public and traditional water access points. Protect and identify opportunities to improve water access for subsistence fishing and other traditional uses. Prioritize land conservation strategies and development ordinances that protect shorelines and critical habitat.
- Develop public education programs and curricula to share information about impacts of sea level rise and promote strategies that protect at-risk ecosystems, communities and cultural landscapes. Partner with public agencies such as Sea Grant, and nonprofit groups such as the Port Royal Sound Foundation and the Gullah/Geechee Sustainability Think Tank in development of programs.

STRATEGIES & ACTIONS

- Recognize scenic highways and byways as important cultural resources and develop appropriate protection measures. Consider nominating Old Sheldon Church Road, and US 21 from Chowan Creek to Folly Road on St. Helena Island, both currently State Scenic Byways, as National Scenic Byways.
- Work with other public agencies and nonprofit agencies to preserve and restore the buildings at Penn Center.
- Educate the public about the Port Royal Sound's integral role in establishing and sustaining the rich history of our county- attracting early explorers, facilitating the start of Reconstruction, supporting thriving industries and more- as well as its continued intricate relationship with our Lowcountry lifestyle today.
- Explore regional partnerships with jurisdictions sharing waterways to promote holistic protections and policies.
- Encourage the efforts of private nonprofit groups such as the Beaufort County Historical Society, and public agencies such as the Reconstruction Area National Historical Park and USCB to preserve and educate the public on the County's unique history. Partner with the municipalities on efforts to preserve and promote local historic resources.

C2. ACTIONS

C 2.1. Partner with the Town of Hilton Head Island to plan and implement the Historic Mitchelville Freedom Park.

C 2.2. In partnership with community members, including the Gullah/Geechee Sea Island Coalition and the St. Helena Island Cultural Protection Overlay District Committee, conduct a baseline cultural resource inventory and vulnerability assessment of buildings, archaeological sites, traditionally used roads, waterways, water access points, fishing areas, burial sites, and sacred grounds to inform protection and stewardship practices for Gullah/ Geechee communities.

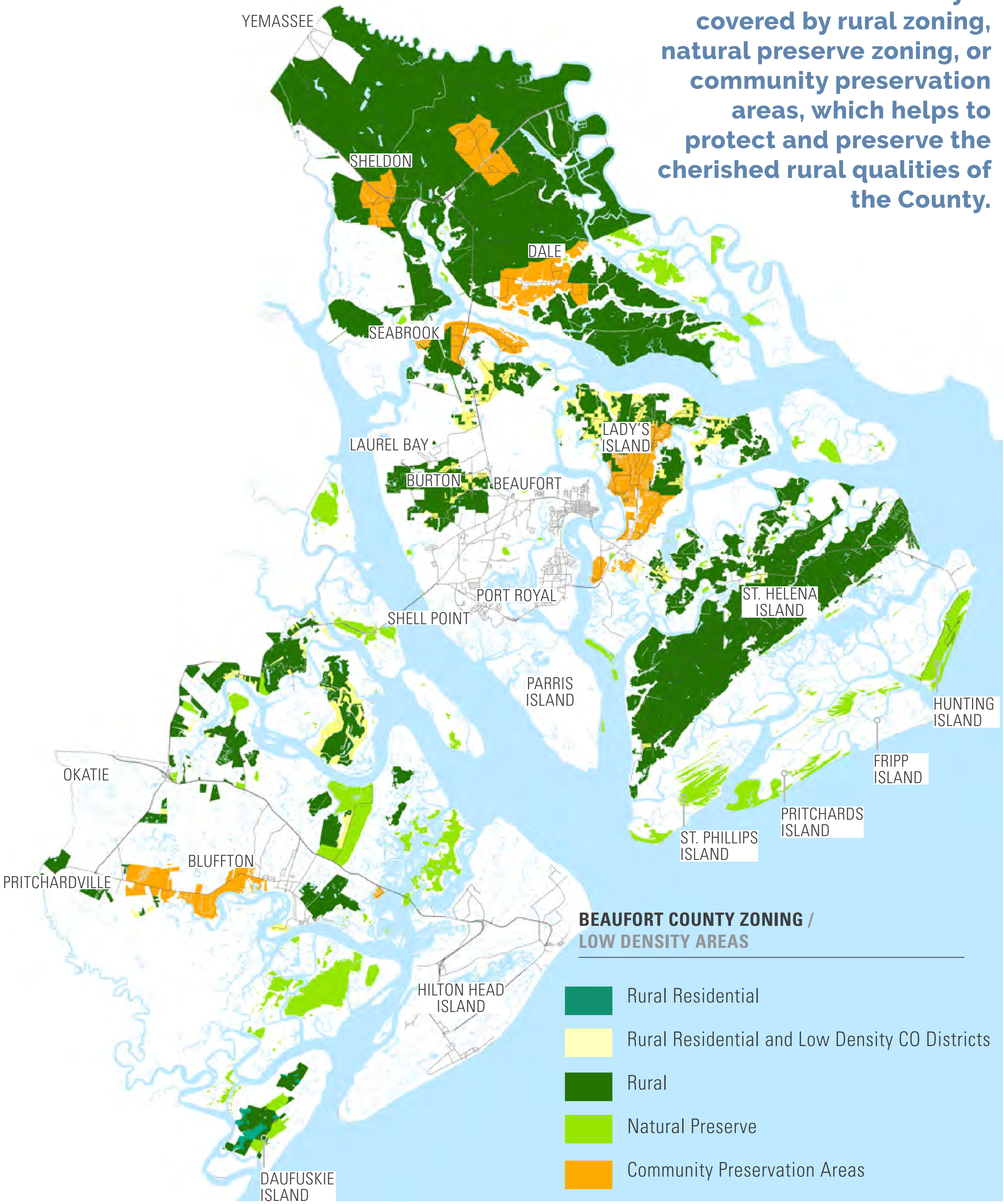
P C 3. CONTINUE TO EMPHASIZE THE PROTECTION OF HISTORIC AND ARCHAEOLOGICAL RESOURCES THROUGH A COMBINATION OF PLANNING, DATA GATHERING, LAND USE REGULATIONS, AND LAND ACQUISITION.

- Coordinate with the SC Department of Archives and History on projects that trigger state and federal permits.
- Review development plans to determine the location of archaeological and historic resources and the potential impact of development.
- Identify ways to protect older vernacular structures, many of which are located in rural areas, to preserve an important component of the historic built environment and as a source of affordable housing.
- Pursue the acquisition of significant archaeological and historic sites via the Rural and Critical Land Preservation Program.
- Consider additional protections for historic cemeteries including acquisition by public or nonprofit entities, easements, and buffer requirements.

C3. ACTIONS

C 3.1. Update the Beaufort County Above Ground Historic Resources Survey.

A significant portion of Beaufort County is covered by rural zoning, natural preserve zoning, or community preservation areas, which helps to protect and preserve the cherished rural qualities of the County.



STRATEGIES & ACTIONS

E C 4. PROMOTE THE PRESERVATION AND VIABILITY OF AGRICULTURE AND FORESTRY.

Where suitable, consider the lease of County-owned properties to family farms or small growers who are interested in actively farming the land. Promote sustainable agricultural practices (crop diversity, low use of pesticides, protection of soil quality, cover crops, etc.). Make active agriculture a condition of the lease.

- Continue to partner with the USDA and other agencies and organizations to match local funds for the preservation of farmland.

C4. ACTIONS

C 4.1. Use the Rural and Critical Land Preservation Program to promote active agriculture and the preservation of agricultural lands, and continue to target the purchase of development rights on active agricultural lands.

E C 5. SUPPORT LOCAL MARKETING INITIATIVES DESIGNED TO INCREASE THE PROFITABILITY OF SMALL-SCALE FARMING BY CONNECTING LOCAL GROWERS WITH CONSUMERS.

- Encourage the use of locally grown produce by adopting a local food purchasing program. This includes area grocery stores, local restaurants, institutions such as schools, and local food banks.
- Create a coalition consisting of Beaufort County, the Rural and Critical Land Preservation Program, Penn Center, the Coastal Conservation League, and local growers, to advocate for local agriculture, and identify policies, programs, and actions to further local agriculture.
- Encourage community gardens and farms in urban and suburban areas by removing regulatory barriers.
- Urge HOAs to accept native plantings in lieu of lawns. This would not only support the pollinator population we depend on for farming, but benefit stormwater and biodiversity while saving property owners' money.

C5. ACTIONS

C 5.1. In conjunction with Clemson Extension, create a website with information on locally grown produce, and retail and restaurants using locally sourced food. The web site should promote organizations that advocate local foods such as Lowcountry Local First and Fresh on the Menu.

E C 6. SUPPORT THE PRESERVATION OF THE COUNTY'S RURAL LANDSCAPE AND WAY OF LIFE.

Support existing organizations that promote cultural resource protection, such as the South Carolina Coastal Community Development Corporation, the Gullah/Geechee Sea Island Coalition, the Cultural Protection Overlay District Committee, the Corners Community Preservation District Committee, the Lowcountry Alliance, and Penn Center.

- Encourage collaboration between the various public and private non-profit groups working to preserve the County's rural landscapes and way of life.
- Continue to recognize the importance of policies such as low-density rural zoning and family compounds in preserving and

enhancing the traditional land use patterns associated with rural Beaufort County and the Gullah/Geechee community.

- Develop a suite of policy, land conservation, land stewardship, and incentive programs that offer greater protection to Heirs' properties in partnership with the Center for Heirs' Property Preservation and the Pan-African Family Empowerment & and Land Preservation Network.
- Explore local and regional partnerships to support local farmers and create demonstration models for sustainable, culturally significant, and environmentally resilient farming practices.
- Consider the designation or creation of a County liaison position to assist rural property owners.

C6. ACTIONS

C 6.1. Periodically evaluate Beaufort County's rural land use policies, including family compound uses, to determine that they are accomplishing the policy goals of preserving the rural landscape and way of life, and that they are fair and equitable to local residents and property owners.

C 6.2. Develop a brochure designed to help small rural landowners understand how to subdivide and transfer land. The brochure should explain family compounds, policies for small rural landowners, home occupation and home business provisions, cottage industry provisions, resources for heirs' property, etc.

Photo source: Design Workshop

SPOTLIGHT: ST. HELENA

St. Helena Island is home to Beaufort County's largest Gullah/Geechee community. Gullah/Geechee communities are comprised of descendants of enslaved people brought from West Africa. The historic isolation of the County's barrier islands was crucial to the survival of this culture. As in other parts of the Southeast, Gullah/Geechee culture is under extreme stress from rapid coastal development, population growth, lack of recognition, and financial hardship. Growth has the potential to substantially alter the traditional social and cultural character of Beaufort County's Gullah/Geechee community, as new residents bring different values and customs.

The existing Cultural Protection Overlay (CPO) District protects St. Helena Island from gentrification that would result in a greater demand for services and higher property values, making it more difficult and costly to maintain the traditional rural lifestyle on the Island.

Beaufort County's Gullah/Geechee communities face other unique challenges brought on by increased development pressure. When the County was primarily rural, large tracts of agricultural and forested land, regardless of ownership, provided the Gullah/Geechee community with access to waterways, oyster beds, hunting grounds, and other elements of the natural environment that were lifelines for the community. New development, especially along high-value waterfront property, has limited entry to these traditional hunting and fishing grounds. In addition, many of the older cemeteries, which play an important role for the Gullah/Geechee community, are located within the original plantations, on private property, making them difficult to access.

Beaufort County's Gullah/Geechee community makes evident that the region's cultural resources are not just the historic sites, waterways, sacred grounds, farmlands, open spaces, hunting grounds, and the land on which traditional events have occurred. The most important cultural resource is the people themselves.

The primary threat to the long-term viability of Beaufort County's Gullah/Geechee communities is land development. Implementing land use policies that concentrate growth in urban areas and protect rural land from suburban development, are the most important actions the County can take to protect its unique Gullah/Geechee heritage.

ST. HELENA STRATEGIES

- Reevaluate the CPO District by assessing whether additional land use restrictions are necessary to meet the intent of the district. Consider the addition of specific design standards that reinforce historic Gullah/Geechee development patterns and character. Include diverse representation on the steering committee that may be formed to guide the process. Ensure public input from all segments of the community.
- Explore the possibility of a Gullah/Geechee Heritage Enterprise Zone to allow cottage industries, and offer heritage tax credits for culturally significant businesses/industries.
- Explore tax credits and grants to help property owners in the CPO District fund housing restoration and adaptive reuse of commercial buildings.
- Explore the potential to base property tax assessment on the land's current use rather than its market value within the CPO District.
- Ensure open access to waterways for traditional Gullah/Geechee fishing families. Work in collaboration with the Open Land Trust and the Rural and Critical Land Program to place easements on these locations in perpetuity to enhance the cultural landscape, working waterfronts, and continuation of Gullah/Geechee traditions.
- Ensure that the Gullah/Geechee burial areas that were mapped in 1999, and any identified subsequently, are platted and protected from development. Consider exempting these properties from stormwater fee assessment and taxation where possible.
- Define the Corners Community as a hub of commerce and culture, and implement design guidelines and land conservation strategies to protect its character and create scenic buffers. Promote a safe pedestrian environment in the Corners Community and other gathering places on St. Helena Island that serve the Gullah/Geechee community.
- Encourage residents challenged by high utility bills to seek assistance through energy assistance programs administered by Beaufort-Jasper EOC.

ST. HELENA ACTIONS

- Reevaluate the CPO District by assessing whether additional land use restrictions are necessary to meet the intent of the district. Consider the addition of specific design standards that reinforce historic Gullah/Geechee development patterns and character. Include diverse representation on the steering committee that may be formed to guide the process. Ensure public input from all segments of the community.
- In partnership with the Sea Level Rise Task Force, commission a comprehensive water study and plan for St. Helena Island that considers stormwater, sea level rise, and

storm surge to better define the risks posed by climate change and new development and recommend strategies to protect against these threats. Engage the Gullah/Geechee community, Penn Center, local churches, area businesses, and local non-profits such as the Friends of Fort Fremont, in preparation of the plan. This study should be aligned with County-wide Gullah/Geechee cultural inventory and vulnerability assessments.

- Consider prohibiting Mining/Resource Extraction within the Cultural Protection Overlay zone and revising conditions for Mining in the CDC to require that the presence of Prime Farmland as defined by the USDA be considered in the decision to approve a permit for mining. Consider a spacing requirement for mines.
- Support nonprofit organizations, such as the Center for Heirs' Property Preservation and PAFEN, with expertise in resolving heirs' property issues. Encourage establishment of local offices in Northern Beaufort County and expansion of their programs throughout the County. Consider partnering with the municipalities to provide support for these groups by applying for grant funds, Accommodations Tax and Hospitality Tax Revenues (if appropriate), and local funds to expand efforts in the area.
- Work with DOT to address road and drainage conditions on state-owned roads on St. Helena Island.
- Ask residents to develop a specific list of areas (addresses) where drainage is an issue. Have these areas assessed by the Stormwater Utility Board and projects developed as appropriate to address concerns. Consider grant funding, including CDBG and EPA, for projects.
- Develop a strategy to permanently address maintenance and safety improvements to "legacy roads" and private roads serving low-and moderate-income property owners. Consider grant programs and public service projects to address immediate maintenance needs
- Ensure that St. Helena residents are included in the planning process for the Parks and Recreation Master Plan. Consider equity issues in development of that plan.
- Assess the condition of existing recreation facilities on St. Helena Island. Develop plans for improvements and add funding costs to CIP. Apply for grant funding for improvements as appropriate.
- Review recreation programs on St. Helena Island. Ensure that programs are addressing community needs and that programs are expanded beyond pre-pandemic levels.
- Work with Penn Center to develop an MOU and lease agreement in order for the County to take a more active role in maintaining MLK Park on St. Helena Island and including applying for grants for park improvements.

Community Meeting on St. Helena

Photo source: Design Workshop

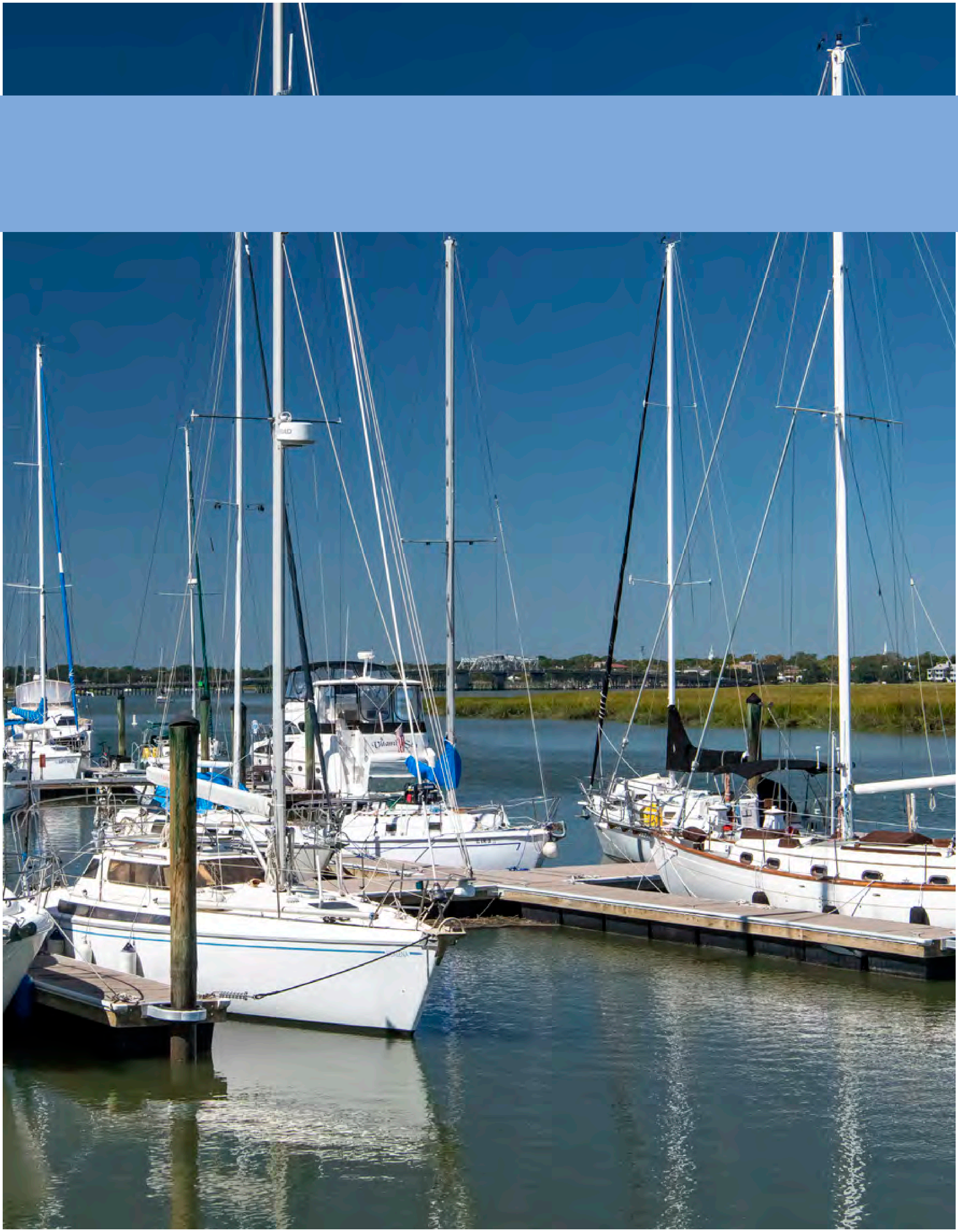


Photo source: Design Workshop

ECONOMY

A resilient economy poised for a sustainable future.

CORE VALUES

1 We value our unique and complex natural environment as a source of life, recreation, economy, culture, and sense of place.

2 We support industries that are clean and environmentally friendly. We are forward-looking and will take advantage of evolving innovative economic opportunities.

3 We prepare our workforce with the skills needed to meet the needs of emerging opportunities.

4 We value our military relationships and recognize their importance to our culture and economy.

5 We recognize that the County is made up of unique natural and cultural environments and we position economic development opportunities that fit those locations.

6 We are business friendly and create the incentives needed to attract new businesses that support our principles.

7 We recognize the need to locate jobs nearer to where people live, to reduce time spent commuting.

8 We recognize that regional cooperation and coordination will expand opportunities for us all.

9 We support the growth and success of our municipalities and collaborate on growth management and land use issues.

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Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.

CONTEXT

Beaufort County's economy has traditionally been based, directly or indirectly, on its natural and cultural resources. Agriculture, forestry, tourism, resort development, even the presence of the military, is the result of the County's unique blend of geography, nature, and culture.

This is still generally true today, with the existing economic drivers being tourism, the military, the retirement industry, residential development, education, and healthcare. All these industries continue to be vital to the economic sustainability of the community.

The County's mild climate, vast and varied water resources, like those of the Port Royal Sound, its ties to the military, and its attractive built environment, have drawn a large influx of new residents, keeping Beaufort County one of the fastest growing counties in South Carolina. Access to safe and healthy waterways on the Port Royal Sound is instrumental in building a link between the County's natural resources and economic development by connecting people and businesses to water-based recreation and industry. Resort, residential, and commercial development has greatly expanded the service-related workforce. Ongoing growth has created the need for infrastructure improvements and additional County services, which require more revenue.

The long-term success and viability of Beaufort County depends upon the creation of a larger, more diversified tax base and creating quality jobs for County residents. Beaufort County has the highest per capita income in the state; however, the County lags behind the state and the nation in average annual wages.

The County is fortunate to have a solid foundation in the military. This positions the area well to attract new business from the aeronautics and other supporting industries. In addition, the County's three military installations create a pool of exiting and retiring service members who bring considerable talent and skills to the local workforce, skills that are especially attractive to the technology and aerospace industries.

At the same time, these individuals often need assistance in transitioning into the civilian workforce. To date, Beaufort County has weathered the periodic threat of base closures; however, a new peril in the form of climate change and rising sea levels is emerging.

Bringing new types of businesses to the area to diversify the economy is critical. New industries should be targeted to build on the region's strengths, including knowledge-based, green industries, and the visual and performing arts.

Comprehensive education and workforce training is needed to better prepare County residents for these and other emerging job opportunities. The future depends on quality job creation that allows citizens to remain or settle in Beaufort County with employment that requires knowledge, talent, and training, and compensates with higher-paying jobs.

Regional cooperation will be necessary to maintain a strong economic outlook moving forward. Most of the growth in the region has been centered in Beaufort County, primarily in the Hilton Head and Bluffton area. As the southern portion of the County has started to build-out, growth has been pushing into Jasper County. The proposed Port of Jasper and associated development will stimulate further growth in Jasper County and the 278 Corridor.

Spanish Moss Trail is a County-wide recreation asset

Photo source: Design Workshop |

Growth, and expansion through annexation, in both Jasper and Hampton Counties, have a direct impact on the natural environment, roads, and character and quality of life in Beaufort County. Continuing to coordinate land use and development, natural resource and open space planning, transportation, and emergency services is key to ensuring a healthy economic future.

It is important for Beaufort County to develop a sustainable economic base, offering opportunities to all its residents. Therefore, this chapter offers the following strategies to develop a resilient economy moving forward:

- Support existing industries and develop new employment sectors.
- Educate the workforce.
- Grow jobs close to where people live.
- Foster collaboration among governments and between agencies.

STRATEGIES AND ACTIONS

R E 1. SUPPORT AND ENHANCE EXISTING ECONOMIC DRIVERS.

- Protect the natural environment, manage growth, and support infrastructure improvements to preserve the region's attractiveness.
- Support the growth of the tourism and hospitality industries by protecting and preserving the qualities that make Beaufort County an attractive place to visit.
- Grow the supply chain for the tourism and hospitality industry so that goods and services can be provided locally rather than by outside businesses. This would provide local jobs and improve the efficiency of and reduce costs to the region's hotels and resorts.
- Promote the Port Royal Sound and its position as the driving force behind environmental tourism, real estate development, and invaluable ecological services. Take steps to ensure that the protection of the Sound is thoughtfully integrated into these endeavors to ensure long-term cohesion and sustainability of industries and our waterways.

E1. ACTIONS

E 1.1. Seek partnership with Port Royal Sound Foundation to educate the community about the Port Royal Sound as a critical economic driver for the community and the importance of keeping it healthy.

R E 2. RECOGNIZE THAT THE MILITARY IS A VITAL COMPONENT OF THE COUNTY'S HISTORY, CULTURE, AND ECONOMY.

- Support the Greater Beaufort Chamber of Commerce's Military Affairs Committee's efforts to promote and lobby for the retention and expansion of the military installations in Beaufort County.
- Work cooperatively with the City of Beaufort and the Town of Port Royal to implement the recommendations of the 2015 Lowcountry Joint Land Use Study (JLUS), and continue to enforce standards within the AICUZ contours that discourage development that would adversely affect the mission of the Marine Corps Air Station Beaufort (MCAS).
- Support Beaufort County's three military bases by providing affordable off- base housing for active- duty military personnel and their families and providing educational opportunities and other amenities to support military families.

E2. ACTIONS

E 2.1. Continue to partner with the Marine Corps to preserve open space around MCAS to protect the facility from undesirable encroachment. This partnership expands the County's efforts to preserve rural and critical land while ensuring the ability of MCAS to remain militarily viable and vital to the national defense. Continue to partner with the Marine Corps to ensure the other strategies and actions within this plan are compatible with the mission of MCAS Beaufort.

E 2.2. Implement transfer of development rights program to compensate affected property owners within the MCAS Airport Overlay District.

E.2.3. Support implementation of the recommendations of the Military Installation Resilience Review being conducted for the County's military facilities.

R E 3. TARGET AND RECRUIT NEW INDUSTRIES.

- Target industries that build on the region's strengths and diversify the local tax base. These industries include aerospace and defense; tourism and hospitality supply chain; health and bio-related fields; knowledge-based industries; and green industries. Develop flexibility with the business license fee program for target industries.
- Support the Beaufort County Economic Development Corporation's efforts to purchase properties and to develop spec buildings by assisting in identifying candidate properties; providing financial support; assisting in off-site transportation improvements; and overcoming regulatory barriers to sites that meet other locational criteria.
- Ensure that there is a sufficient quantity of appropriately located, zoned and environmentally suitable land for non-retail commercial uses such as business parks, research and development centers, product assembly, distribution centers, cottage industries, and light to moderate industrial uses.

E3. ACTIONS

E 3.1. Provide the Beaufort County Economic Development Corporation with a list of properties meeting locational requirements for office and light industrial uses on a regular basis.

E 3.2. Purchase approximately 30 acres in 3 or 6 acre tranches in each local jurisdiction within Beaufort County through the Beaufort County Economic Development Corporation, to provide ample space for companies wishing to expand or move to Beaufort County.

R E 4. DEVELOP INCENTIVES FOR BUSINESSES TO EXPAND OR LOCATE IN THE COUNTY.

- Create incentives-tied to the County's target industries and designed to stimulate private investment in the development of appropriate sites near Beaufort County's two airports.
- Reduce the County's personal property tax rates for registered, County-based aircraft.
- Consider the standardization of competitive business license fee rates and classifications across Beaufort County and each of its municipalities.

E4. ACTIONS

E 4.1. Provide more flexibility in commercial zoning districts to permit smaller non-retail commercial uses such as small assembly facilities and light industrial operations, or contractor's offices that do not adversely impact surrounding retail uses.

E 4.2. Create incentives, such as an accelerated building permit process, height and density bonuses and fee reductions and waivers, for commercial and industrial projects that intend to meet either LEED or Energy Star standards.

R E 5. ESTABLISH LOCATIONAL CRITERIA FOR NEW BUSINESSES.

- Locate jobs close to municipalities, outside of environmentally sensitive land and land prone to flooding, and close to the highest concentrations of households to reduce impacts on traffic and commute times.
- Encourage the planning, development, and permitting of mixed-use developments that will attract young professionals.

STRATEGIES AND ACTIONS

E5. ACTIONS

E 5.1. Target land purchases to incentivize the location of new employers in walkable mixed-use communities such as Buckwalter Place.

E E 6. DEVELOP A HIGHLY SKILLED AND WELL-TRAINED WORKFORCE.

- Work with educational partners, both within and outside of Beaufort County, including universities, colleges, and trade schools, to tailor their educational programs to the County's unique economic opportunities that support the knowledge-based economy and green industry technologies.
- Support and enhance programs such as TWEAC, TCL's Transitioning Military Training Program, and instituations such as USCB and the miliary bases, that assist individuals leaving the military in enhancing the skills needed for employment in the public and private sectors.
- Involve youth in implementation of the plan and actively recruit the input of students in future planning efforts. Serve as guest speakers in classrooms. Invite students to observe Planning Commission and County Council meetings. Partner with teachers to invite presentation of planning-related student projects at Planning Commission meetings.

R E 7. CREATE A BUSINESS-FRIENDLY ENVIRONMENT.

- Identify properties that are currently under municipal or County control that can be offered to relocating businesses.
- Review and update state and local incentives on a regular basis to attract the right industries for the region as well as keep pace with the changing face of business and industry.
- Support green and sustainable development projects that meet economic development requirements, by streamlining the review processes, as well as creating fee reductions and waivers, and building height or density bonuses.
- Add a specified definition for Knowledge-intensive businesses to the list of businesses qualified for the state Jobs Tax Credit.
- Promote state and federal brownfield clean-up programs including the state Brownfields/Voluntary Cleanup Program (VCP) that allows a non-responsible party to acquire a contaminated property with state Superfund liability protection for existing contamination by agreeing to perform an environmental assessment and/or remediation. Financial incentives including tax credits are available to property owners who enter into the VCP. Encourage property owners to apply for funding through the Brownfields Cleanup Revolving Loan Fund.
- Clarify the home business and home occupation standards in the CDC and update the Cultural Protection Overlay to broaden the cottage industries standards.

R E 8. FORGE REGIONAL AND STATE PARTNERSHIPS AND COLLABORATION.

- Support legislation that would amend the current South Carolina economic development qualifying criteria from a Per Capita Income base to an Average Regional Wage base, which would more accurately reflect the income levels of the region's working population.

- Coordinate incentives between counties and municipalities in the region to create a level playing field.
- Maintain and grow partnerships and shared priorities with Jasper and Hampton Counties to include economic development, land use, transportation, and signage.
- Provide an additional tax credit in Multi-County Park agreements for companies whose new construction meets LEED and Energy Star standards. The tax credit should be based on the level of green building certification.

P E 9. RECOGNIZE THE IMPORTANCE OF THE VISUAL AND PERFORMING ARTS COMMUNITY AS A KEY COMPONENT OF QUALITY OF LIFE AND SOURCE OF ECONOMIC DEVELOPMENT.

- Support the planning, development, and permitting of a visual and cultural arts community, which is essential to attracting and retaining young professionals and enhancing quality of life.
- Provide local matching funds to the Community Arts Grant Fund to support individual artists, art education programs, and local arts organizations.
- Continue to support the creation of venues, classrooms, and galleries to showcase new and emerging local artists.
- Continue to provide space in libraries and other County buildings to display the work of local artists.

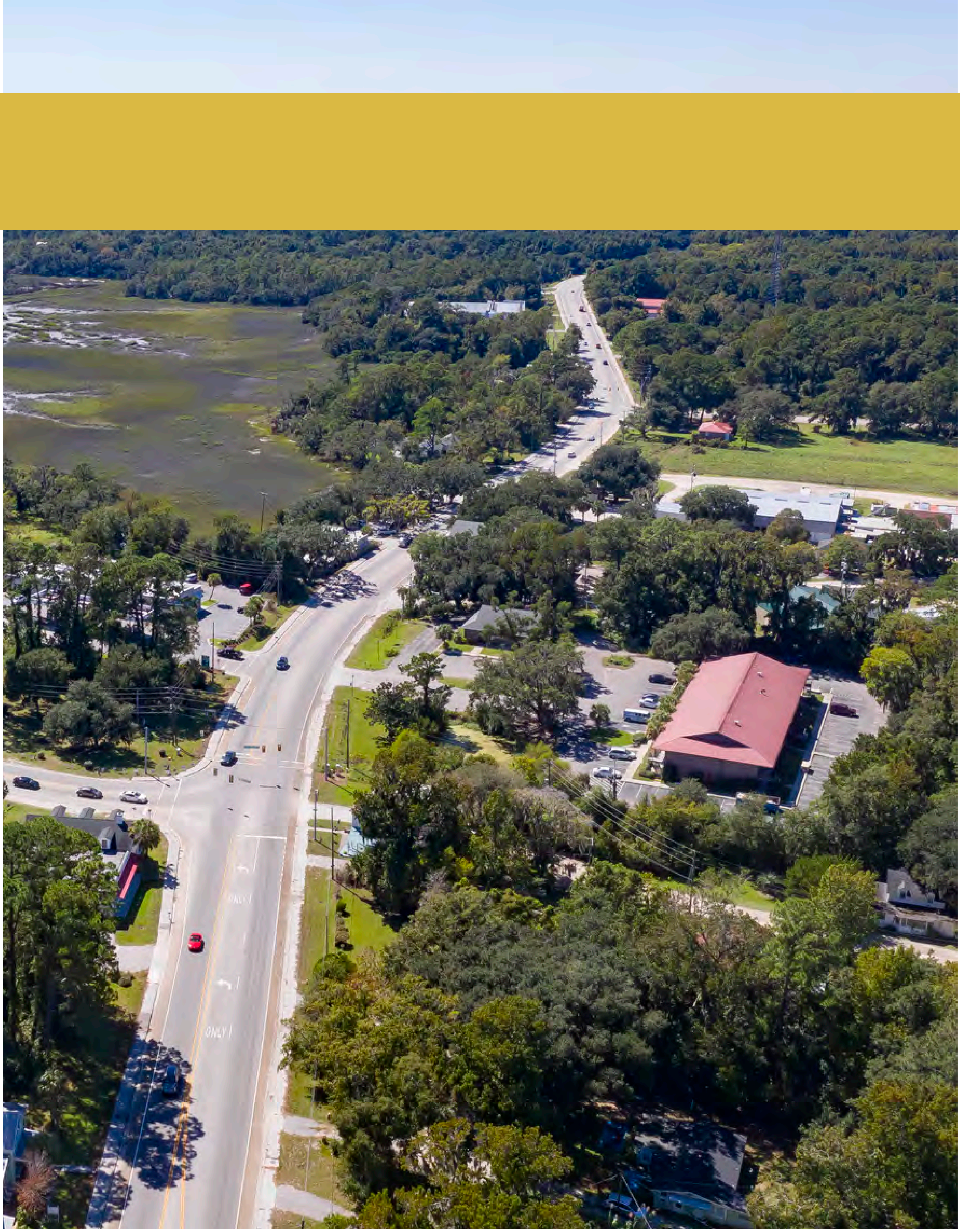

Photo source: Design Workshop

MOBILITY

Innovative, multimodal, and cost effective infrastructure that sustains a high quality of life..

CORE VALUES

1 We understand our roads support our community character and sense of place.

2 We believe that context-sensitive "Complete Streets" should define the design of all of our roads.

3 We believe that a healthy, multimodal approach to transportation provides choices to residents and visitors, especially the most vulnerable.

4 We want innovative transportation management solutions to be integrated into transportation planning.

5 We work collaboratively with our neighboring jurisdictions to create common approaches to mobility and connectivity.

6 We believe our roads express our landscape and should be harmonious with our environment.

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Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.

CONTEXT

Traffic congestion on Beaufort County's roads is one of the most noticeable indicators of the adverse impacts of new growth. As a result, Beaufort County has invested heavily in improving its transportation network over the last 15 years.

Examples of large-scale, highly-visible improvements include the Bluffton Parkway; the widening of US 278 from SC 170 to the bridge to Hilton Head Island; the widening of the McTeer Bridge and Lady's Island Drive; and the widening of US 17 from Gardens Corner to the county line.

These projects were made possible through a resolute effort to raise local funds through impact fees and the capital project sales tax and leverage state and federal transportation funds.

While the county and the region will continually need to improve its road network to keep up with new growth, several factors challenge the sustainability of the current levels of commitment to fund and implement large-scale transportation improvements:

- Fiscal Constraints: The limited availability of tax dollars to fund large-scale transportation improvements and competition with other public needs, such as schools, parks, and public safety facilities.
- Environmental and Geographical Constraints: Beaufort County's unique physical environment limits the construction of new roads.
- Quality of Life Constraints: Even if the County had unlimited resources to address traffic congestion issues, many citizens would object to continual road widening or grade separated intersections as eroding the character and aesthetics of the Lowcountry.

Therefore, as Beaufort County continues to grow, its approach to addressing transportation infrastructure will need to shift its focus away from large scale transportation and toward smaller scale network improvements that preserve and increase the efficiency of the road network. Such projects include intersection improvements, turning lanes, parallel roads, and intelligent transportation systems (ITS).

In addition to small scale network improvements, it is important to promote other modes of transportation such as transit, water-based transportation, walking, and cycling in order to reduce automobile dependency.

Over time, improving other modes of transportation will not only reduce vehicle miles travelled (VMTs), but increase the quality of life by creating transportation choices.

Therefore, this chapter offers the following strategies to maximize the efficiency of the county's road network while promoting policies and alternative transportation choices to reduce our dependence on automobile transportation.

- Work cooperatively and regionally to implement needed road improvements.
- Maximize the efficiency of the existing road network.
- Adopt a Complete Streets Policy.
- Promote a diversity of transportation mode choices including water taxis/ ferries.
- Encourage walkable and transit-ready development.
- Develop transportation improvements that enhance the County's sense of place.

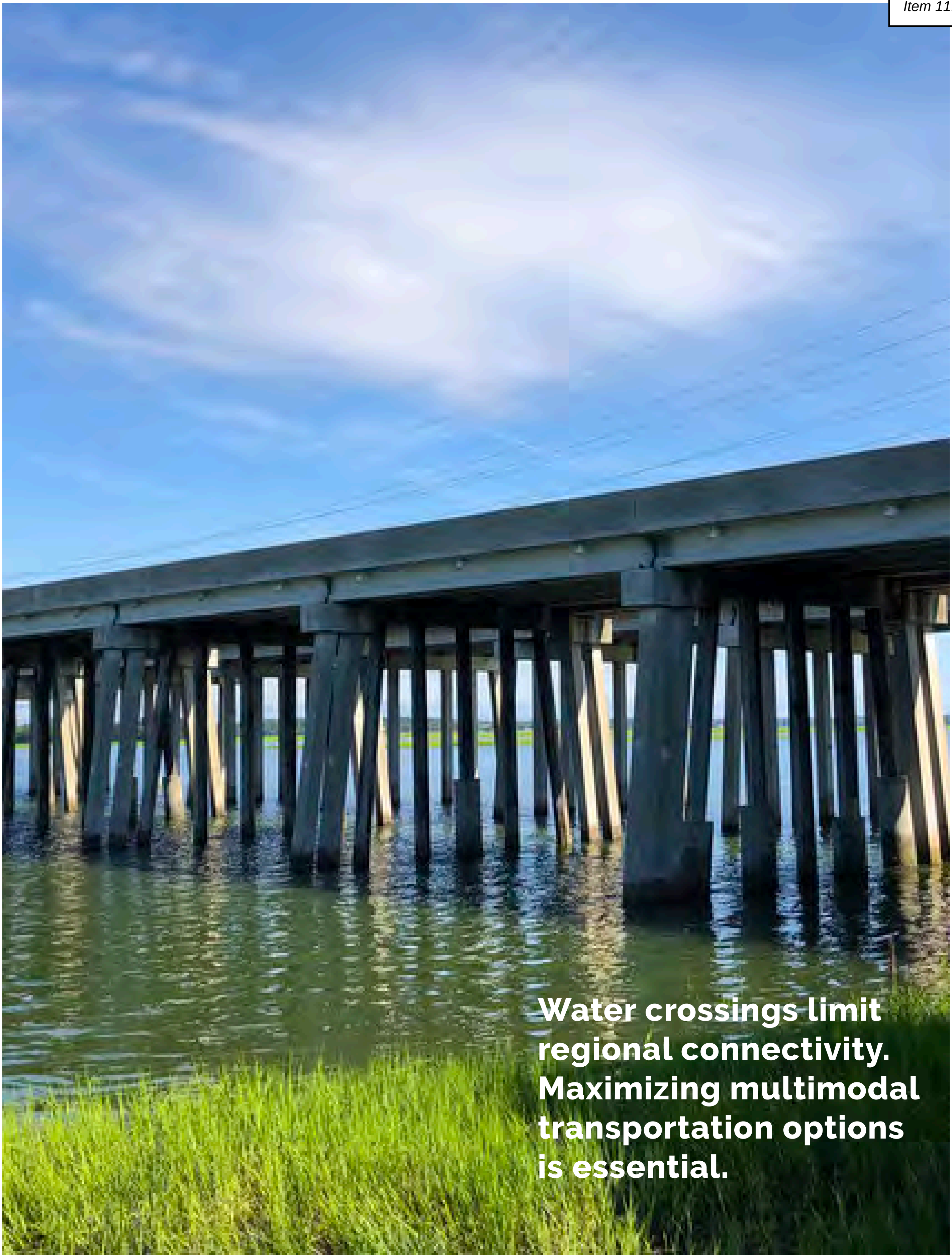


Photo source: Beaufort County

STRATEGIES AND ACTIONS

P M 1. ADOPT A COMPLETE STREETS POLICY.

- All streets shall be planned, designed, operated, and maintained to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities.
- All future transportation projects should adhere to a Complete Streets Policy in an appropriate urban, suburban, or rural context.
- Support and fund projects and programs that promote a diversity of transportation choices such as transit, cycling, and walking.
- Through LATS Metropolitan Planning Organization, develop a shared regional commitment to develop complete streets, and to work with SCDOT to convert state highway corridors into multimodal corridors.

M1. ACTIONS

M 1.1. Formally adopt a Complete Streets policy that requires all streets to be planned, designed, operated, and maintained to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. All future transportation projects should adhere to the Complete Streets policy in an appropriate urban, suburban, or rural context.

M 1.2 Prepare corridor master plans so that major arterial and state highways can evolve into complete streets.

R M 2. MAINTAIN AND ENHANCE A SAFE, EFFICIENT, REGIONAL ROAD NETWORK.

- In order to maintain an acceptable quality of life in the region, conditions on the regional road network outside of urbanized areas should not fall below LOS "D". Within urban areas, consider using a different metric to evaluate mobility such as multi-modal LOS or accessibility.
- Continue to work cooperatively with the municipalities, neighboring counties, LATS, and DOT to identify, fund, and implement needed road improvements. The funding strategy should use revenue from Guideshare funds, impact fees, capital projects sales tax, and grant opportunities.
- Develop a network of secondary streets to improve levels of service at failing intersections.
- Approach each road widening as a last resort to be considered after alternative strategies have been deemed inadequate to address transportation needs.

M2. ACTIONS

M 2.1. Develop a funding strategy and implement the transportation projects in the 10-year Capital Improvements Program.

M 2.2. Update impact fees every five years to insure that future development is paying for its impact on the transportation network.

M 2.3. Place an initiative on the 2022 ballot to reimpose a 1% capital project sales tax to fund transportation improvements that includes roads and multi-use pathways. Establish a regular schedule for future referendums.

M 2.4 Include needed transportation improvements in the LATS Long Range

Roadway designs can provide environmental curtains that preserve habitat connectivity *Photo source: Design Workshop*

Transportation Plan to insure maximum utilization of Guideshare funding for county transportation projects.

RM 3. PRESERVE AND ENHANCE NETWORK EFFICIENCY BY ADOPTING, APPLYING AND ENFORCING POLICIES TO MANAGE ACCESS AND REDUCE VEHICLE MILES TRAVELED (VMTS)

- Adopt land use policies that encourage internal trip capture and promote development whose location and density are suitable to support public transit and other alternative modes of transportation.
- Consider to use and improve on the following VMT reduction strategies – access management, improving secondary road network, promoting alternative transportation modes, and Intelligent Transportation Systems (ITS – as an alternative to road widening. Approach road widening as a last resort to be considered after alternative strategies have been deemed inadequate to address transportation needs.
- Support improvements to existing rail infrastructure and expansion of passenger service serving the County.
- Identify opportunities and incentives for improving/expanding marine access and transport services, e.g., ferry services, water taxis, public dockage services, and kayak launches.

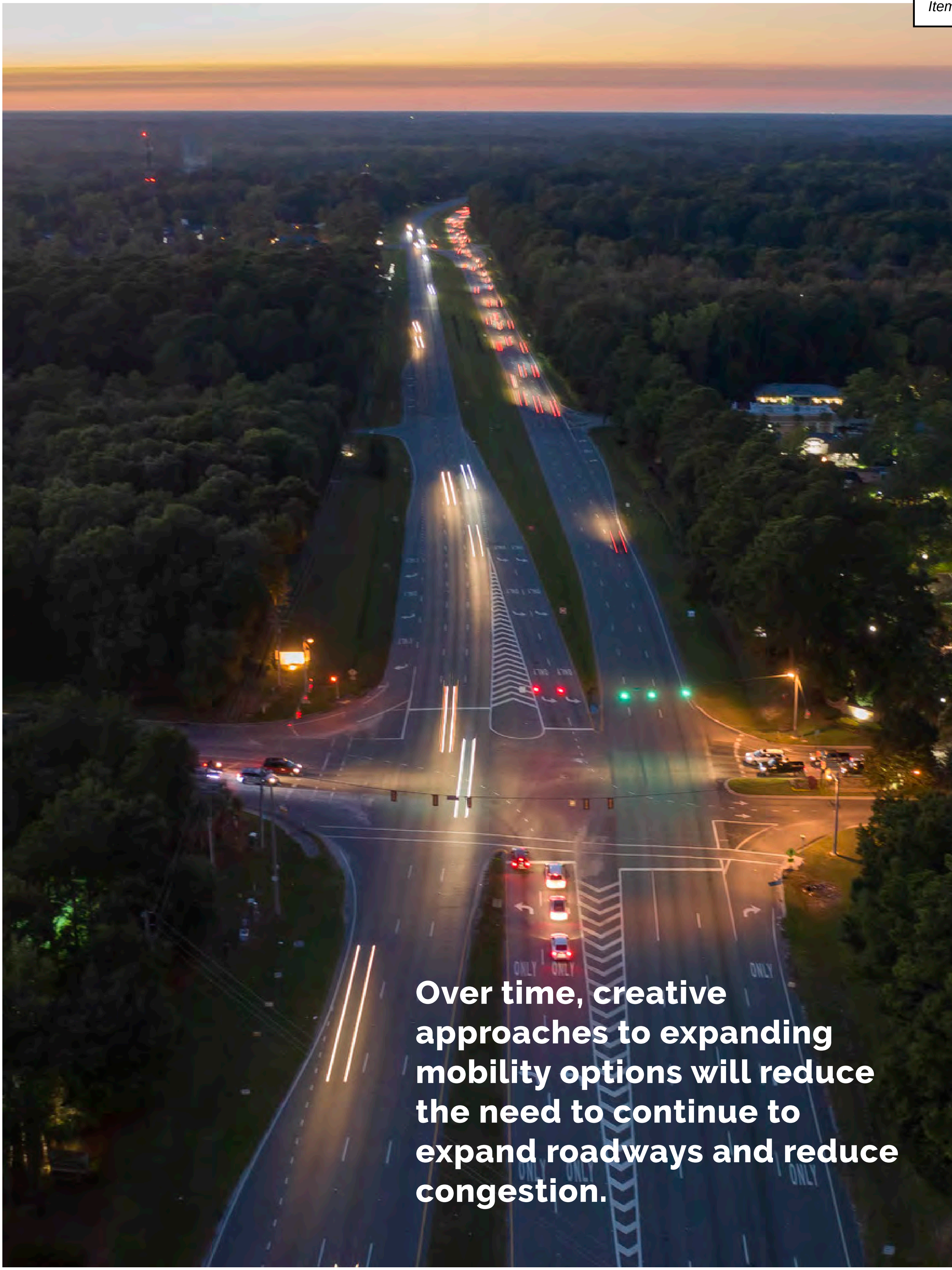


Photo source: Design Workshop

STRATEGIES AND ACTIONS

P M 4. PROMOTE CONTEXT SENSITIVE TRANSPORTATION IMPROVEMENTS THAT ENHANCE THE LOCAL ENVIRONMENT.

- Use context-sensitive design principles in the development and redesign of all streets and roads.
- Coordinate billboards, signage, landscape, streetscape standards for roads that cross jurisdictional boundaries, such as along the SC 170 corridor and the SC 462 corridor.
- Explore design standards and innovative road construction techniques to protect tree canopies and vegetated buffers, link wildlife habitat, and preserve wetlands.
- Work with DOT to identify projects in the preliminary engineering state to incorporate bike / pedestrian improvements.
- Advocate for state funding for Safe Routes to School beginning with state delegation.
- Work with SCDOT to widen shoulders and provide adequate width to the right of rumble strips.
- Work with LATS during the update of the Long Range Transportation Plan to incorporate bicycle and pedestrian projects in the plan and advocate for a target percentage of funding to be devoted to bicycle and pedestrian facilities.

E M 5. PRIORITIZE BICYCLING AND WALKING TO CONNECT RESIDENTS WITH JOBS, SCHOOLS AND OTHER DESTINATIONS; PROVIDE SAFE FACILITIES THAT BENEFIT PERSONS OF ALL ECONOMIC STATUSES, AGES, AND ABILITIES.

- Develop a funding strategy and anticipated annual revenue for trail projects that includes Accommodations Tax, Guideshare funds, Capital Project Sales Tax, dedicated local funding, and state and federal grants.
- Develop a non-profit to advocate pathway projects in Beaufort County and raise private donations.
- Work with Friends of the Spanish Moss Trail to expand its role to advocate and raise private donations for pathway projects that connect to the Trail.

M5. ACTIONS

M 5.1. Complete the Spanish Moss Trail and make continuous progress on other greenway, trail, sidewalk, and bicycle lane projects.

M 5.2. Dedicate a staff position to plan and implement bicycle and pedestrian facilities.

M 5.3 Develop a funding strategy and implement the bicycle and pedestrian projects in the 10-year Capital Improvements Program.

M 5.4 Adopt "Beaufort County Connects 2021", the Bicycle/Pedestrian Plan for the County.

E M6. SUPPORT THE DEVELOPMENT OF BUS RAPID TRANSIT FEATURES IN HIGH-DEMAND CORRIDORS, SUCH AS OFF-BOARD FARE COLLECTION, PLATFORM LEVEL BOARDING, AND DEDICATED LANES AND STOPS SHELTERED FROM AUTOMOBILE TRAFFIC.

M6. ACTIONS

M6.1. Increase the numbers of park and ride locations along major transportation routes that connect employees with their jobs.

M6.2. Promote the use of transit to reduce seasonal and local traffic and provide opportunities for employees to access job opportunities.

M6.3. Support Palmetto Breeze's efforts to establish a fixed-route bus service between Hilton Head Island and Bluffton and in the Beaufort/Port Royal area. Consider adding stops in the Sheldon/Seabrook areas.

M6.4. Incentive "transit- ready" development projects that cluster moderate to high density residential development, retail, services and employment centers within walking distance of transit stops.

R M 7. UPGRADE AIRPORTS.

- Support the enhancement of the Hilton Head Island Airport and the Beaufort Executive Airport to support economic development and tourism in the region.
- Consider the impacts of airport improvements on the environment, MCAS Beaufort, and the surrounding community.

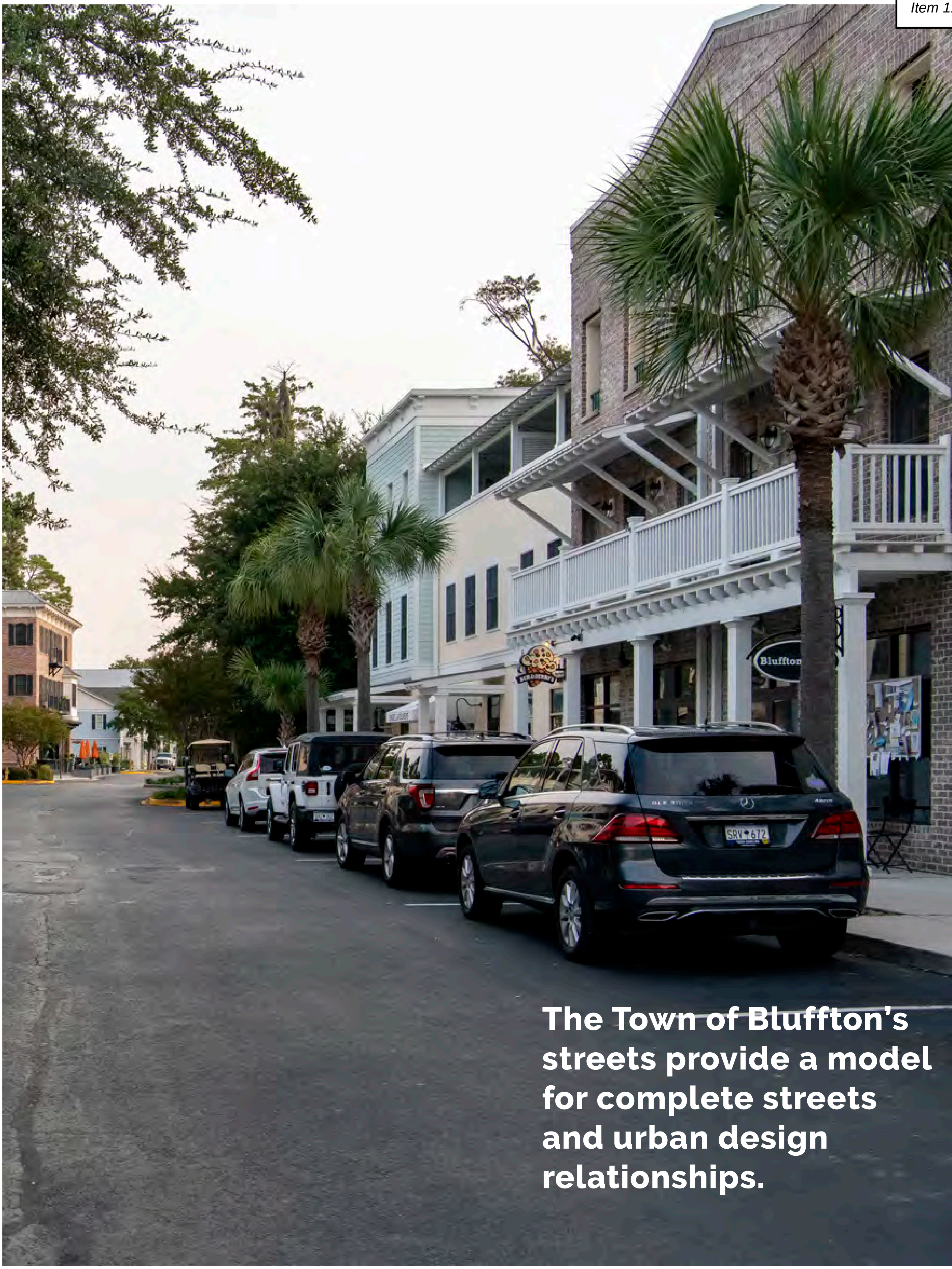


Photo source: Design Workshop

Photo source: Design Workshop

HOUSING

Promote quality, affordable housing available and accessible to all residents.

CORE VALUES

1. We provide the support needed for our citizens to access a happy and successful life.
2. We want our citizens to have equitable access to high quality services, amenities, education and infrastructure.
3. We desire safe, stable neighborhoods.
4. We know our population is aging and also becoming more diverse.
5. We believe a community should offer a mix of housing types available to residents of varying incomes, ages, and abilities.
6. We understand the need to ensure housing that is affordable to our workforce.
7. We believe that diversity in housing, in neighborhoods, and in people, adds to resiliency.

Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.

CONTEXT

Beaufort County is the most affluent county in South Carolina in terms of median household income. This wealth is not spread evenly, however, but varies greatly across the county's diverse population and geography. The median income for African-American and Hispanic households is significantly lower than for the County as a whole. According to the Centers for Disease Control (CDC) Social Vulnerability Index (SVI), Beaufort County has areas of high vulnerability related to housing and transportation, especially in its more rural areas. Median income on St. Helena Island in 2019 was only two-thirds that of the County as a whole ($44,190 in Census Tract 11.02 verses $68,377 for the County). The Sheldon and Seabrook areas (Census Tracts 1 and 2) had the lowest median income in the County in 2019, at $38,395 and $42,466 respectively.

Attaining affordable housing is a problem for both renters and homebuyers. According to the Beaufort County, South Carolina Housing Needs Assessment by Bowen National Research, in 2017, 47.4% of Beaufort County renters are "cost- burdened," or paying more than 30% of their income toward housing. Northern unincorporated Beaufort County had the highest number of cost- burdened renters at 55.9%. Over 33% of Beaufort County homeowners are paying more than 30% of their income toward housing, which is significantly higher than the statewide average of 23%. Slightly over 70% of the available housing inventory for sale is priced above $300,000, while only 10% of the inventory is available for less than $200,000.

The situation is even more difficult for very low-income residents. While about 18% of Beaufort County residents can afford a $500 per month rent, only 6.3% of the rental housing market is listed at or below that price.

Government subsidized housing currently has 280 families on the waiting list. The one-bedroom wait list is the longest and the wait time is almost three years. The wait list for Housing Choice Vouchers (formerly Section 8) has over 1,000 families on it and is not expected to open for additional applications until 2023 or later.

The greatest projected growth by household age group is expected to occur among seniors, which creates the need for senior-based housing, health care and programs, assisted living facilities and continuing care facilities. Many housing developments within the County do not provide parks, open spaces, and amenities, which requires people to travel to enjoy public recreational opportunities. Many residents have to drive--often long distances--to get to their workplace, which congests roadways, utilizes land for parking, and lengthens the workday.

Beaufort County will need to have an active role in affordable housing in order to build a sustainable future for tourism and other major industries, protect its military bases, and continue to be a desirable place to live for people of all income levels. A comprehensive affordable housing approach will:

- Foster the creation of affordable housing near jobs, services and public transit.
- Reduce regulatory barriers to the creation of affordable housing.
- Establish an ongoing funding source to address housing needs.
- Partner with non-profit agencies and the private sector.
- Work regionally to address affordable housing needs.

Photo source: Design Worksh

STRATEGIES AND ACTIONS

E H 1. DEVELOP POLICIES FOR THE APPROPRIATE LOCATION AND QUALITY OF AFFORDABLE HOUSING.

- Locate affordable housing in infill sites that are accessible to employment, services, schools, parks, and public transportation.
- Encourage affordable housing to be located in mixed-income, mixed-use, walkable communities.
- In rural areas, affordable housing strategies should be focused on the rehabilitation of existing dwellings for low-/moderate-income homeowners, eliminating barriers to expanding existing family compounds, and assisting families in clearing titles to heirs' property.
- Support efforts to enable older adults and seniors to transition into housing to meet their specific needs. Ensure that senior housing is located in walkable communities or near transit so that seniors can access shopping and services without the necessity of a car.

H1. ACTIONS

H 1.1. Create affordable housing location criteria and weighting to refine affordable housing location mapping included in the Comprehensive Plan. Update every five years.

R H 2. REDUCE REGULATORY BARRIERS TO THE DEVELOPMENT OF AFFORDABLE HOUSING.

- Expand on existing affordable housing density bonuses. Explore other regulatory incentives including the fast tracking of permits, etc.
- Continue to support a waiver or reduction of impact fees for eligible affordable housing projects. Continue to explore other programs that reduce development costs for affordable housing without compromising quality.

H2. ACTIONS

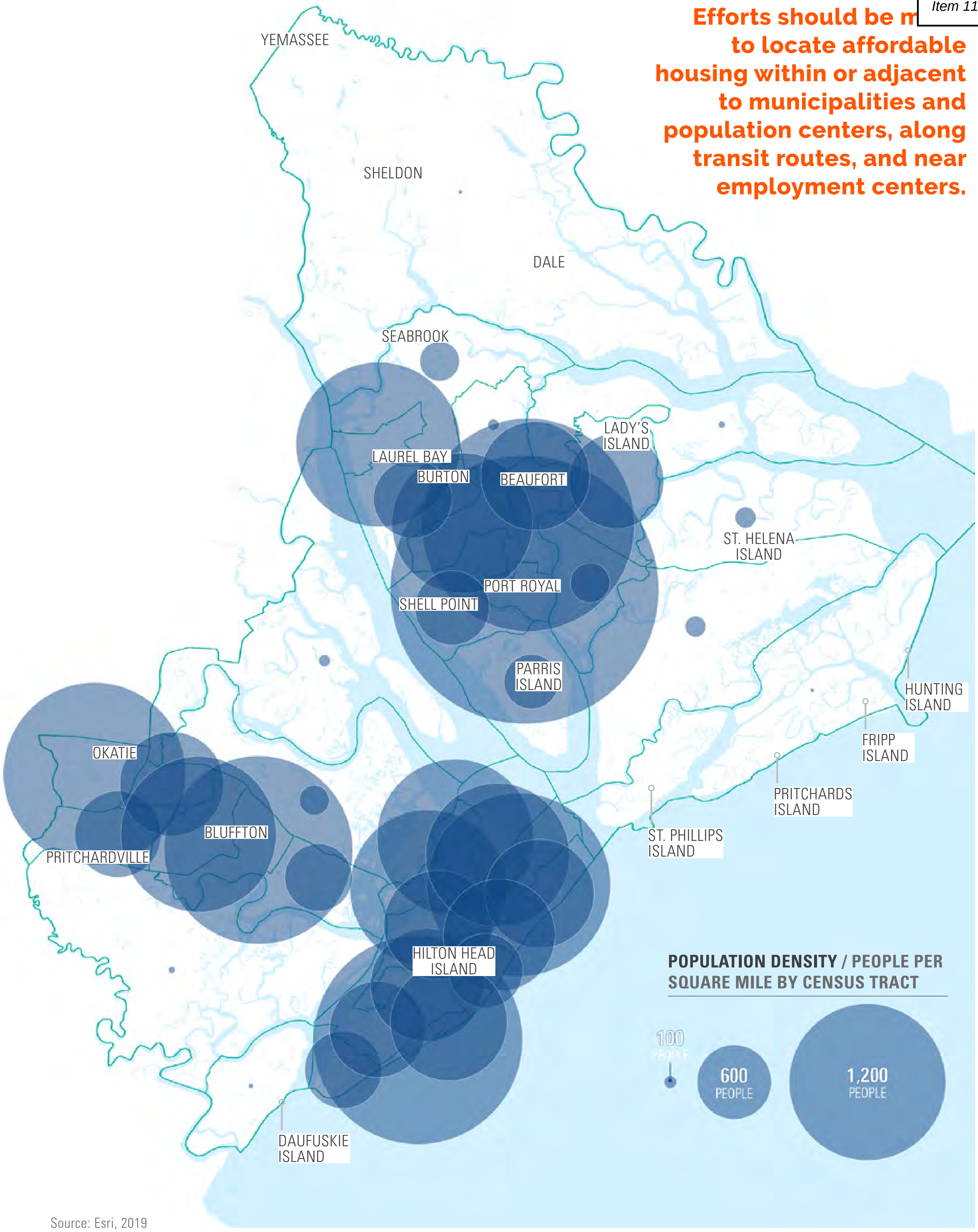
H 2.1. Work to eliminate barriers to developing affordable and workforce housing by periodically evaluating and updating the Community Development Code.

H 2.2. Expand on the existing density bonuses in the Community Development Code to incentivize the creation of affordable housing by the private sector. Consider expanding the required affordability period beyond 25 years.

R H 3. AGGRESSIVELY PURSUE THE DEVELOPMENT OF AFFORDABLE HOUSING.

- Use the recommendations from the 2018 Housing Needs Assessment to inform which affordable housing projects to support or pursue.
- Develop and maintain partnerships with non-profit organizations to expedite the construction of new affordable housing and provide programs that address needs such as down payment assistance. Such partnerships include purchasing of land, innovative financing, providing local matches to grant applications, and providing technical assistance.
- Support state efforts to enact legislation enabling local jurisdictions to adopt inclusionary zoning regulations that link

Efforts should be m to locate affordable housing within or adjacent to municipalities and population centers, along transit routes, and near employment centers.



Source: Esri, 2019

STRATEGIES AND ACTIONS

the production of affordable housing to development of market rate housing.

- Establish an ongoing dedicated funding source to assist in local affordable housing initiatives. The County should consider establishing a housing trust fund in order to pool limited resources, manage dedicated funding, and to prioritize and manage affordable housing initiatives. Consider securing state legislation in order to adopt a real estate transfer fee to fund housing initiatives.
- Consider re-establishing the Affordable Housing Task Force or a similar group to serve as a public advisory committee to the housing coordinator to help bring diverse perspectives to the table and avoid duplication of programs and services.

H3. ACTIONS

H 3.1. In cooperation with local municipalities and Jasper County, create a Regional Affordable Housing Trust Fund and provide annual funding to support affordable housing needs in the Lowcountry.

H 3.2. Consider establishing an Affordable Housing Land Trust to acquire and hold land. The land is leased to others to build affordable units, with the land remaining in ownership of the trust. Since land is taken out of the market, the impact of land appreciation is removed, therefore enabling long-term affordable housing.

H 3.3. Hire a housing coordinator for Beaufort County to implement the policies of this plan.

H 3.4. Seek funding through the Home Investment Partnership Program (HOME) and the Community Development Block Grant (CDBG) Program to rehabilitate substandard housing and create new affordable housing.

H 3.5. Consider prohibiting short term rentals as the primary use of the property in certain residential zones; i.e., only permit short term rentals in conjunction with 4% properties.

H 3.6. Review zoning districts to determine if appropriate opportunities exist to incorporate more “missing middle housing.”

Photo source: Design Worksho

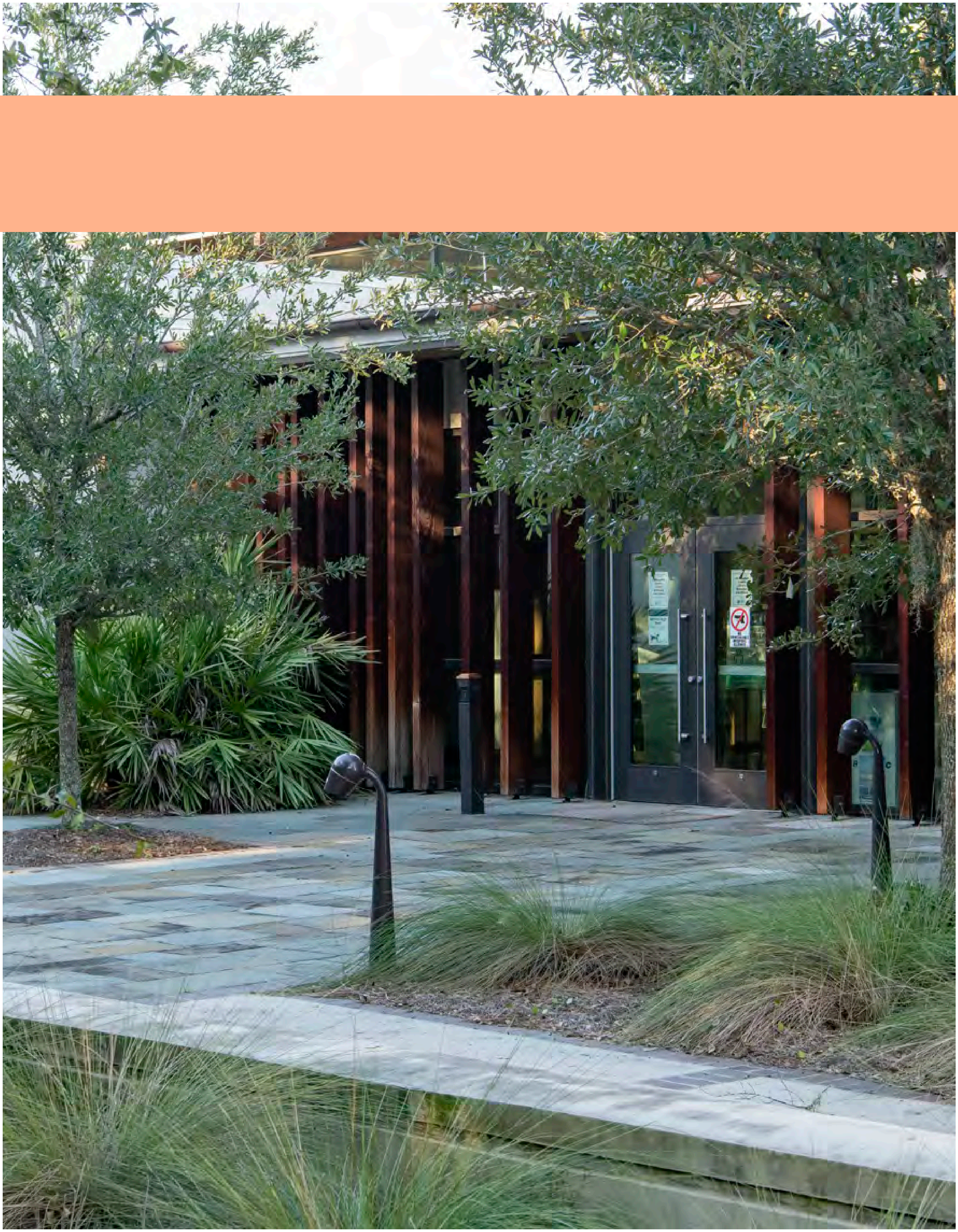


Photo source: Design Worksh

COMMUNITY FACILITIES

High quality, resilient community facilities and services for all residents.

CORE VALUES

1 We desire equitable access to quality facilities and services for all residents.

2 We believe critical facilities should be located outside of vulnerable, flood-prone areas.

3 We develop new community facilities in concert with Place Type Overlay future land use designations.

4 We believe in promoting green building practices and reducing the environmental impact of County facilities.

Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.

CONTEXT

As growth continues at a rapid rate, Beaufort County faces a significant challenge to meet the need for equitable distribution of services and community facilities to all of its citizens. Access to recreation, schools, water and sewer utilities, and public health and safety services should be expanded as the County works to accommodate its population growth, especially in Southern Beaufort County. Examples of recent successes include the development of nine existing and planned Passive Parks; 10 constructed miles of the Spanish Moss Trail in Northern Beaufort County; enhancements to boat public boat ramps and fishing piers; a successful bond referendum to renovate school facilities and add classroom space; and additional EMS facilities, vehicles, and staff.

The County will need to address several factors as it continues the expansion of community facilities to meet the demands of new growth:

- Accessibility: Ensure the population is served fairly and has equitable access to schools, parks, and public health and safety facilities. Consider what levels of service are appropriate relative to the density of identified areas.
- Environment: Locate future community facilities away from areas that are prone to flooding, and retrofit existing facilities to maximize their resilience to sea level rise and increased flooding.
- Place Type Areas: Balance the development of future community facilities with the varying densities and characters of local communities, and the natural environment.

Beaufort County has a responsibility to provide quality facilities and services to all of its citizens while continuing to expand its environmental stewardship efforts. Therefore, this chapter sets forth the following strategies to guide the development and enhancement of future and existing community facilities and ensure that the County:

- Provides quality facilities and services throughout the County.
- Develops resilient public infrastructure.
- Promotes energy efficiency in County operations.
- Expands the public health and safety service network.

Interpretive parks in Port Royal

Photo source: Port Royal

Interpretive parks in Port Royal

Photo source: Port Royal

STRATEGIES AND ACTIONS

R CF 1. DEVELOP RESILIENT AND EQUITABLE PUBLIC FACILITIES, INFRASTRUCTURE, AND PROGRAMS.

- Develop policies to locate public infrastructure in areas resilient to coastal flooding. This includes developing a strategy to inventory and retrofit vulnerable existing critical infrastructure..
- Ensure that the design of new public facilities enhances the communty's sense of place.
- Evaluate availability and quality of public facilities and programs.

CF1. ACTIONS

CF 1.1. Map and analyze locations of existing vulnerable critical infrastructure using projected future conditions. This includes developing an inventory of low-lying public facilities and critical infrastructure, including roads, sewer, water, public buildings, and stormwater infrastructure.

CF 1.2. Develop policies that require the design and location of future capital improvements and critical infrastructure to account for projected sea level rise and lifespan of structure.

R CF 2. EXPAND THE USE OF GREEN BUILDING DEVELOPMENT AND OPERATIONS PRACTICES TO REDUCE CONSUMPTION OF NATURAL RESOURCES, PROMOTE ENERGY EFFICIENCY, AND REDUCE POLLUTION.

- Evaluate all County operations and policies to promote energy efficiency and to reduce energy consumption, including where future facilities are located.
- Continue to expand the provision of online services, where practical, to reduce or eliminate the need for the public to travel to County facilities.
- Develop commuting policies and incentives for County employees such as telecommuting, carpooling, and alternative commuting modes such as walking, cycling, and transit.
- Support Green Building by requiring future County buildings and additions to be LEED certified; encourage other local governments and agencies to adopt similar policies; and provide tax or other incentives to the private sector for LEED buildings.
- Evaluate existing and future land use regulations, design standards, and building codes to ensure that they do not place unreasonable barriers to providing site and building features designed to merit LEED credits (e.g., rain barrels, cisterns, and green roofs).
- Provide support to local agencies that administer low-income weatherization programs such as the Weatherization Assistance Program offered through the US Department of Energy.
- Continually reevaluate development regulations to remove any unnecessary regulatory barriers that deter local renewable energy generation.
- Assist private communities in overcoming barriers placed by restrictive covenants.

CF2. ACTIONS

CF 2.1. Conduct an energy audit for all County facilities (existing, undergoing renovation, and under design). The County should consider entering into an energy performance contract with an Energy Service Company to perform the audit and implement the improvements.

Palmetto Breeze provides an option for commuters

Photo source: Beaufort County

The Audit should include an evaluation of the feasibility of using renewable energy, such as wind and solar, to reduce energy costs in County facilities

CF 2.2. Install electric vehicle charging stations at every Council facility that houses a sizeable workforce or has high public visitation.

E CF 3. EXPAND WATER AND SEWER SERVICES TO AREAS OF NEED WITHIN URBANIZED OR URBANIZING AREAS.

- Support the extension of public water in the Seabrook/Stuart Point CP, Dale CP, the Pritchardville CP, and other rural communities that are currently served by private wells by working with both BJWSA and, in the northern most part of the county, Lowcountry Regional Water System (LRWS). Prioritize communities within designated urban growth boundaries. Promote Clemson Extension's "Be Septic Safe Program" to owners of septic tanks to prevent groundwater contamination and extend the life of septic tanks.
- Work with the Lowcountry Council of Governments, Deep Well Project, and other agencies to pursue grants to assist low- and moderate-income residents with laterals and tap fees.
- Restrict the expansion and location of new regional sewage collection and transmission facilities in rural areas except where a documented public health or environmental safety issue has been identified.

Beaufort County's rich history can become part of the educational experience of residents and visitors.

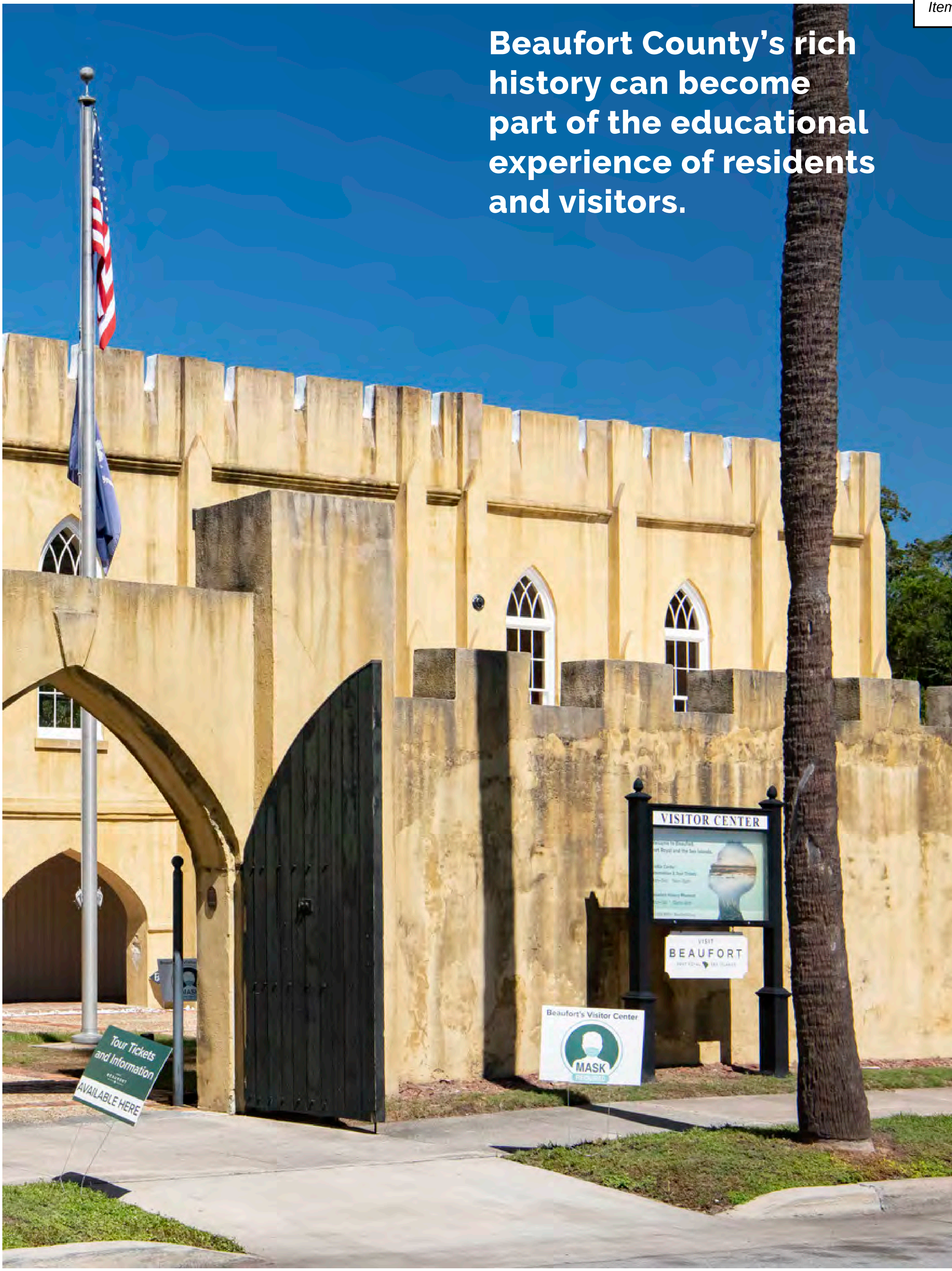


Photo source: Design Workshop

CF3. ACTIONS

CF 3.1. Adopt county-wide policies that limit residential density for developments that are not served by public sewer.

CF 3.2. Work with BJWSA to identify and prioritize areas with the highest concentration of on-lot septic systems for connection to sewer if these neighborhoods are within urbanized areas or within designated growth boundaries.

R CF 4. CREATE A COMPREHENSIVE PLAN FOR SUSTAINABLE WASTE REMOVAL AND DISPOSAL.

- Design and implement a plan for provision of multiple disposal alternatives, including composting, for the County.
- Continue efforts to form alliances with neighboring counties to develop alternative methods for waste disposal and recycling.
- Initiate the placement of a transfer station and a Material Recovery Facility (MRF) in Beaufort County to provide an alternative to disposal and recycling at the Hickory Hill Landfill and MRF. Ensure appropriate siting to avoid impacting communities and sensitive habitats.
- Explore means of initiating mandated curbside pick- up for solid waste and recycling in Districts 6, 7, and 9, and encourage the Town of Hilton Head to provide or require curbside pick-up.
- Explore an exclusive franchise system, allowing haulers to bid on servicing an entire Solid Waste District or a designated area within the Solid Waste District if not feasible for one hauler to service the entire district. This will help to reduce costs for citizens and decrease truck traffic in residential neighborhoods.
- Pursue recycling options for yard waste as an alternative to placement in a construction and demolition landfill or incineration.
- Expand options to help the public dis toxic items such as household hazardous waste that degrade water quality.

CF4. ACTIONS

CF 4.1. Install trash compacting equipment to increase the efficiency and capacity of County high usage convenience centers.

CF 4.2. Design and implement a plan for sustainable waste removal and disposal for the County, including multiple disposal alternatives, like various recycilng streams and composting.

E CF 5. DEVELOP LIBRARIES THAT FIT WITH CURRENT TRENDS IN PROGRAMMING AND ARE DESIGNED TO SERVE THE VARYING NEEDS OF THE CITIZENS OF THE COUNTY.

- Establish a Level of Service of 1.0 square foot per capita building space and two collection items per capita.
- Expand the bookmobile program to meet the needs of residents who are unable to physically travel to a branch location.
- Expand on-line services for e-books, audio books, music streaming, and other services.

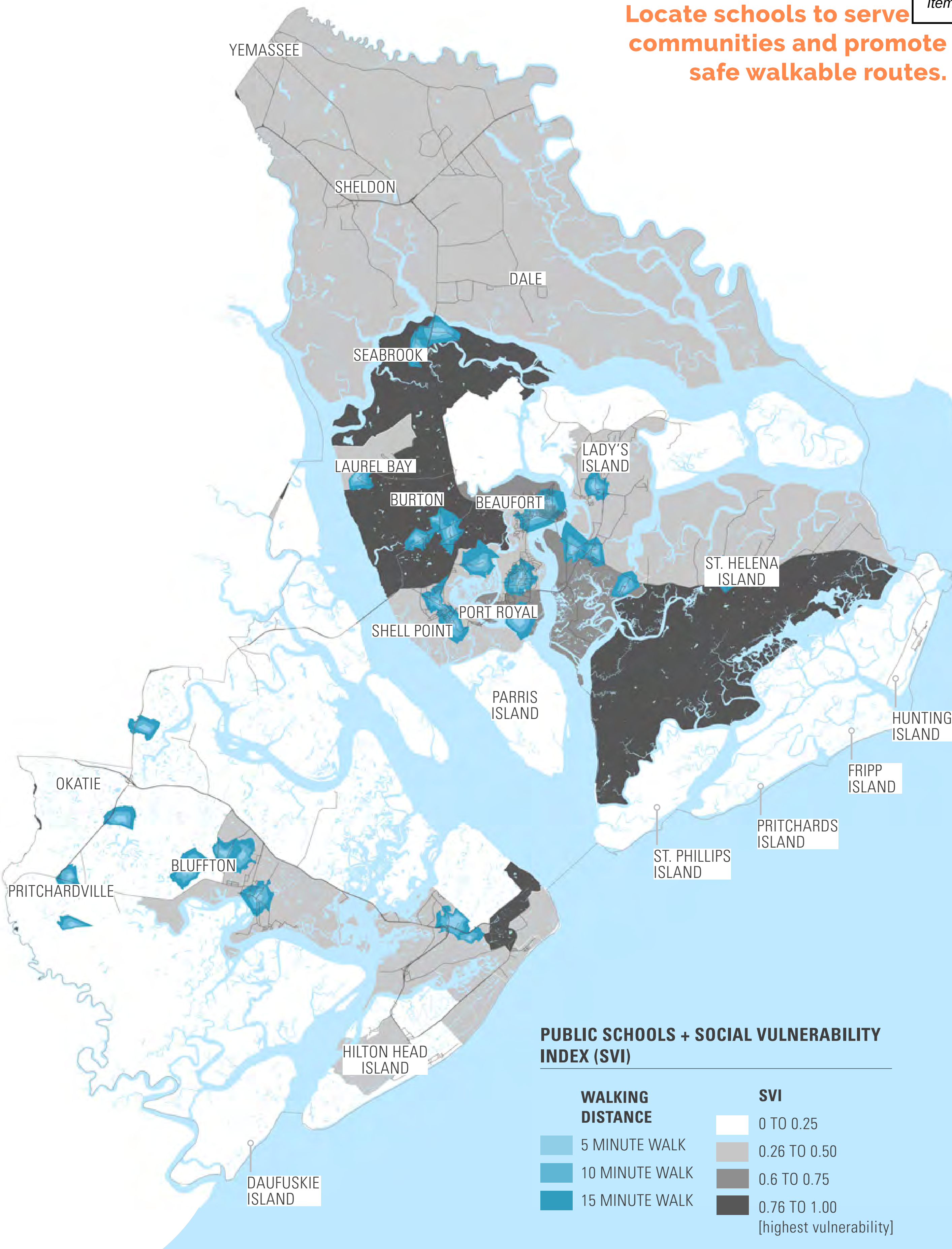
CF5. ACTIONS

CF 5.1. Review and update Impact Fees every five years.

CF 5.2. Renovate and repair the Beaufort, Hilton Head Island, Lobeco, and Bluffton facilities to meet current operational needs.

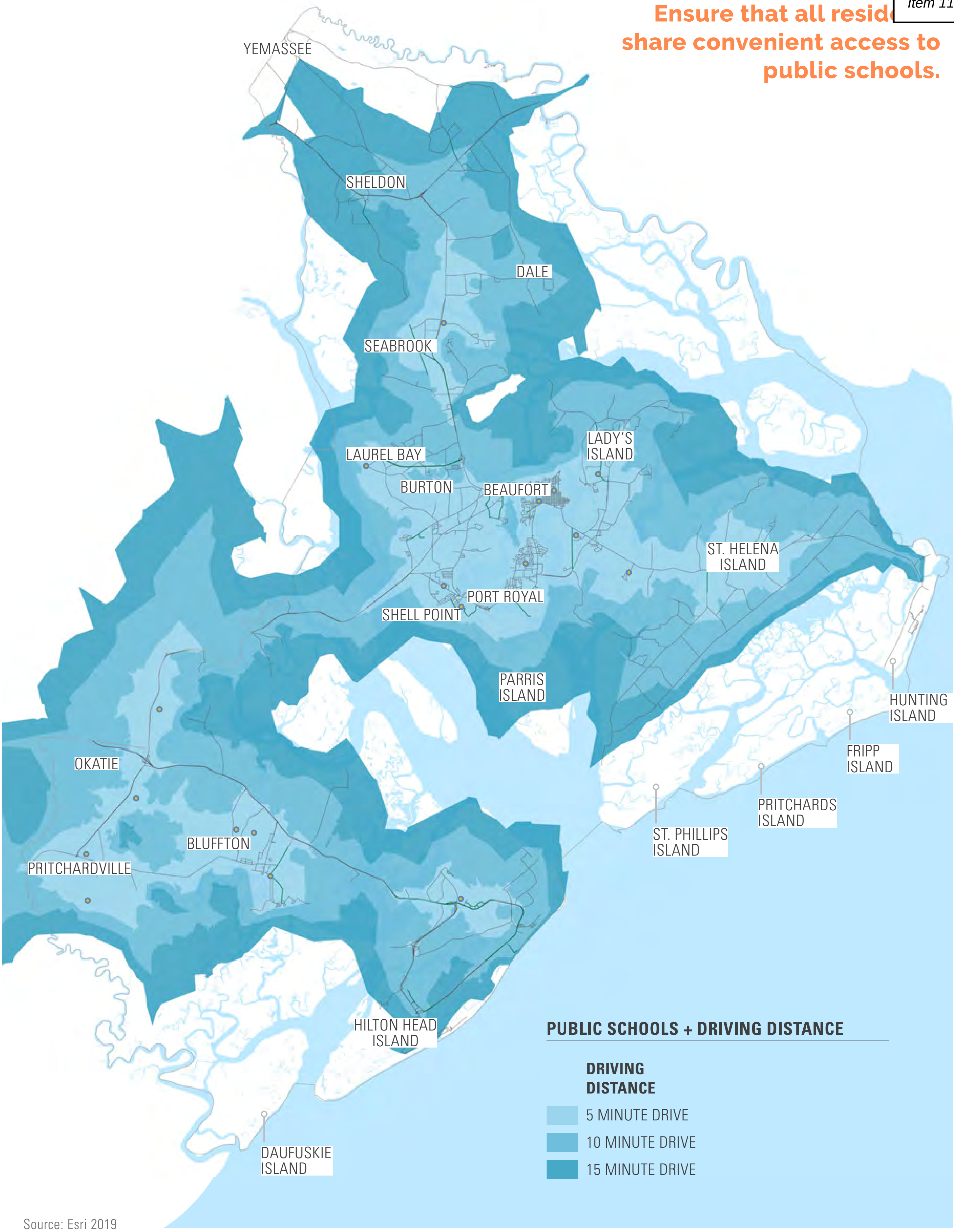
CF 5.3. Develop two additional library facilities: one 12,000 - 15,000 square foot facility in the Okatie area, and one 3,000 - 5,000 square foot facility at Burton Wells Park.

Locate schools to serve communities and promote safe walkable routes.



Source: Esri 2019

Ensure that all residents share convenient access to public schools.



Source: Esri 2019

E CF 6. ENSURE THAT SCHOOLS ARE PLANNED FOR AND LOCATED TO SERVE THE COUNTY'S DIVERSE POPULATION FAIRLY AND TO THE SAME HIGH LEVEL OF QUALITY.

- Conduct an analysis to ensure that school quality and access is balanced equitably across the County so that every student has access to educational opportunity.
- Coordinate the timing and siting of future school facilities through Intergovernmental Agreement, coordinated funding, coordinated growth projections, and coordinated land use planning to project future facility needs.
- Encourage cooperation between the School District and other community facility providers (parks, libraries, fire protection) to coordinate future land purchases to serve mutual needs.
- Maintain and expand coordination with the school district to ensure that major development proposals do not have an adverse impact on current school capacity.
- Seek future school sites that are in close proximity or within residential areas so that more children can walk to school.

CF6. ACTIONS

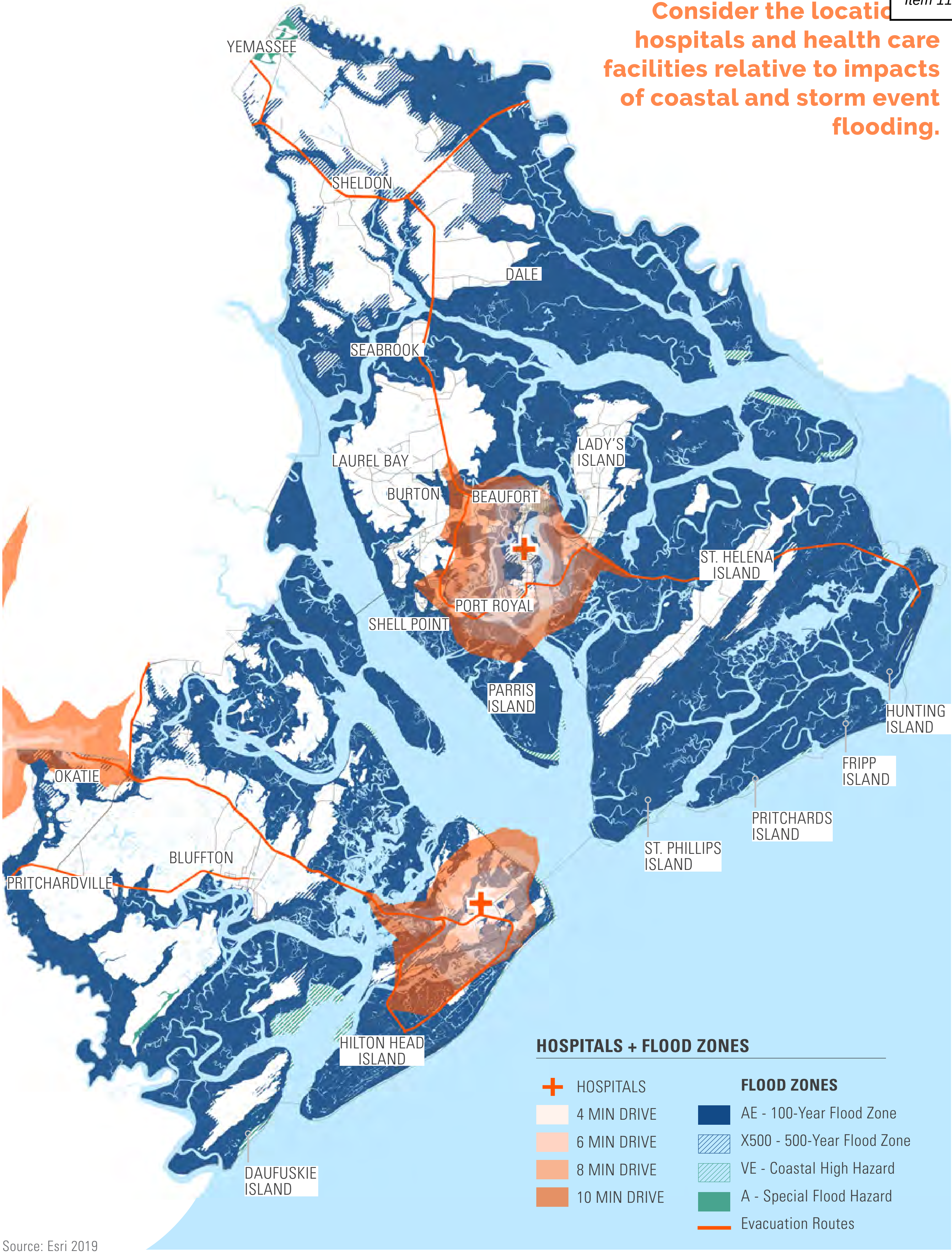
CF 6.1. Establish "Safe Routes to Schools"' ' standards and routing plans, consistent with recommendations of Bike and Pedestrian Task Force, that require a strong pedestrian orientation in residential areas so that pedestrian ways are available for children to safely walk to school.

CF 6.2. Adopt school impact fees for Southern Beaufort County.

E CF 7. ESTABLISH A PUBLIC HEALTH AND SAFETY NETWORK THAT CREATES ACCESSIBILITY ACROSS THE COUNTY.

- Provide updated land use and population projections to be used by the fire districts to project future capital needs.
- Support the fire districts' efforts to improve ISO ratings by providing excellent dispatching services, improving and enforcing building codes, and supporting public water improvements in areas with lack of fire hydrants and/or inadequate water pressure.
- Continue the cooperative relationship between the Burton Fire District and the City of Beaufort and the Town of Port Royal, and the Lady's Island/St. Helena Fire District and the City of Beaufort, in providing high quality, cost effective fire services.
- Use the South Carolina Hurricane Plan to provide a framework of local actions necessary for emergency operations to respond to hurricanes and tropical weather events threatening the County. Work cooperatively with municipalities, inland counties, and the State to ensure that emergency evacuation times are minimized.
- Consider the geographic reach of law enforcement so that there is equitable coverage county-wide.
- Include the EMS administrative offices, training center and storage space needs in the planned Law Enforcement Center (LEC) complex.
- In addition to EMS, other related departments including the Dispatch System, Emergency Services, and Traffic Management should be housed in the new LEC to allow for efficient communication regarding shared requirements.

Consider the location of hospitals and health care facilities relative to impacts of coastal and storm event flooding.



Source: Esri 2019

CF7. ACTIONS

CF 7.1. Renovate the existing Emergency Medical Services (EMS) headquarters on Depot Road to meet the needs of the administration for parking, training and storage. The facility's design, circulation, and security measures need to be context sensitive to the adjacent Spanish Moss Trail.

CF 7.2. Expand or replace the EMS station located at the shared Bluffton Fire District Station on William Pope Drive near Sun City to adequately accommodate EMS's personnel and operational space needs.

CF 7.3. Construct either an extension to the existing Detention Center facility or a new facility to accommodate anticipated operational demand. The facility needs to house specific special populations such as inmates with addiction or mental health issues. The operational costs of an additional facility should be studied to determine if a true benefit would be derived from adding to the existing facility or constructing a new one.

CF 7.4. Construct a new Law Enforcement Center to ensure that there is adequate space to house existing and future law enforcement personnel.

CF 7.5. Build an appropriate facility to house the Emergency Management Department within or attached to the proposed Law Enforcement Center.

CF 7.6 Work with BJWSA to provide additional fire hydrants on Warsaw Island, extending and replacing lines as necessary. Apply for grant funding as appropriate, including CDBG. Identify other rural areas where lack of fire hydrants or water supply pose safety concerns. Request that BJWSA include water service improvements in rural areas in their CIP.

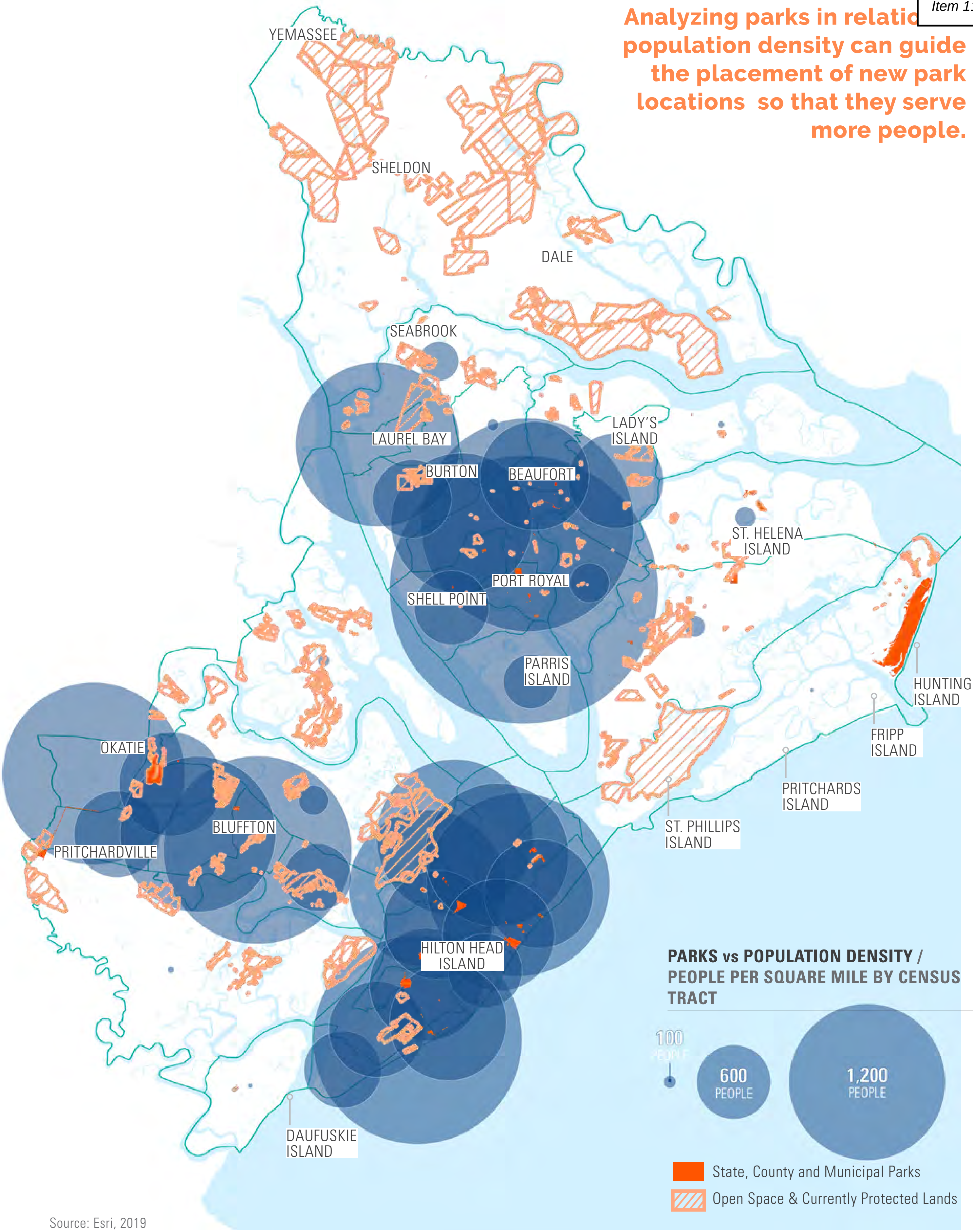
CF 7.7. Work with BJWSA to install water lines and fire hydrants on Seabrook Road and Stuart Point Road on Port Royal Island. Apply for grant funding as appropriate, including CDBG.

CF 8. PROVIDE PARKS AND OPEN SPACES TO MEET THE NEEDS OF CITIZENS.

- Ensure, based on establishing acceptable metrics, that passive and active parks are programmed for the diverse demography of the County,
- Locate new parks where people can access them safely by walking and biking and serve population centers; make improvements as needed for better access at existing parks.
- Link passive and active parks planning with Greenprint planning and complete streets planning.
- Increase public access to the water by improving access on waterfront and marshfront properties currently owned by the County or other public entities; by purchasing additional waterfront and marshfront properties through the Rural and Critical Land Preservation Program; and by providing incentives to encourage public access to the water in private developments.
- Pursue park facilities that generate revenue via user fees. These facilities include water parks, campgrounds, tennis facilities, and picnic shelters.
- Review the current park management organizational structure and make recommendations for reorganization if warranted.
- Develop a strategy to address park needs by expanding on existing funding options and seeking new sources of funding, including revenue-generating park programs.
- Pursue facilities in active parks that generate revenue via user fees. These facilities include water parks, campgrounds, tennis facilities, and picnic shelters.

Item 11.

Analyzing parks in relatio population density can guide the placement of new park locations so that they serve more people.



Source: Esri, 2019

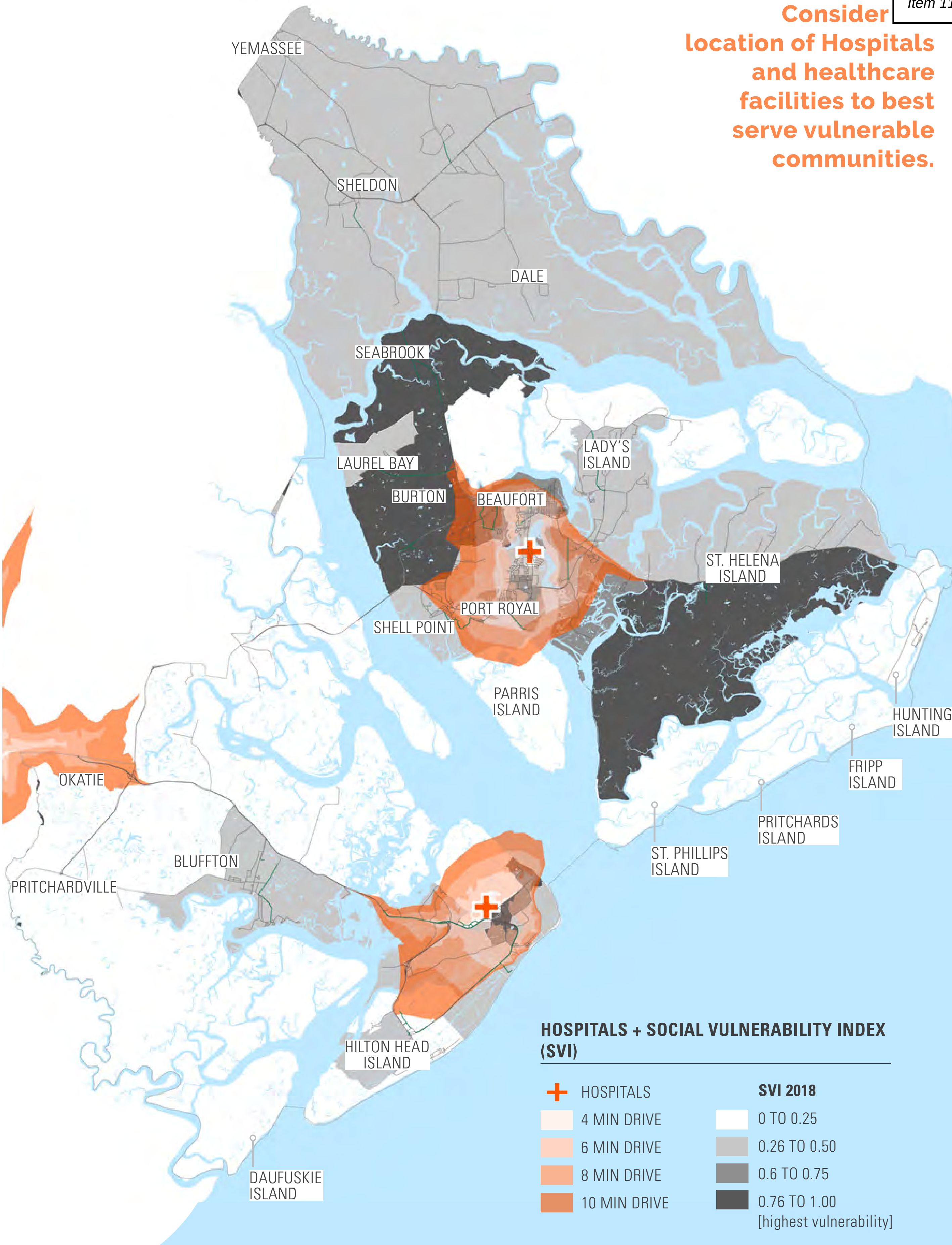
CF8. ACTIONS

CF 8.1. Create a Parks and Recreation Master Plan that establishes acceptable metrics for accessibility and programming. Ensure public participation from all areas of the County and segments of the community in the planning effort. Consider incorporating new uses in parks as appropriate such as splash pools, horseback riding, mountain bike trails, community gardens, camping, and ice skating.

CF 8.2. Implement the recommendations of the Parks and Recreation Master Plan according to the prioritization and timeline outlined in the document.

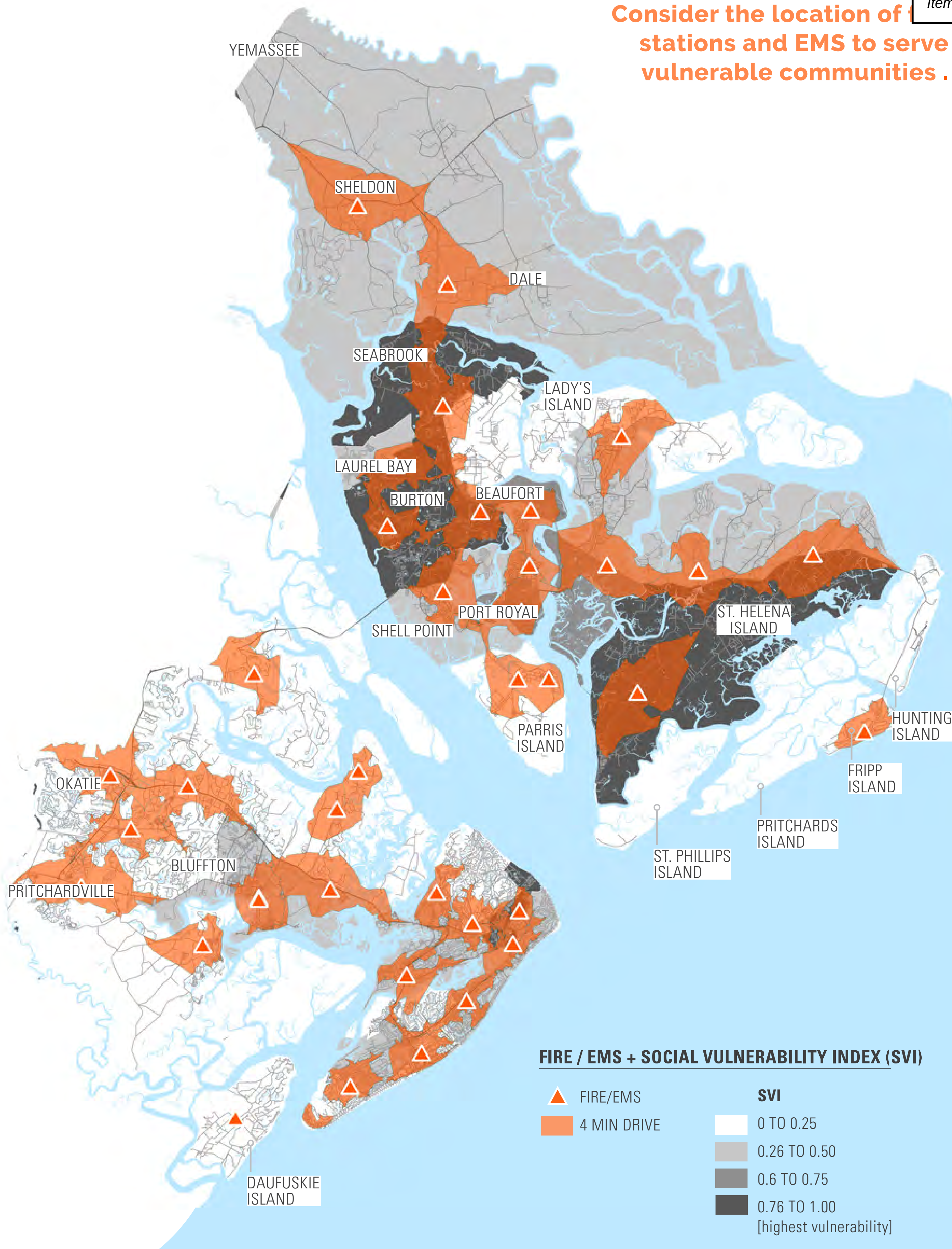
CF 8.3. Maintain a passive parks manager position to oversee the development of passive parks on Rural and Critical Land Preservation properties. Actively pursue the development of passive parks.

Consider location of Hospitals and healthcare facilities to best serve vulnerable communities.



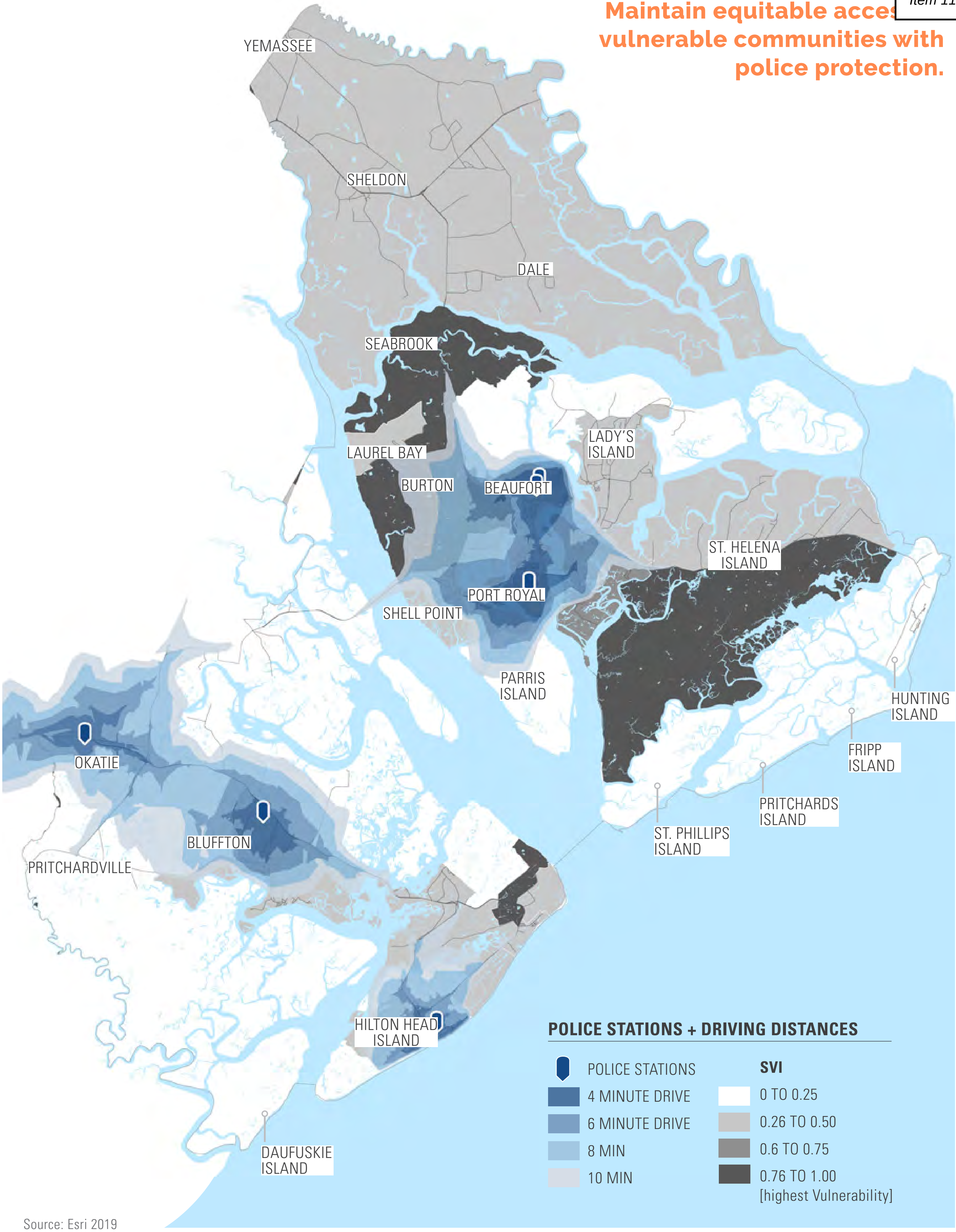
Source: CDC, BEAUFORT COUNTY

Consider the location of f stations and EMS to serve vulnerable communities .



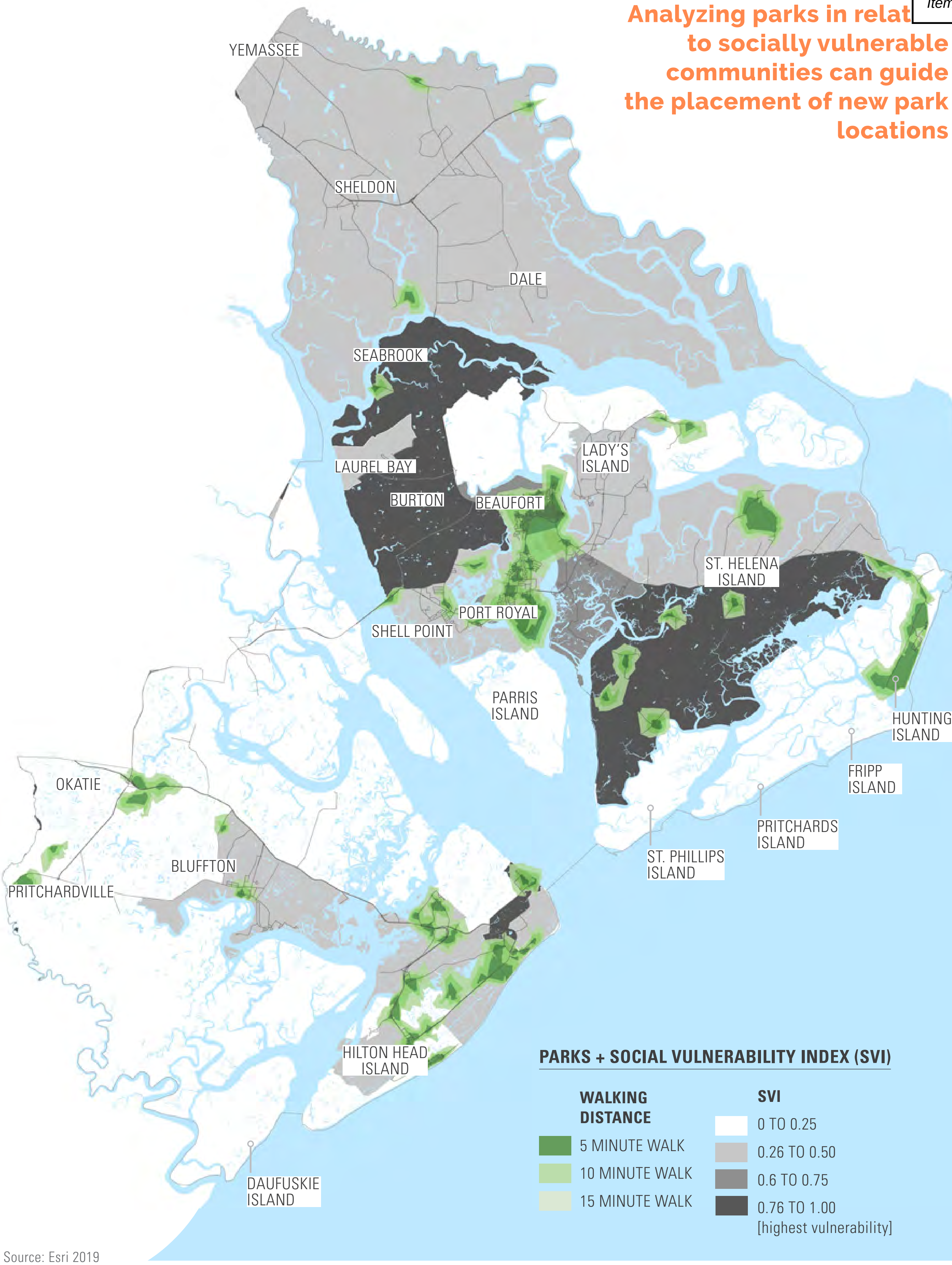
Source: CDC, BEAUFORT COUNTY

Maintain equitable access for vulnerable communities with police protection.



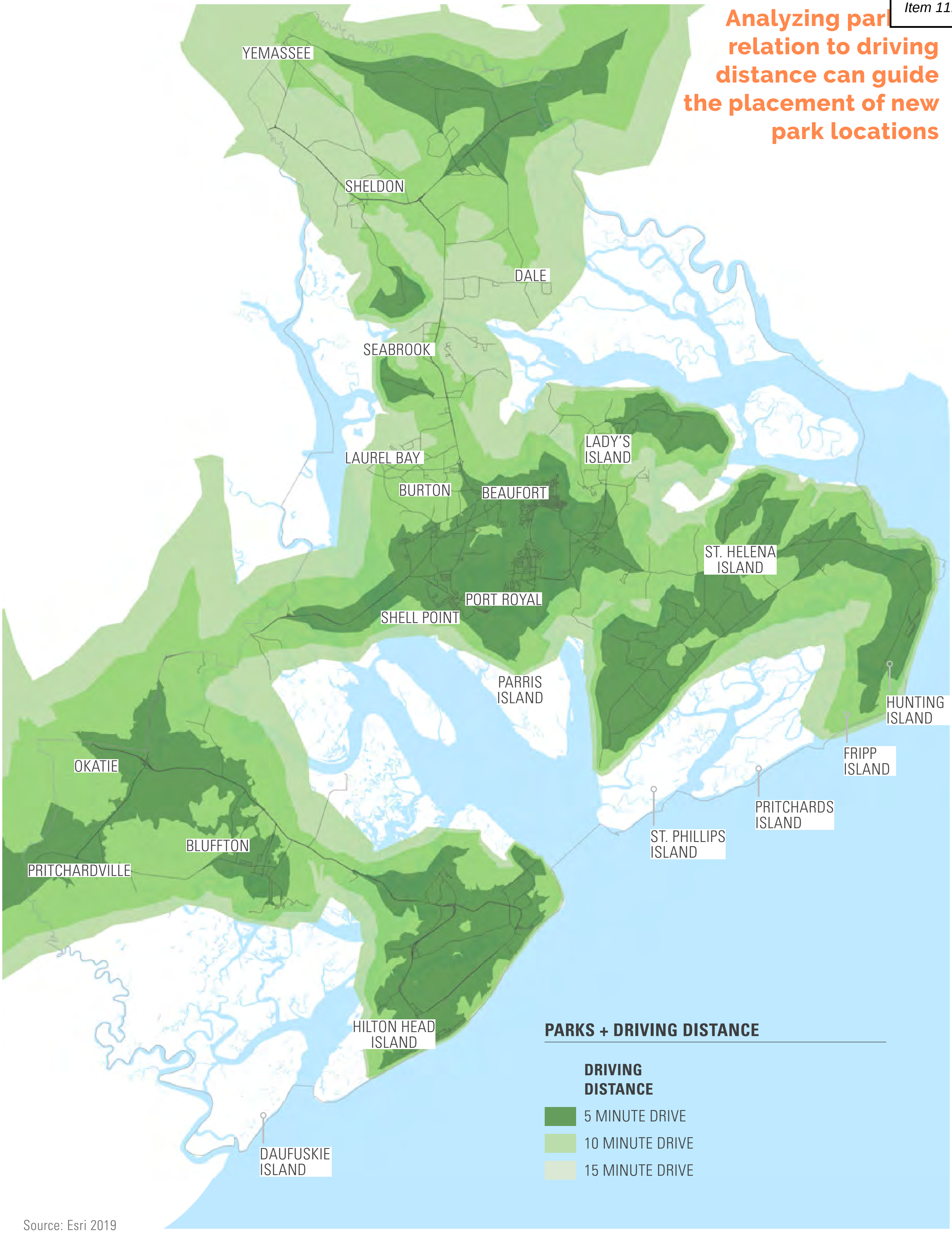
Source: Esri 2019

Analyzing parks in relat to socially vulnerable communities can guide the placement of new park locations



Source: Esri 2019

Analyzing parks in relation to driving distance can guide the placement of new park locations



Source: Esri 2019

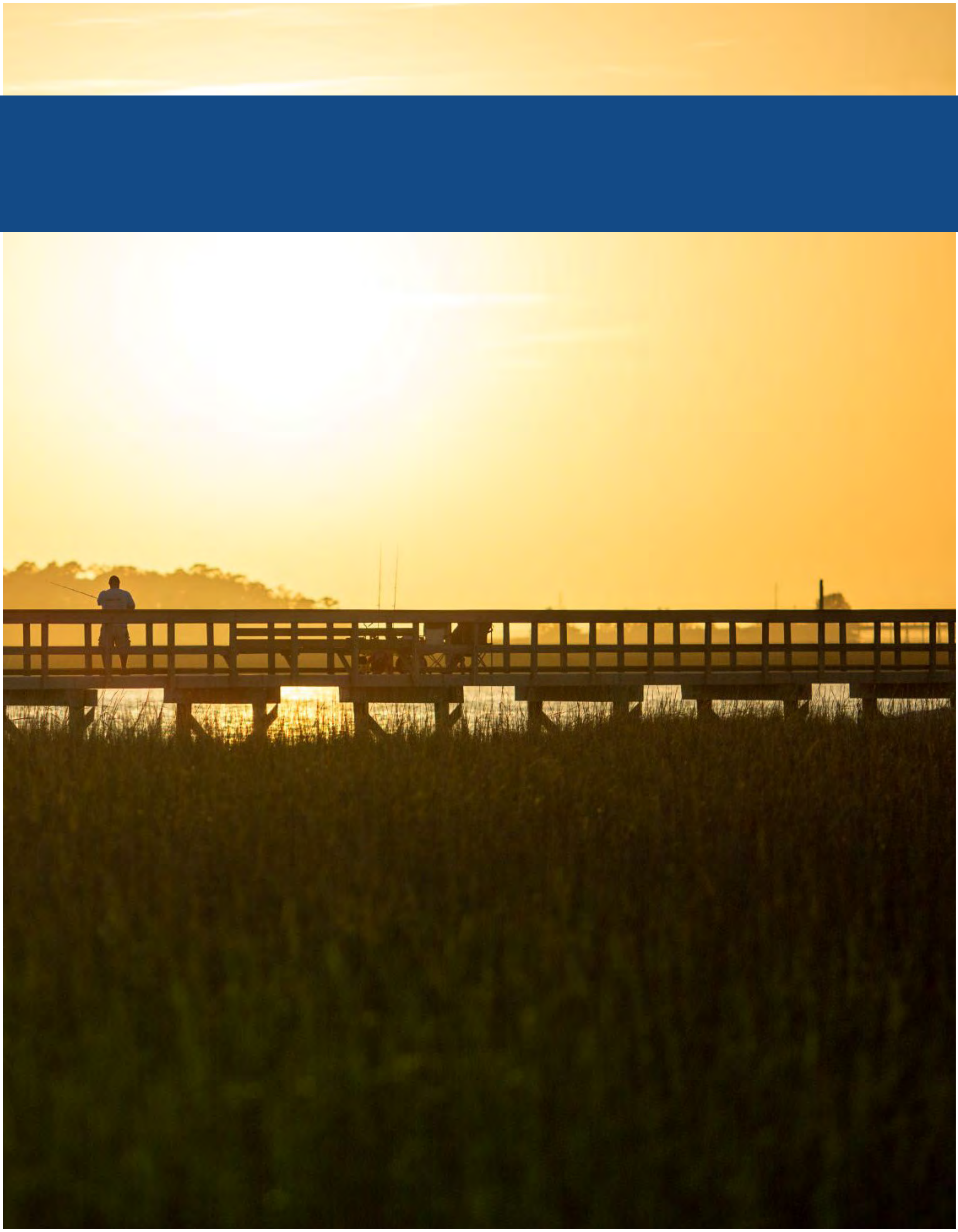


Photo source: Port Royal

BUILT ENVIRONMENT

Diverse, quality neighborhoods that support community life, work in balance and synergy with our natural environment, promote health and wellness, enable diversity, and enhance quality of life.

CORE VALUES

1. We desire a built environment that is in harmony with our natural environment.

2. We believe that development should be focused where it is best suited from an environmental, economic, infrastructure, and community service standpoint.

3. We desire development that supports and expresses our climate, landscape history, character, and lifestyle, and which promotes traditional town and neighborhood planning principles.

4. We respect private property and the ability for land-owners to profit from their land.

5. We preserve and promote our cultural, ethnic and socioeconomic diversity within our approach to planning the built environment.

6. We collaborate regionally to coordinate the development of the built environment and the protection of our natural environment.

i Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.

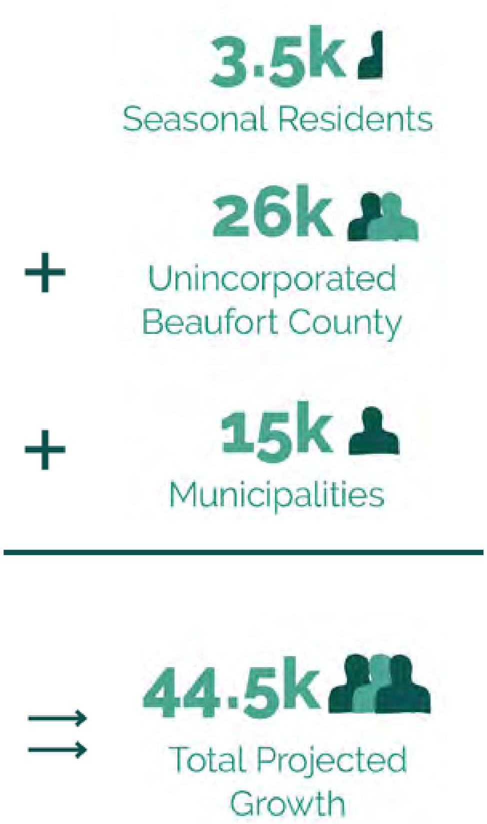
CONTEXT

Beaufort County is known for the detailed planning work it has done over the last 20 years. The County has defined where and how it wants to grow, and is implementing its long range plans through its Community Preservation Districts, rural zoning, special overlay zones, and transect-based design standards.

The County and its municipalities will continue to experience significant growth over the next decade. According to the most current estimates, the County is expected to add over 44,000 people by 2030. Of those, approximately 15,000 are assumed to be within the municipalities and 26,000 within unincorporated areas of the County. Fortunately, there is remaining land within existing PUDs and large subdivisions in the County and the municipalities that can absorb a significant quantity of this growth. Focusing on infill development (development on vacant lots within existing developed areas) will accommodate growth where infrastructure already exists. There is also zoned land serviced by infrastructure located adjacent to the municipalities and existing growth areas that is available for future growth. Given the available land that is already serviced, or near services, it is possible through education, development standards, and overlays, that the County can continue to grow while protecting rural areas and valuable natural and cultural resources.

Future growth in Jasper County, especially in Hardeeville, and also in the Town of Yemassee, will have a direct effect on Beaufort County's future from a transportation, natural resource, and service delivery standpoint. Working with Jasper County, Hardeeville, and Yemassee on shared values, policies, and standards will help reduce these impacts.

Future considerations could include additional growth boundaries, environmental corridors, complimentary zoning, collaborative growth modeling, density sharing, joint environmental stewardship, mutual commitments toward alternative modes of transportation, and other growth management concepts that would benefit the County and the region.



Source: The 2045 Low Country Council of Government transportation modelling assumptions

Photo source: Design Work

GROWTH & POPULATION DATA

Beaufort County's rapid growth rate is a relatively recent phenomenon in its 240-year history.

Population	
Total Population	187,117
Land Area (sq mi)	576.0
Population Density	324.8
Change in Population 2010-2020	15.3%
Population Age 18 and Over	81.1%
Race Alone[1]	
White	69.9%
Black or African American	14.9%
American Indian and Alaska Native	0.4%
Asian	1.3%
Native Hawaiian and Other Pacific Islander	0.1%
Some Other Race	5.7%
Two or More Races	7.6%
Hispanic Origin	
Hispanic or Latino	12.5%
Not Hispanic or Latino	87.5%
Housing	
Total Housing Units	98,068
Occupied Housing Units	77.9%
Group Quarters[2]	
Group Quarters Population	4.4%
Institutional Group Quarters Population	0.3%
Non-Institutional Group Quarters Population	4.1%

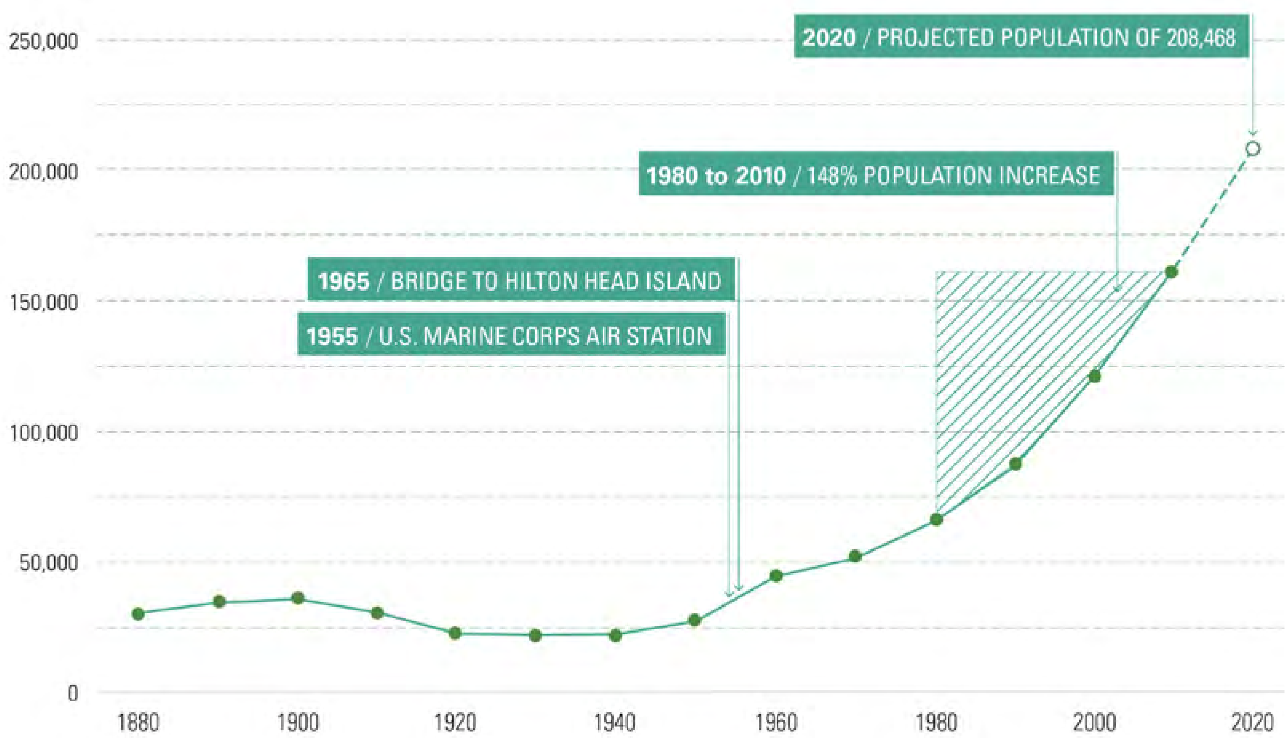
Beaufort County's population has grown significantly in the last 20 years and it's expected to continue. Much of the growth is being driven by people moving to the area from outside the county and is changing the racial and ethnic makeup of the county.

While overall the population is becoming older and more affluent, changes in prosperity and economic opportunity have not been evenly distributed across the county.

This recent rapid population growth and projected trends has policy implications for equity, public facilities, transportation, affordable housing, water quality, and natural and cultural resources.

For more detailed information on Beaufort County's population, reference the Beaufort County Atlas.

BEAUFORT COUNTY POPULATION GROWTH OVER TIME



PLANNING FOR AND MANAGING GROWTH

Beaufort County has a long history of planning for orderly and place-based growth. It has many tools in place that guide development and protect the built and natural environment. The municipalities that make up the County use similar and complementary codes and policies, which creates continuity in design and character.

And the county keeps growing! It is expected that by 2030, the population for Beaufort County will be near 224,970. And while this number sounds concerning, the analysis conducted for the 2040 Comprehensive Plan demonstrates that projected growth can be accommodated while also balancing the protection of natural and cultural resources.

Key to achieving this balance is directing growth away from sensitive natural areas and instead, targeting developed areas where infrastructure and services already exist.

This Plan provides several strategies which are outlined below to further refine how, where, and in what form Beaufort County can continue to grow.

Ongoing coordination between Beaufort County and Jasper County on shared principles, standards, limits of growth, and natural resource protection, will benefit all citizens and visitors to the region. After all, it is the unique sense of place, natural environment, and culture that fuels the economy.

Beaufort County's growth management strategy begins with a future land use map that guides land use policies and development decisions. The strategy is further refined by place type areas and growth corridors that provide more specific direction on the character and intensity of development with an emphasis on place making. Ultimately, the Greenprint Overlay is applied to establish balance and harmony between the built and natural environment.

URBAN GROWTH BOUNDARIES

PLACE TYPES AND TRANSECT ZONES

COMMUNITY PRESERVATION DISTRICTS

STORMWATER BEST MANAGEMENT PRACTICES MANUAL

GREEN PRINT PLAN

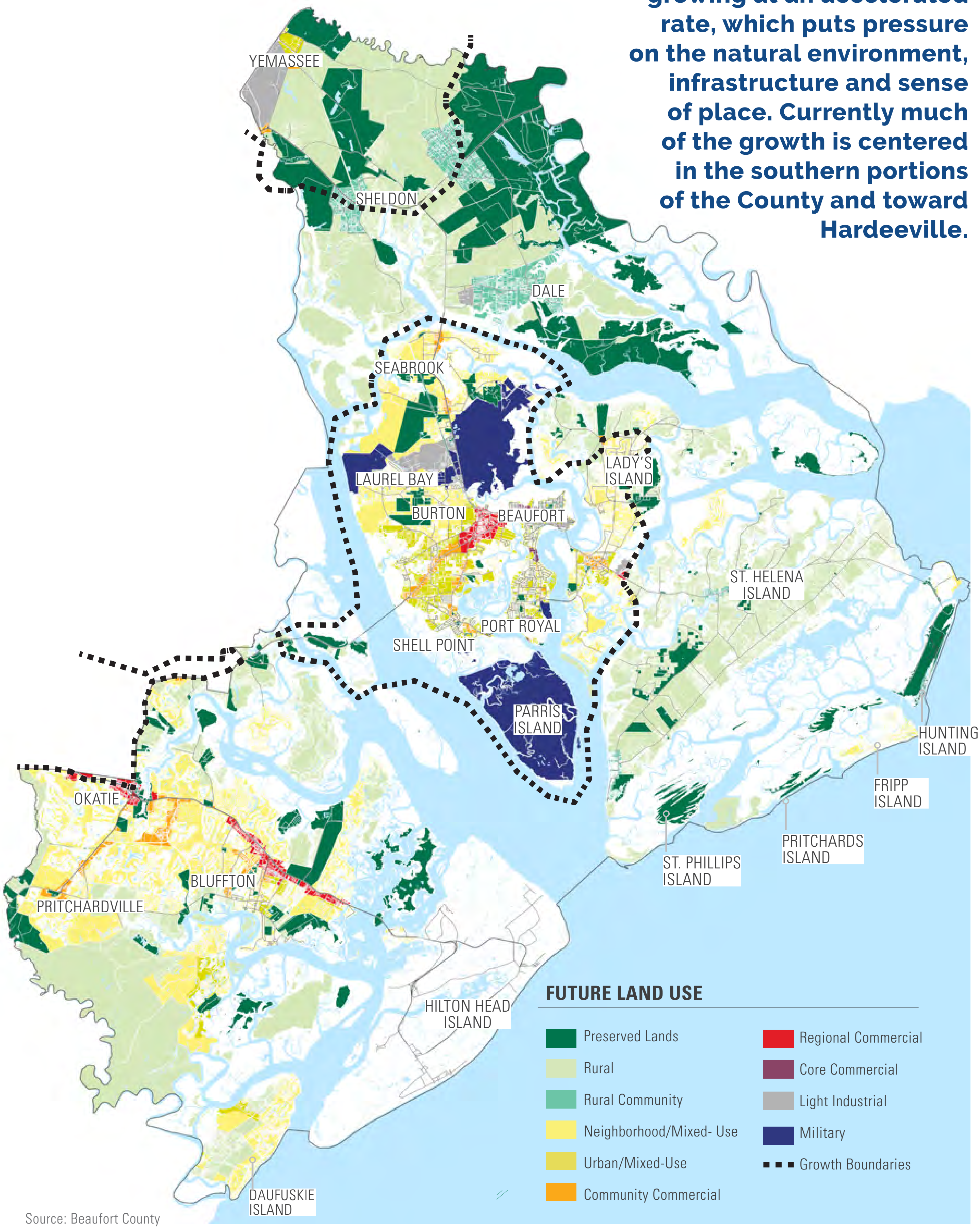
RURAL AND CRITICAL LANDS PRESERVATION PROGRAM

RURAL ZONING AND RESOURCE PROTECTION ZONING

NATURAL RESOURCE AND TREE PROTECTION STANDARDS

Item 11.

The County has growing at an accelerated rate, which puts pressure on the natural environment, infrastructure and sense of place. Currently much of the growth is centered in the southern portions of the County and toward Hardeeville.



Source: Beaufort County

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FUTURE LAND USE DEFINITIONS

Beaufort County's primary tool for managing growth is its future land use map. This Future Land Use Map provides the geographic framework to guide the County's land use policies and development decisions.

Rural Future Land Uses

Preserved Lands: This land use category includes all public parks; and public and private lands that are preserved through conservation easements.

Rural: Rural areas should retain their rural character with low-density residential development, supporting small scale commercial development, and agricultural land uses. The maximum gross residential density in rural areas is one dwelling unit per three acres, except for undeveloped rural marsh islands that are not accessible by car. These island shall have a maximum gross residential density of one dwelling unit per ten acres. Rural areas should not be targeted with the development of major public infrastructure or the extension of public sewer service except where a documented health, safety, and/or welfare condition warrants such an expansion.

Rural Communities: Rural communities are proposed to serve the surrounding rural area with small-scale retail and service uses and low to moderate density residential. Community-based planning is recommended to protect the unique qualities of these areas. Gross density should be approximately one dwelling unit per acre; however, slightly higher densities may be permitted in a rural center as part of a community plan.

Urban/Suburban Land Uses

Neighborhood Mixed-Use: Moderate-density residential is the primary use, with some supporting neighborhood retail establishments. New development is encouraged to be pedestrian-friendly, have a mix of housing types, a mix of land uses and interconnected streets. The maximum gross residential density is approximately two dwelling units per acre with some denser pockets of development.

Urban Mixed-Use: Future development should be compatible with the type and mix of land use currently found in the municipalities with an emphasis on infill and redevelopment and walkable, mixed-use communities. Gross residential densities are between two and four dwelling units per acre with some denser pockets of development.

Community Commercial: Community commercial uses typically serve nearby residential areas. An example of a community commercial use is a shopping district anchored by a grocery store.

Regional Commercial: Regional commercial uses are those uses which due to their size and scale will attract shoppers and visitors from a larger area of the county and outside the county. Typical uses include "big box" retail uses, chain restaurants, and supporting retail.

Core Commercial: Core commercial areas include downtown Beaufort, Bluffton, and Port Royal and are oriented as a traditional main street with a pedestrian scale and zero lot line development.

Light Industrial: Uses in this category include, but are not limited to, business parks, research and development centers, product assembly, distribution centers, cottage industries, and light and heavy industrial uses.

Military: This land use category includes all military installations including Parris Island and the U.S. Marine Corps Air Station.

Future Land Use Overlays

Growth Boundaries: Growth boundaries are a regional land use strategy that identify those areas where municipalities are likely to grow and provide services over the planning horizon period of 20 years. The areas of the county beyond the growth boundary are considered to be rural areas that should be preserved in accordance with the rural future land uses identified in this section.

Cultural Protection Overlay (CPO): The CPO applies to St. Helena Island and promotes the long-term protection of the Gullah/Geechee community by restricting incompatible development, such as gated communities, resorts, and golf courses. The CPO should be periodically reassessed to determine whether additional land use restrictions are necessary to meet the intent of the district.

Air Installation Compatible Use Zone (AICUZ): This overlay is based on the Air Installations Compatible Use Zone Study for MCAS Beaufort 2013. Residential development and places of assembly (e.g., churches, schools, etc.) should be highly limited in these areas. Light industrial, commercial, and agricultural uses are considered appropriate to this area.

1. IDENTIFY LAND AREAS MOST "SUITABLE" FOR DEVELOPMENT OR PRESERVATION

WETLANDS & HYDRIC SOILS

PROJECTED SEA LEVEL RISE

FLOOD ZONES

PLANNED UNIT DEVELOPMENTS

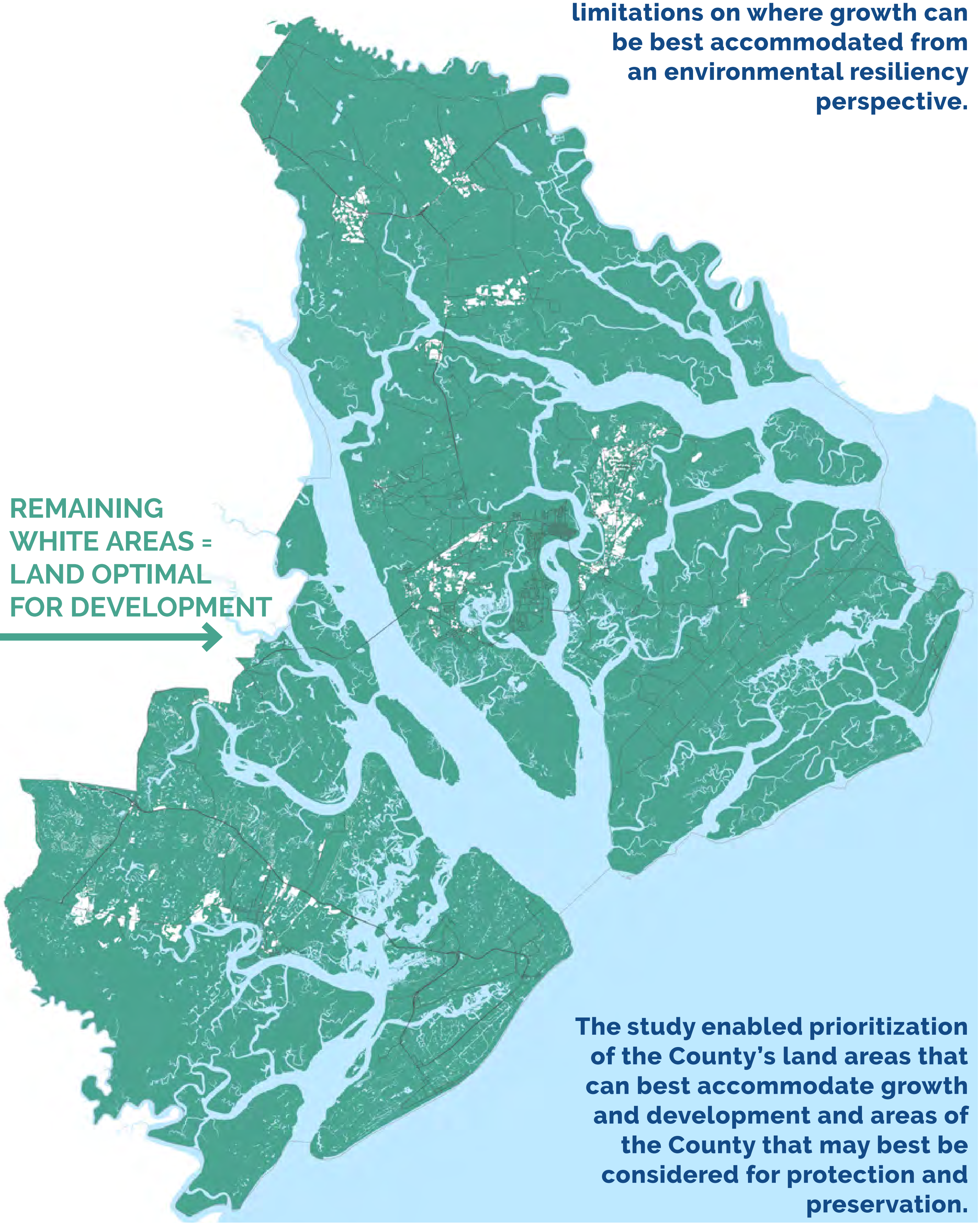
AREAS OUTSIDE THIS STUDY

PARCELS < 0.5 ACRE (MINIMUM LOT SIZE FOR SEPTIC)

PROTECTED LANDS

RURAL + PROTECTED ZONING

A land suitability analysis created in GIS to map potential limitations on where growth can be best accommodated from an environmental resiliency perspective.



REMAINING WHITE AREAS = LAND OPTIMAL FOR DEVELOPMENT

The study enabled prioritization of the County's land areas that can best accommodate growth and development and areas of the County that may best be considered for protection and preservation.

Source: Beaufort County and Design Workshop

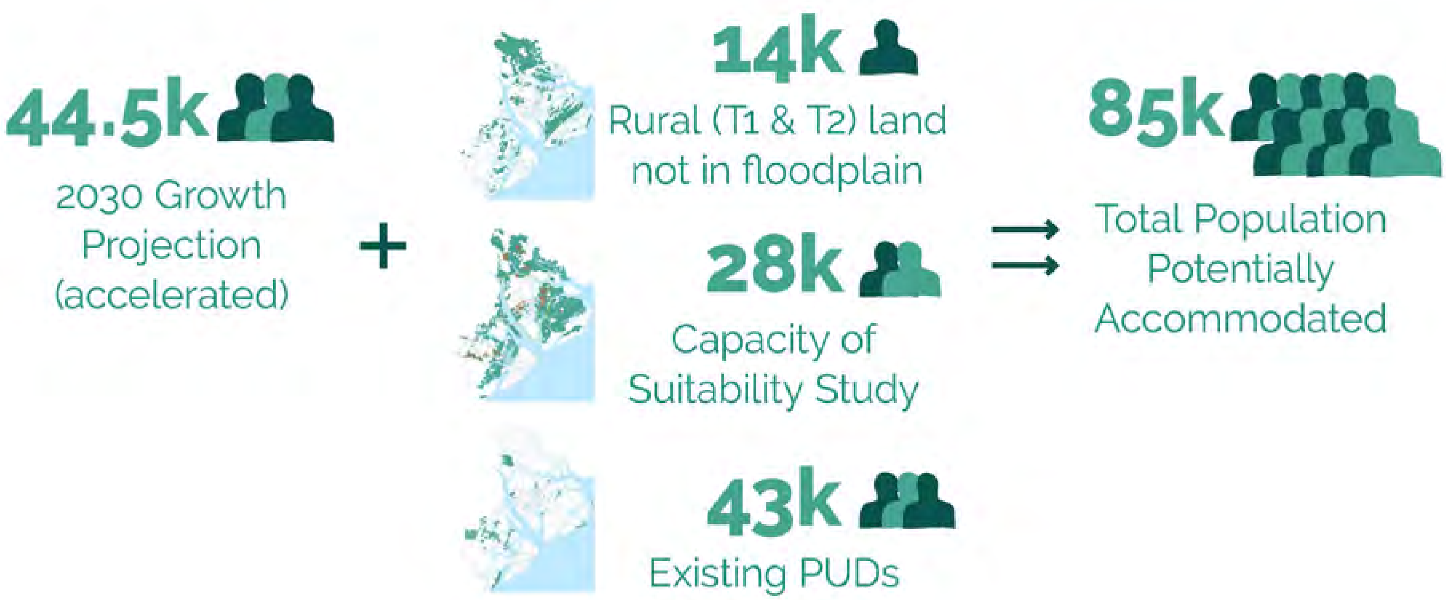
2. LEVERAGE "SUITABLE" LAND AREAS AND EXISTING CAPACITY OF PLANNED UNIT DEVELOPMENTS

As part of understanding how growth can best be accommodated, a "build-out" projection was created based on existing zoning. This was done to determine how much population growth could be absorbed by residentially-zoned land, that was considered the "most suitable' for new development or redevelopment. Part of that analysis included inventorying the available undeveloped capacity of the existing PUDs and subdivisions.

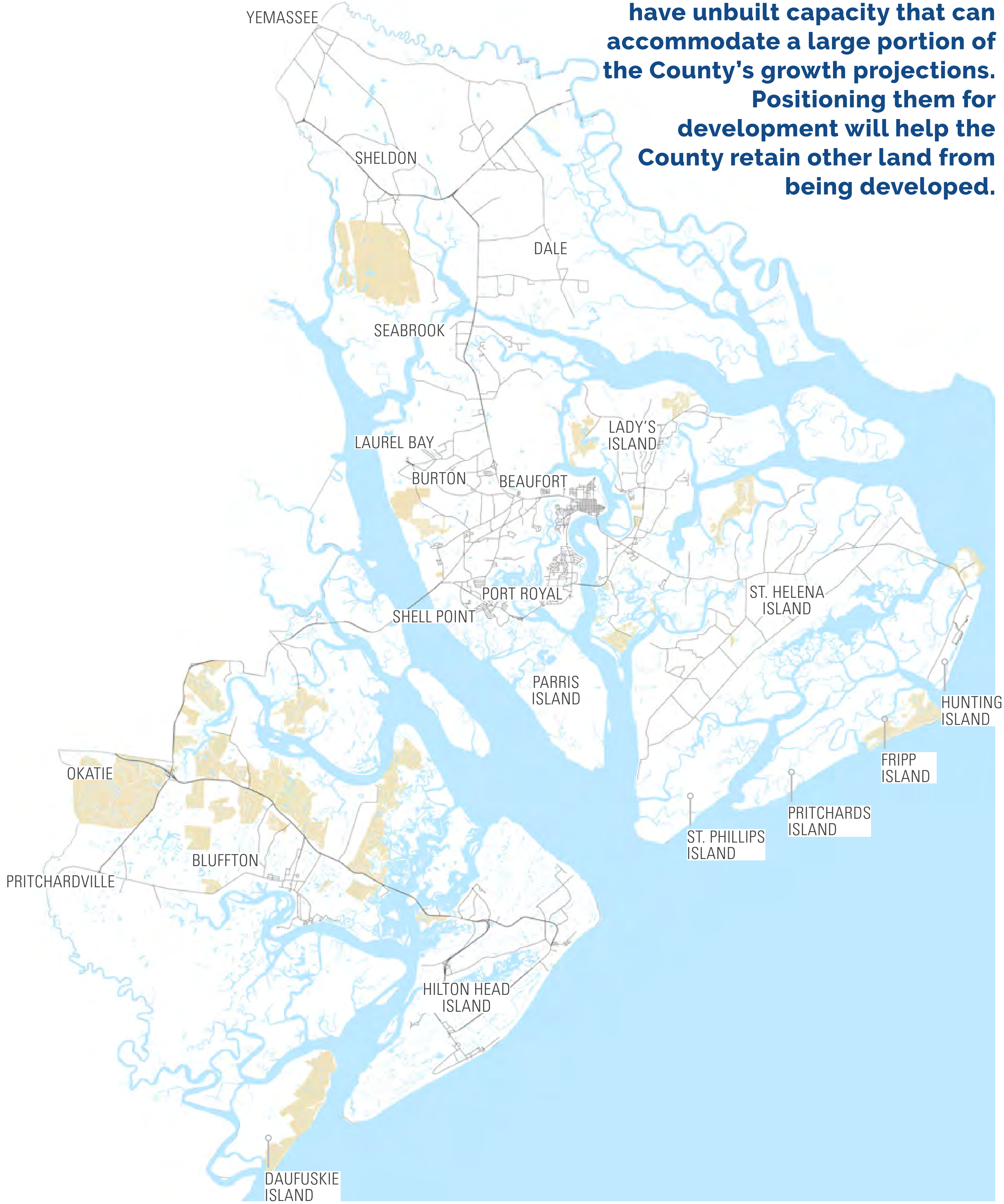
In total, the existing PUDs and subdivisions can accommodate close to 43,000 people based on available lot inventories prepared by the municipalities and the County when using county-wide average people per household. The suitable land that is zoned single family can accommodate an additional 28,000 people.

This amount, along with rural zoned land, completely accommodates the projected growth within the Long Range Transportation Plan's model for the Comprehensive Plan period.

These numbers suggest that the County and its municipalities can achieve balance between growth and environmental protection.



The County's and municipal Planned Unit Developments have unbuilt capacity that can accommodate a large portion of the County's growth projections. Positioning them for development will help the County retain other land from being developed.



Source: Beaufort County and Design Workshop

3. CREATE CONCENTRATED GROWTH CORRIDORS

Some areas of the County such as along US 278, SC 170, and areas adjacent to the municipalities may benefit from enhanced area planning to ensure that they are providing a complimentary mix of uses; affordable housing and are anticipating the potential of increased transit use over time.

As an example, a plan for US 278 can promote the inclusion of "Transit Ready Nodes" that prepare the corridor for the potential for regular fixed-route transit service (and eventual Bus Rapid Transit) services to link Bluffton and Hardeeville to jobs and amenities closer to the coast in Hilton Head. Doing so would alleviate traffic and promote a multimodal sense of place along the corridor.

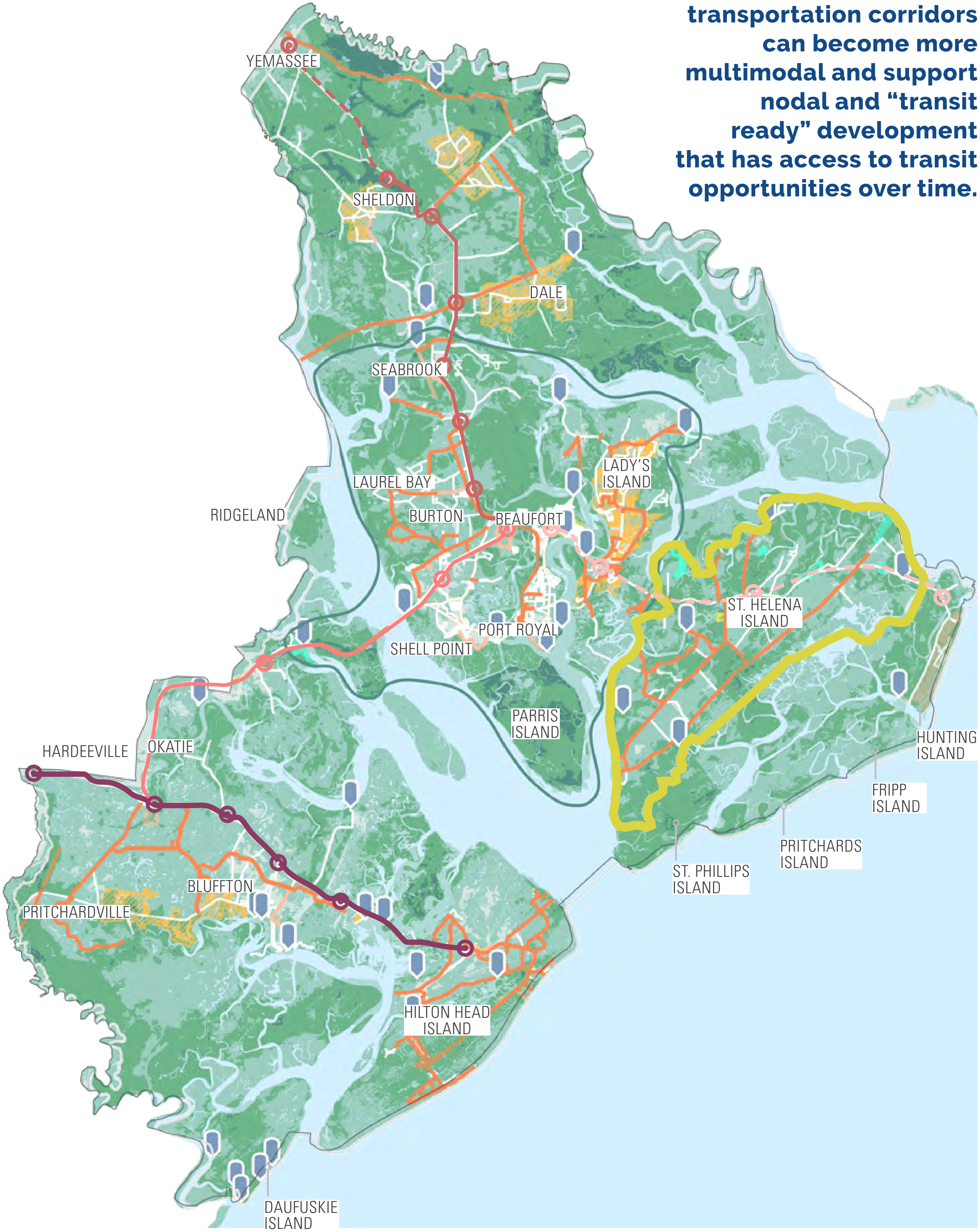
GREENPRINT OVERLAY AND TRANSIT

- Existing North Beaufort County Growth Boundary
- Greenprint Overlay
  Highly Developable (Lowest Priority for Conservation) to Least Developable Highest Priority for Conservation)
- Public Water Access
- Trails
- County Bike-Ped Task Force: Proposed Paths
- Palmetto Breeze Route

POTENTIAL FUTURE TRANSIT

- Potential BRT Corridor
- Potential Bus Commuter Line (Dashed to Rural Nodes)
- Potential Bus Commuter Line (Dashed to Rural Nodes)
- Potential Bus Commuter Line
- Potential Bus Stops with 1500ft walking radius

The County's major transportation corridors can become more multimodal and support nodal and "transit ready" development that has access to transit opportunities over time.



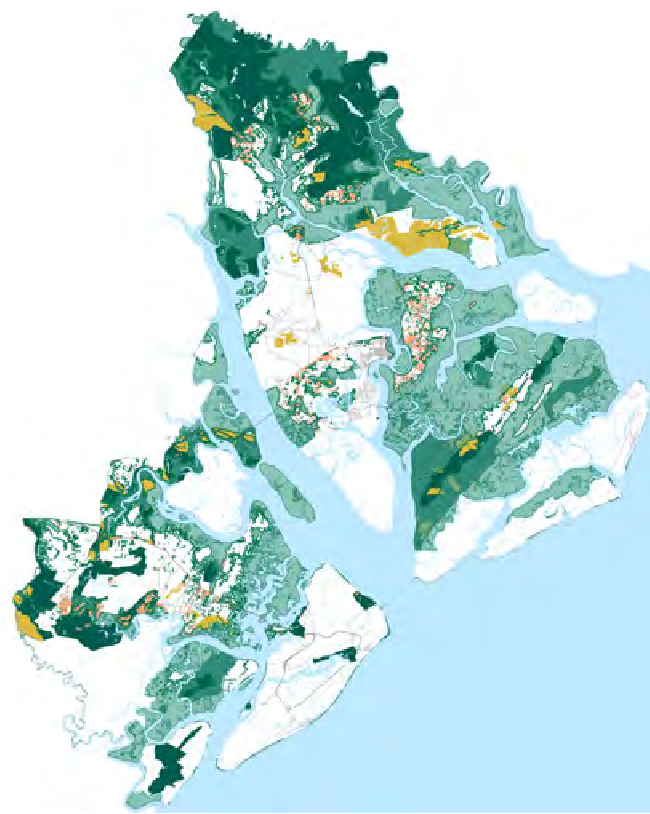
Source: Beaufort County and Design Workshop

4. DESIGNATE AREAS FOR SENDING AND RECEIVING TRANSFER OF DEVELOPMENT RIGHTS

Based on the Greenprint Priority mapping, land areas can be designated as sending areas (where residential density is transferred from elsewhere) and receiving areas (where residential density is added). This tool enables lands that are within the Greenprint priority areas to participate economically while also reducing development within critical environments.

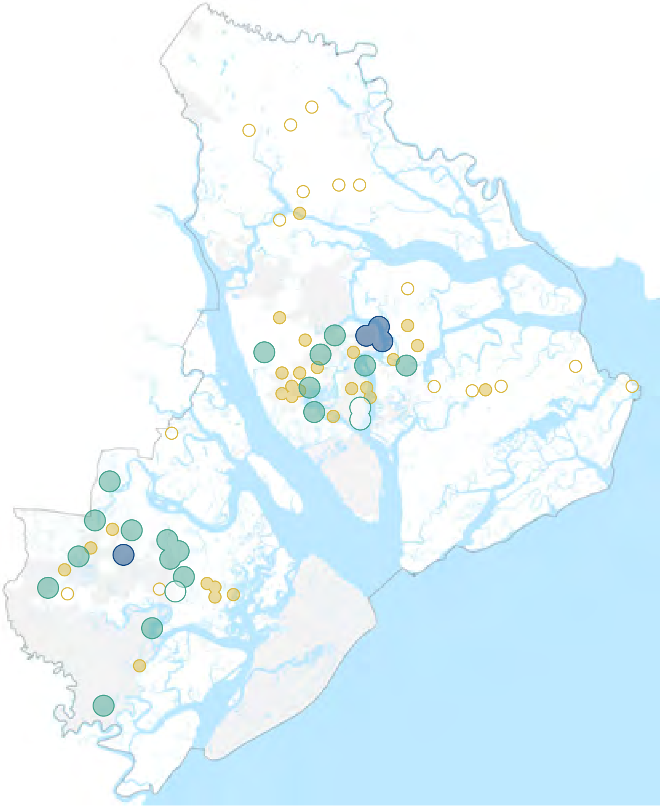
5. ESTABLISH DEVELOPMENT / CONSERVATION POLICIES BASED ON THE GREENPRINT OVERLAY MAP

Based on the Greenprint Overlay Map, zoned land areas can be further restricted to match their development standards with their natural environmental condition. These areas could be subject to new tools, policies, and codes that support a balanced approach to developing within or near sensitive and critical natural resources, protect people from rising flood waters, help preserve water quality, and reduce damages from major storm events.



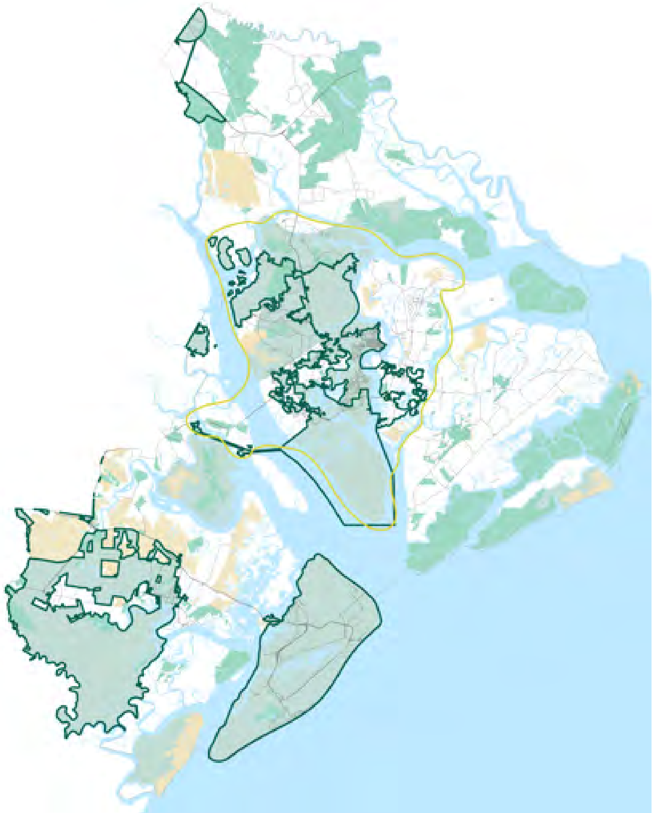
6. DESIGNATE ADDITIONAL PLACE TYPE AREAS OR COMMUNITY PRESERVATION AREAS

Community-based plans that promote mixed-use, walkable places have been successful in Dale, St. Helena Island, Lady's Island, and Seabrook in building on local character and promoting growth in proximity to existing settlements. Additional areas of the County could be considered for this type of community-based planning so that a clearer vision is established for critical areas of the County where detailed planning has not yet occurred.



7. EXPAND GROWTH MANAGEMENT POLICIES

Some fast-growing jurisdictions in other places around the country have placed annual limits on growth and/or restricted where growth can occur, tying growth to an important metric such as maintaining jobs to housing balance based on their desire to retain a particular character and quality of life. This could be considered as a way to protect adjacent counties or municipalities from sprawling development and to time development with the availability of infrastructure and services.



8. INTEGRATE THE GREENPRINT PLAN

The Greenprint Plan is the open space plan for Beaufort County. It promotes environmental health and cultural landscape preservation by protecting Beaufort County's open space for the betterment of its ecology, economy and quality of life.

The 2020 Greenprint Plan was developed in tandem with this Comprehensive Plan, presenting a unique opportunity to coordinate the plans' processes and recommendations for accommodating environmental hazards associated with sea levels and increased flooding, guiding development to places where it will work best with the natural environment, protecting environmentally and culturally precious areas of the County, and reinforcing the community vision for the Comprehensive Plan to establish balance and harmony between the built and natural environments.

The Greenprint Plan informs the Comprehensive Plan by:

- Clearly showing how future growth and the natural environment can coexist.
- Becoming a tool for the County to evaluate development proposals based on open space criteria.
- Enabling landowners, developers, and builders to be better informed about how various areas of the county are prioritized for growth and preservation.
- Influencing how and where transportation, housing, future land uses, economic development, and public facilities are located.
- Becoming the starting point for more criteria, prioritization, policies, and programs that encourage land preservation and bolster economic benefits of owning and developing land.

A Composite Priority Land Map was generated by weighting the environmental criteria of the Greenprint Composite Priority Land model.

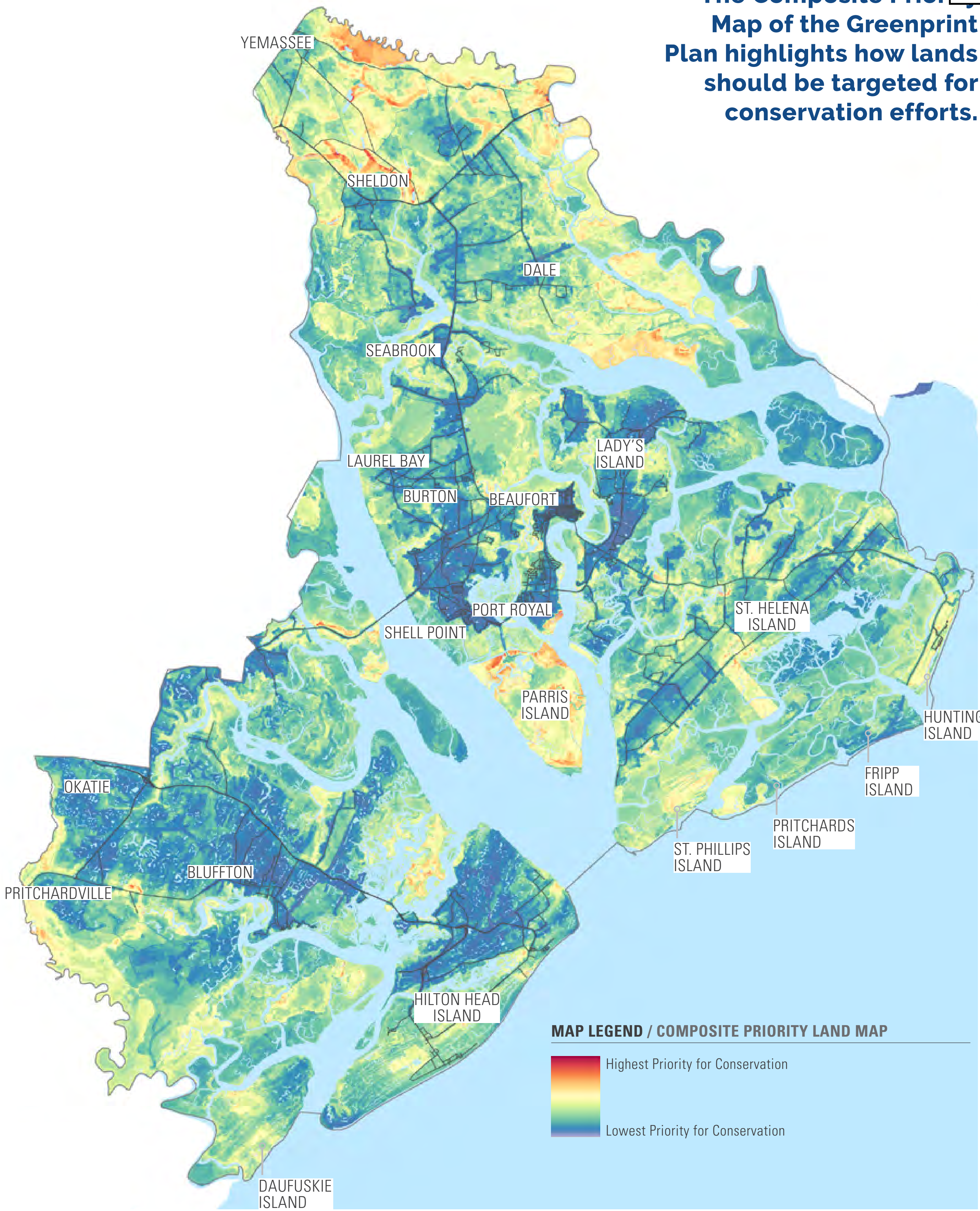
The Greenprint Overlay Map reflects the open space values of Beaufort County residents and can be a powerful tool to guide Future Land Use, growth management planning, and the development of strategies, policies, plans, and overlays that define appropriate development types, densities, and standards within and adjacent to the priority areas.

By refining conservation and development approaches based on the Greenprint Overlay Map, Beaufort County can ensure its future growth is strategic, meeting the demands of population growth while protecting the natural environment that is key to the County's identity and sense of place.

Refer to Section 4.1 of the Greenprint Plan for more information about the prioritization model and mapping criteria.

Item 11.

The Composite Priority Map of the Greenprint Plan highlights how lands should be targeted for conservation efforts.



CROSS WALK TO COMPREHENSIVE PLAN: GREENPRINT OVERLAY MAP

The Greenprint Overlay is derived from the Greenprint Plan's prioritization mapping model. Because the model was informed by GIS data and community input, the Greenprint Overlay Map reflects the open space values of Beaufort County residents and can be a powerful tool to guide Future Land Use, growth management planning and the development of strategies, policies, plans and overlays that define appropriate development types, densities and standards within and adjacent to the priority areas.

The Greenprint Overlay Map is a consolidation of the environmental priorities, divided into four zones based on the Greenprint Composite Priority Land Map. The four zones represent different levels of environmental priority along with different levels of need for protection and conservation.

The darkest green zones representing areas most in need of protection and the lightest green zones represent areas with the least priority for protection and the most suitable for development.

This four-tiered overlay informs how new development should be positioned, where conservation-oriented development standards should be applied, and where focused conservation efforts should be prioritized.

Future land use planning should utilize the four tiered overlay when determining where and how to develop. It should also inform the creation of specific codes and overlays that will guide development as described in the table below.

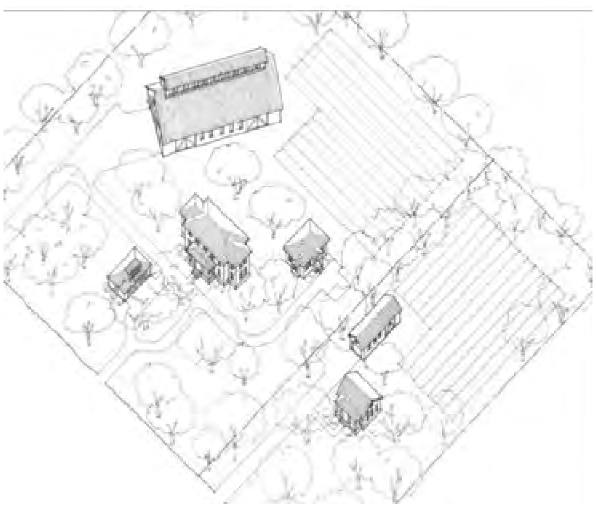
Highly Developable	Lands that are the lowest priority for preservation, generally upland, and away from flooding associated issues.	Lands within these areas can and should support high levels of development intensity to support growth, employment and affordable housing goals.
Developable with Restrictions 1	Lands located close to or within lower level priority preservation environments	Lands within these areas can but with additional Low Impact Development (LID) standards and buffers to limit the impact to the critical environments they are adjacent to.
Developable with Restrictions 2	Lands located close to or within higher priority preservation environments and closer to highest priority preservation environments	Lands within these areas should only support limited development at low levels of intensity, conservation based development and the highest levels of Low Impact Design (LID) and sustainable development practices
Least Developable	Lands within highest priority preservation environments	Lands within these areas should only be preserved and not be developed

Source: Beaufort County, Design Workshop

COUNTY ZONING IS BASED ON A RURAL-TO-URBAN TRANSECT

T1 Natural

T3 Edge &
T3 Hamlet Neighborhood

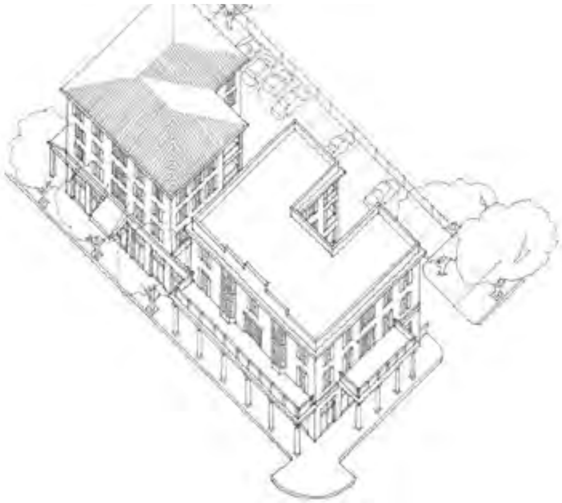


T2 Rural, Rural Neighborhood, Open & Rural Center Zoning

T3 Neighborhood Zoning

RURAL

Existing Transect Based Zoning can be further refined to better harmonize with the four-tiered Greenprint Overlay system to ensure balance and harmony with the natural environment.



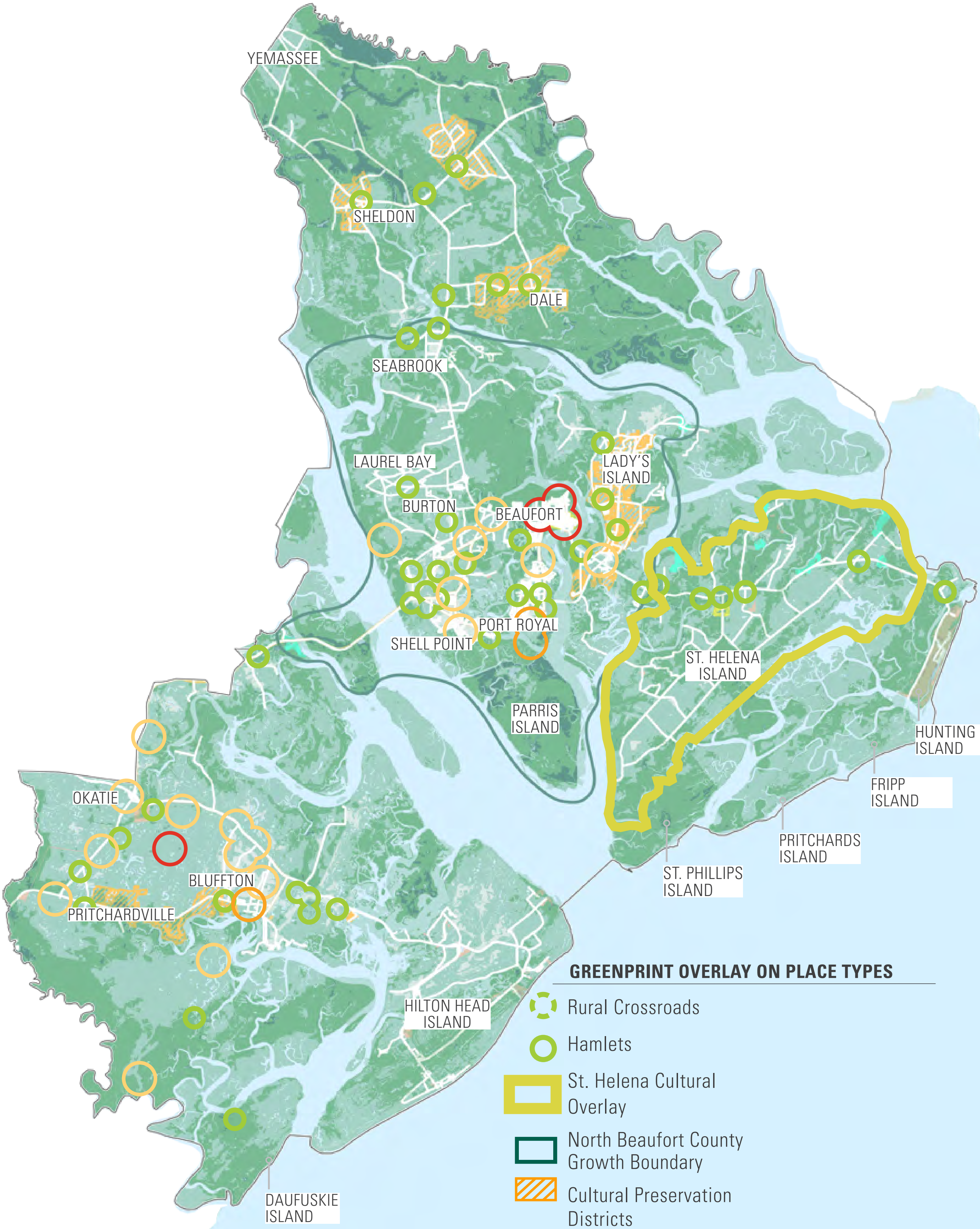
T4 Hamlet Center

T5 Urban Center (in municipalities only)

County and Municipal Zoning Codes include the use of Transect Based Zoning, Place Types, and a Uniform Development Ordinance to define the nature and character of land use and development. These tools help retain the County's sense of place and character and ensure best practices in community and neighborhood development.

T4 Neighborhood Center, Village Center & Mixed Use Zoning

URBAN


YEMASSEE
SHELDON
DALE
SEABROOK
LAUREL BAY
LADY'S ISLAND
BURTON
BEAUFORT
PORT ROYAL
SHELL POINT
ST. HELENA ISLAND
PARRIS ISLAND
HUNTING ISLAND
FRIPP ISLAND
PRITCHARDS ISLAND
ST. PHILLIPS ISLAND
OKATIE
BLUFFTON
PRITCHARDVILLE
HILTON HEAD ISLAND
DAUFUSKIE ISLAND
GREENPRINT OVERLAY ON PLACE TYPES
Rural Crossroads
Hamlets
St. Helena Cultural Overlay
North Beaufort County Growth Boundary
Cultural Preservation Districts

STRATEGIES AND ACTIONS

R BE 1. CHANNEL NEW GROWTH INTO MUNICIPALITIES, EXISTING DEVELOPMENTS, AND PUDS THAT HAVE CAPACITY TO GROW, IN ORDER LIMIT GREENFIELD DEVELOPMENT AND PRESERVE ENVIRONMENTALLY SENSITIVE LANDS.

- Promote Infill Development and Redevelopment within the municipalities and in immediately adjoining areas in order to limit greenfield development. Make PUDs and subdivisions that are only partially developed a priority.
- Continue active engagement with the municipalities and neighboring counties on regional cooperation and planning. Use the Southern Lowcountry Regional Board (SOLOCO) and the Northern Beaufort County Regional Plan Implementation Committee to promote this cooperation.
- Revise the growth boundaries on Lady's Island to reflect the recommendations of the Lady's Island Plan 2018. Work with the City of Beaufort and Town of Port Royal to revise the growth boundaries on Port Royal Island to reflect the emphasis on infill and redevelopment.
- Work with all local governments in and adjacent to the County, to establish growth boundaries.
- Maintain and enhance rural land use policies for areas outside of growth boundaries.

BE1. ACTIONS

BE 1.1. Regularly inventory platted vacant lots in existing PUDs and subdivisions, and create an inventory of lots ideal for infill development.

BE 1.2. Formalize a regional planning program between Beaufort County, Jasper County, and the City of Hardeeville that recognizes the mutual benefit of coordinated planning along jurisdictional boundaries.

BE 1.3. Develop a SC 170 Area Plan in conjunction with the City of Hardeeville and Jasper County that defines a growth framework for the corridor and addresses issues of joint concern such as transportation and environmental protection.

BE 1.4. Work with the Town of Yemassee to develop a consistent growth management strategy for the area of the County north of US 17. The strategy should include a mutually agreed upon growth boundary.

R BE 2. ALLOW GROWTH TO MIRROR RECOMMENDATIONS OF GREENPRINT PLAN PRIORITY MAPPING (NO DEVELOPMENT, LOW IMPACT DEVELOPMENT, PRESERVING MOST CRITICAL PROPERTIES, ETC.).

- Use the Greenprint overlay that designates areas of environmental importance, such as the floodplain, to craft development standards that protect the natural environment and use to review all development and land use proposals.
- Use regulatory tools such as rural zoning, open space set-aside requirements, buffers and natural resource protection standards, as the primary tools to protect areas of environmental importance. Use land purchase and the purchase of conservation easements for the most critical properties.

P BE 3. CREATE POLICIES THAT ARE COMPATIBLE WITH THE LOCATION, CULTURE, AND ACCESSIBILITY OF AREAS TARGETED FOR GROWTH.

- Use Place Type Overlay to identify areas of the County where walkable urbanism is appropriate. Scale Place Types appropriately based on their location within the County, from most urban to most rural. The urban to rural hierarchy shall be city, town, village, hamlet, and rural crossroads.
- Create community or small area plans for areas of the County that do not have one, such as St. Helena Island, Sheldon, and Dale, using a community-based process to promote and ensure access to basic services, parks, economic opportunities and affordable housing.
- Prepare a mixed-use development plan, using a community-based process, to support walkable and "bus transit-ready" development patterns along major roads such as US 278, Bluffton Parkway, and the Okatie Highway to reduce traffic over time.

BE3 ACTIONS

BE 3.1. Reevaluate the effectiveness of existing place-making implementation tools such as the Place Type Overlay District in the Community Development Code, and make revisions as necessary.

BE 3.2. Initiate a prototype community- based Place Type implementation plan that involves property owners, business owners, and other stakeholders to serve as a vision for other areas of the county where walkable urbanism is appropriate.

R BE 4. ENSURE THAT COUNTY LAND USE REGULATIONS AND POLICIES CREATE RESILIENT, EQUITABLE COMMUNITIES WITH A SENSE OF PLACE REFLECTIVE OF THE COUNTY'S UNIQUE CHARACTER.

- When adopting new land use policies or regulations, consider the impact, including unintended consequences, on low-income and minority communities. Periodically review existing policies.
- Continue the ban on new PUDs.

Item 11.

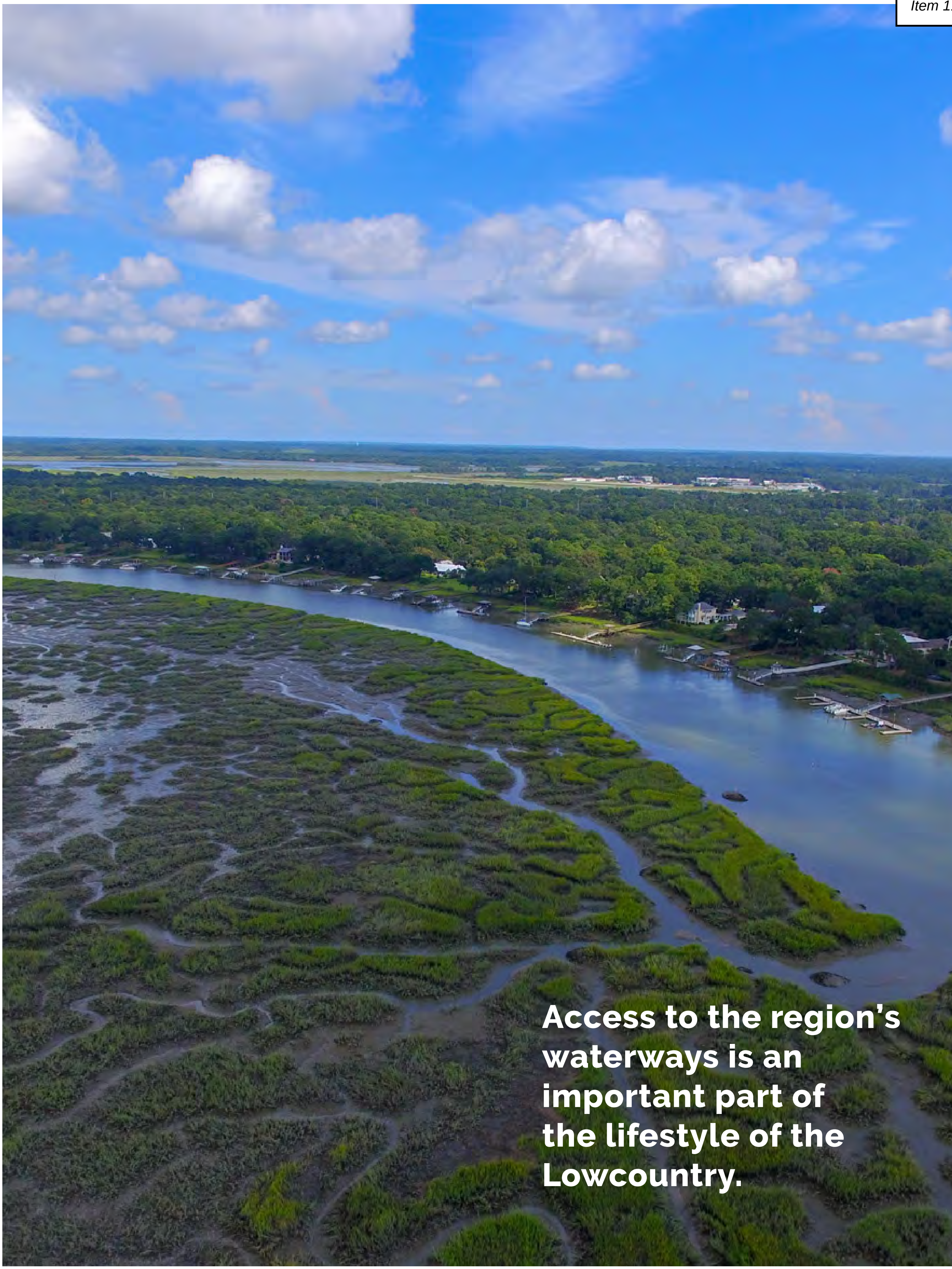
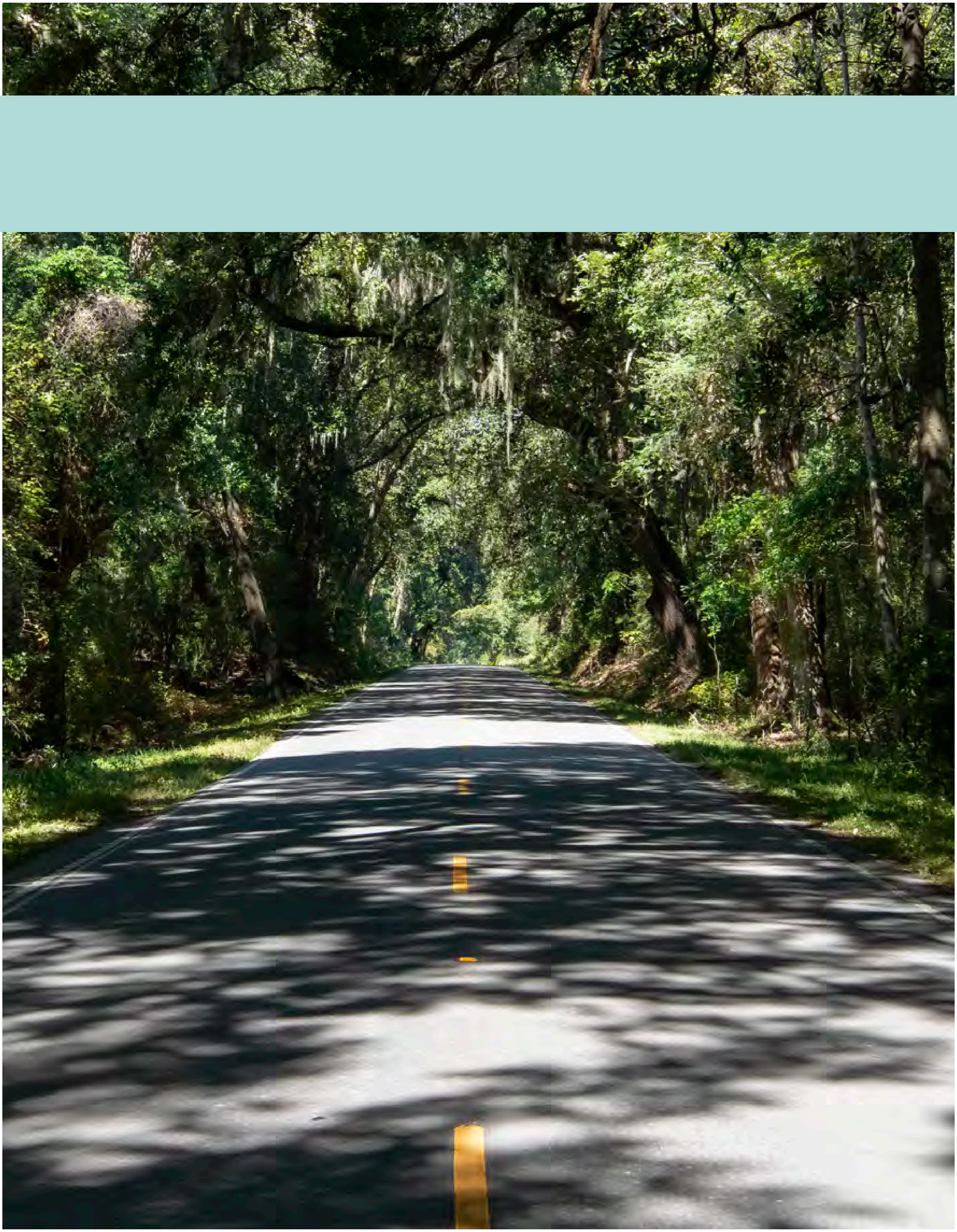


Photo source: Design Works



Scenic roadway with tree canopy in Beaufort County

Photo source: Design

FOCUSED PLANNING AREAS

A county comprising diverse, connected neighborhoods with equitable access to services and amenities where residents have a strong voice in their future.

PRINCIPLES

1 We value our rural heritage and our unique and complex natural environment as a source of life, recreation, economy, culture, and sense of place.

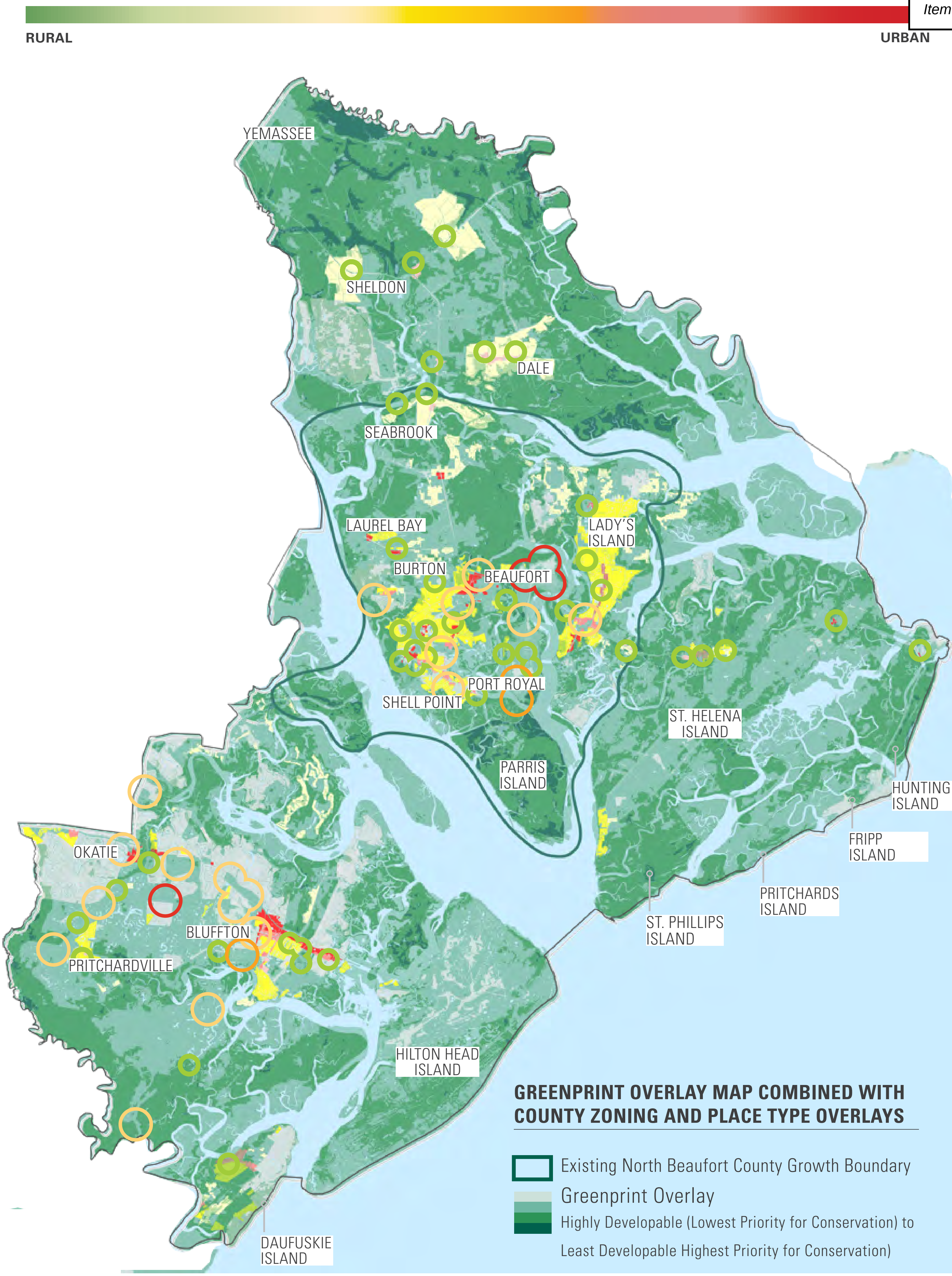
2 We believe in allowing local communities to determine their vision and to define their growth.

3 We believe development should be done in balance with preserving our natural systems.

4 We understand our economy and lifestyle depend upon the diversity of the places and cultures that make up our County.

5 We believe that all areas of the County deserve access to infrastructure, community services, mobility, and economic prosperity, regardless of where they are located.

i Refer to the County Atlas, Greenprint, Action Playbook, and other supporting documents with more information.


RURAL
URBAN
YEMASSEE
SHELDON
DALE
SEABROOK
LAUREL BAY
LADY'S ISLAND
BURTON
BEAUFORT
PORT ROYAL
SHELL POINT
ST. HELENA ISLAND
PARRIS ISLAND
HUNTING ISLAND
FRIPP ISLAND
PRITCHARDS ISLAND
ST. PHILLIPS ISLAND
OKATIE
BLUFFTON
PRITCHARDVILLE
HILTON HEAD ISLAND
DAUFUSKIE ISLAND
GREENPRINT OVERLAY MAP COMBINED WITH COUNTY ZONING AND PLACE TYPE OVERLAYS
Existing North Beaufort County Growth Boundary
Greenprint Overlay
Highly Developable (Lowest Priority for Conservation) to
Least Developable Highest Priority for Conservation)

CONTEXT

Beaufort County has many unique places with different characters, history, cultures, and landscapes. In recognition of this, the County created Place Type Overlay (PTO) Zone Standards within its Community Development Code.

The PTO Zone is intended to create and reinforce walkable, urban environments with a mix of housing, civic, retail, and service choices. The PTO is made up of three place types:

- Rural Crossroads Place Type. Rural crossroads are typically located at the intersection of two or more rural roads. They provide a small amount of pedestrian-oriented, locally-serving retail in a rural context, and transition quickly into agricultural uses or the natural environment as one moves away from the intersection. Historic examples of rural crossroads include Pritchardville and the Corners Community on St. Helena Island.
- Hamlet Place Type. Hamlets are typically larger and more intense than rural crossroads and are often located at the edge of the rural and urban condition. A hamlet often has a small, pedestrian-oriented main street with surrounding and supporting residential fabric that is scaled to the size of a pedestrian shed (the distance a person would walk in five minutes, generally a quarter-mile). The main street and surrounding residential fabric transitions quickly into agricultural uses or the natural environment. A historic example of a hamlet includes the original settlement of Bluffton along Calhoun Street. The community of Habersham began as a hamlet.
- Village Place Type. Villages are made up of clusters of residential neighborhoods of sufficient intensity to support a central, mixed-use environment. The mixed-use environment can be located at the intersection of multiple neighborhoods or along a corridor between neighborhoods. Habersham is a good example of a hamlet that is evolving into a village.

Defining Beaufort County's future growth with the use of Place Types, the Greenprint Overlay Map, and transect zoning, will help achieve the community's vision of achieving balance between the built and natural environment, as well as:

- Improve the built environment and human habitat.
- Promote development patterns that support safe, effective, and multi-modal transportation options, including auto, pedestrian, bicycle, and transit. This will minimize vehicle traffic by providing for a mix of land uses, walkability, and compact community form.
- Provide neighborhoods with a variety of housing types to serve a diverse population.
- Remove barriers and provide incentives for walkable urban projects.
- Promote the greater health benefits of a pedestrian-oriented environment.
- Reinforce the character and quality of local communities, including crossroads, neighborhoods, hamlets, and villages.
- Reduce sprawling, auto-dependent development.
- Protect and enhance real property values.
- Reinforce the unique identity of Beaufort County that builds upon the local context, climate, and history.

The Focal Area Plans that follow recognize the value of Place Types and promote their use across the County.

FUTURE LAND USE: MULTIMODAL PLACE TYPES

The use of bus transit is growing in Beaufort County and presents an important opportunity for the future. By linking municipalities, Place Types, and areas of concentrated growth, employment, or attraction, transit can help alleviate traffic along the County's major roads, enable workers to equitably access job opportunities, and provide tourists transportation choices while visiting the County. Palmetto Breeze has been actively integrating new ideas, such as the Hilton Head Trolley, to best fit transit to users. Place Types might also be developed in areas where water transit is or may become available.

GREENPRINT OVERLAY MAP AND TRANSIT

- Existing North Beaufort County Growth Boundary
- Greenprint Overlay
  Highly Developable (Lowest Priority for Conservation) to Least Developable Highest Priority for Conservation)
- Public Water Access
- Trails
- County Bike-Ped Task Force: Proposed Paths
- Palmetto Breeze Route

POTENTIAL FUTURE TRANSIT

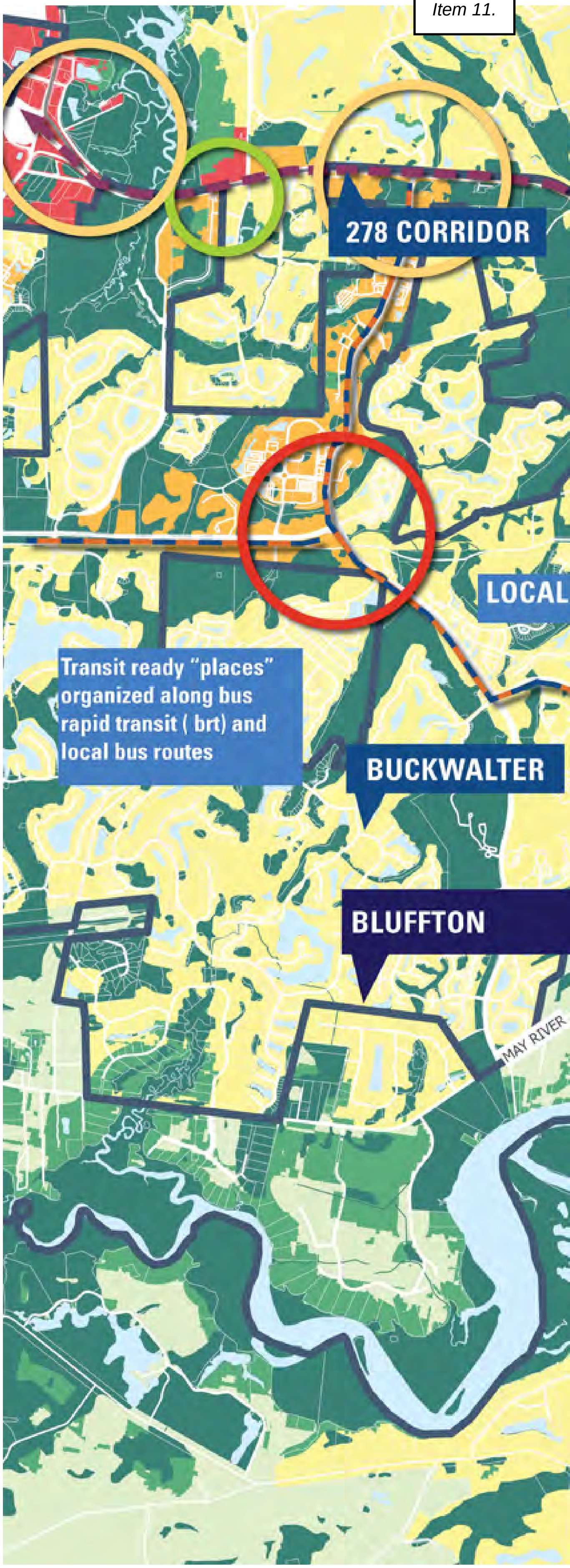
- Potential BRT Corridor
- Potential Bus Commuter Line (Dashed to Rural Nodes)
- Potential Bus Commuter Line (Dashed to Rural Nodes)
- Potential Bus Commuter Line
- Potential Bus Stops with 1500ft walking radius

Over time, as bus services increase, attitudes shift, and the County becomes more multimodal, bus routes can better connect destinations and places within the County, enabling citizens to be able to live where they choose and ride transit to their jobs.

US 278 CORRIDOR

As the numbers of residents and commuters increase in southern Beaufort County, traffic pressure continues to grow along the US 278 Corridor. Compounded with heavy tourist traffic and the growth of Hardeeville and Jasper County, congestion will continue to build and affect quality of life and the tourism industry in the area.

Establishing Fixed-Route Transit and planning for transit-ready nodes that support mixed-use development are possible solutions to this challenge. By guiding growth to transit-ready nodes, the County and its municipalities can attain affordable housing goals while promoting internal trip capture and developing a higher quality gateway through southern Beaufort County.



BASE MAP LEGEND

Greenprint Overlay

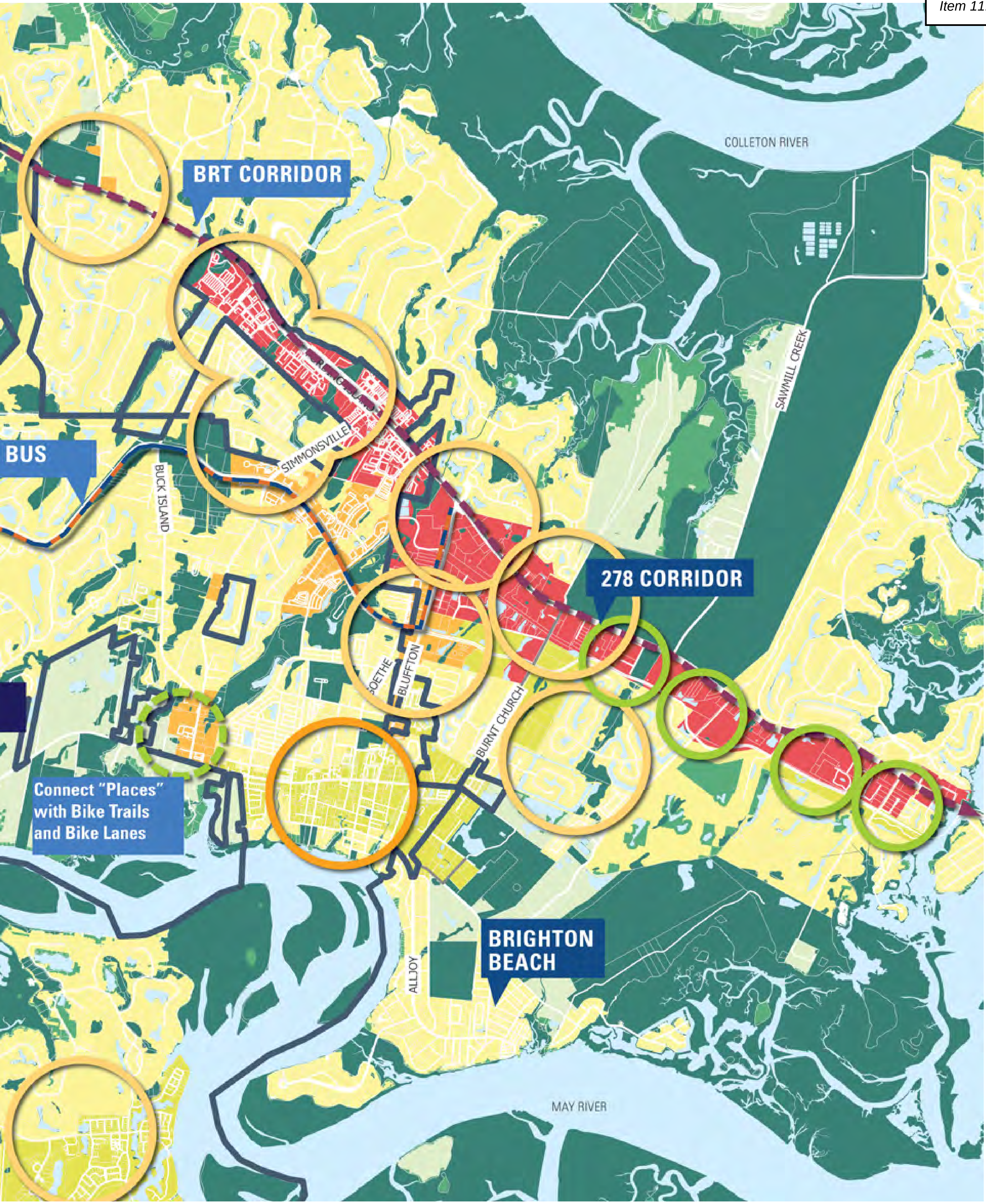
- Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes, Wetlands and Preserved Lands)
- Historic Districts
- Fishing Villages
- Palmetto Breeze Route

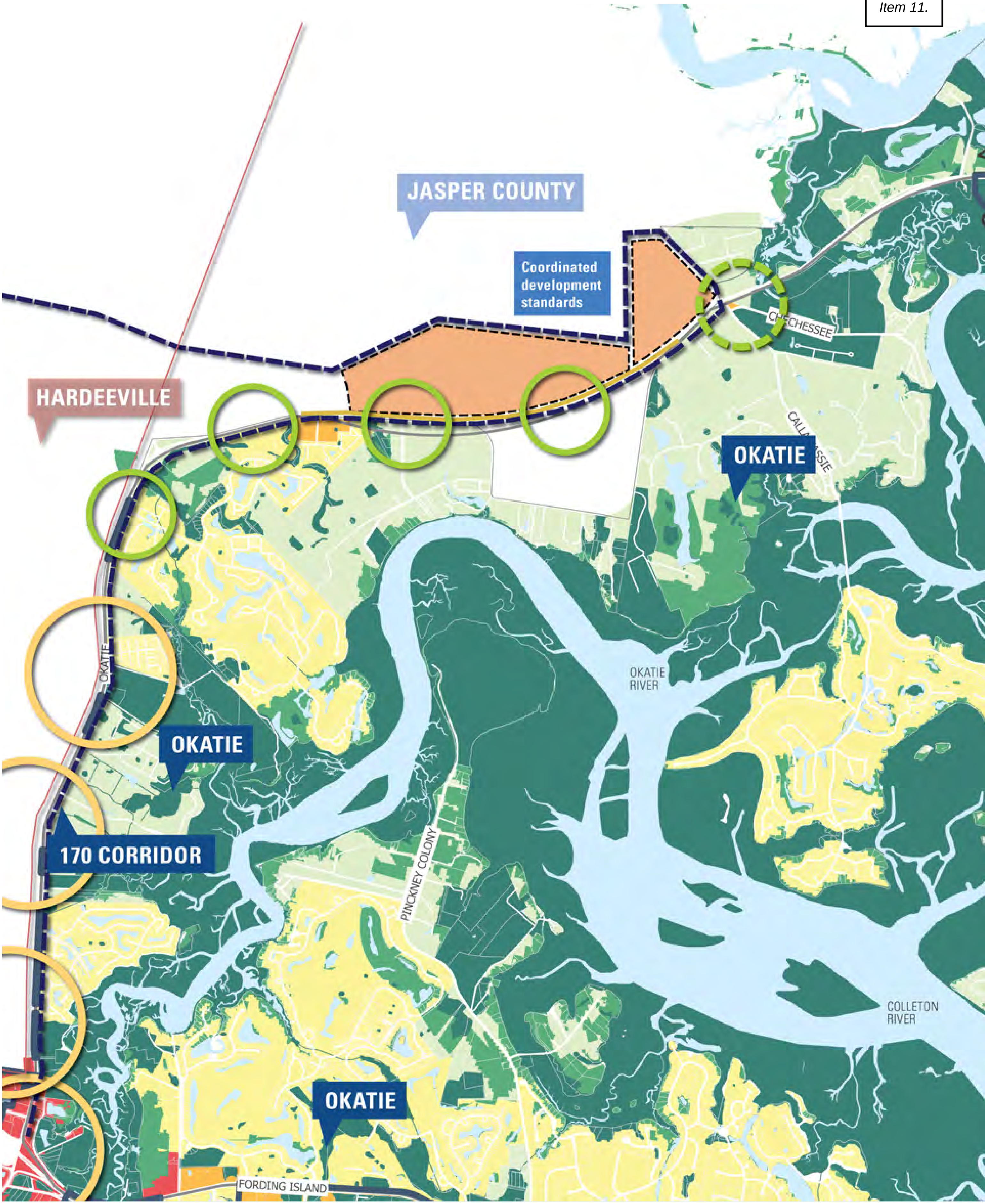
Place Type Overlays

- Rural Crossroads
- Hamlets
- Villages
- Towns
- Cities
- ProposedTrolley Route
- Proposed Bus Route

Future Land Use

- Rural
- Rural Community
- Neighborhood/Mixed- Use
- Urban/Mixed-Use
- Community Commercial
- Regional Commercial
- Core Commercial
- Light Industrial
- Military


COLLETON RIVER
BRT CORRIDOR
SAWMILL CREEK
BUS
SIMMONSVILLE
BUCK ISLAND
278 CORRIDOR
GOETHE
BLUFFTON
BURNT CHURCH
Connect "Places" with Bike Trails and Bike Lanes
BRIGHTON BEACH
ALLJOY
MAY RIVER


JASPER COUNTY
Coordinated development standards
HARDEEVILLE
OKATIE
OKATIE
170 CORRIDOR
OKATIE
OKATIE RIVER
COLLETON RIVER
PINCKNEY COLONY
FORDING ISLAND
OKATIE

JOINT 170 CORRIDOR PLANNING STANDARDS:

- Continuous access management standards.
- Multipurpose trail both sides.
- 50’ tree and landscape protection buffer both sides.
- 35 mph posted speed limit.
- Landscaped center median.
- Signalized intersections and crosswalks at major intersections.
- Beaufort County’s “Place Type” standards applied at regular intervals to create nodal development patterns.
- Coordinated development standards.
- Coordinated open space linkages.
- Coordinated streetscape standards.
- Coordinated billboard signage standards.

SC 170 CORRIDOR

The SC 170 Corridor is an important part of the image and character of the County. Concerns about signage, sprawling development, traffic management, and the loss of rural lands is of concern to the residents that use this road for their primary access.

Cooperation between Beaufort County, Hardeeville, and Jasper County are key components of a shared community vision for this corridor. The corridor should have jointly planned policies and standards related to design, land use, placemaking, landscape, environmental buffers, and signage. It is also important to establish agreements on the limits of urbanization and growth in Hardeeville and Jasper County.

Establishing Place Types that coincide with major intersections, consistent buffers of native vegetation, joint review of proposed plans along the corridor, and agreement on access management standards will lead to a corridor with walkable mixed-use nodes at intervals, natural buffers between the road and development, compatible land uses across jurisdictions, and safer, better managed traffic.

BASE MAP LEGEND

Greenprint Overlay

- Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes, Wetlands and Preserved Lands)
- Historic Districts
- Fishing Villages
- Palmetto Breeze Route

Place Type Overlays

- Rural Crossroads
- Hamlets
- Villages
- Towns
- Cities
- ProposedTrolley Route
- Proposed Bus Route
- Proposed Urban Growth Boundary

Future Land Use

- Rural
- Rural Community
- Neighborhood/Mixed- Use
- Urban/Mixed-Use
- Community Commercial
- Regional Commercial
- Core Commercial
- Light Industrial
- Military

BEAUFORT & PORT ROYAL

The adoption of the 2020 Beaufort County Comprehensive Plan in concert with the Port Royal Comprehensive Plan provided an opportunity to establish shared planning principles.

Within the Beaufort & Port Royal Focal Area, emphasis should be placed on redesigning roads to be safer, multimodal, and human-scaled. Additionally, plans for a Palmetto Breeze trolley service between Port Royal and Downtown Beaufort will be an asset to mobility and sense of place, and should be prioritized.

Growth management west of Port Royal should be informed by Place Types influenced by the Greenprint Overlay Map, existing transportation network, and potential of a trolley service. A new Town Place Type along Parris Island Gateway will add a walkable destination and place to live, establishing a sense of place and identity for this portion of the County.

Joint planning and cooperation, an annexation strategy, and shared development and infrastructure service standards are key to the execution of the Port Royal and Beaufort County plans.

BASE MAP LEGEND

Greenprint Overlay

Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes, Wetlands and Preserved Lands)

Historic Districts

Fishing Villages

Palmetto Breeze Route

Place Type Overlays

Rural Crossroads

Hamlets

Villages

Towns

Cities

ProposedTrolley Route

Proposed Bus Route

Future Land Use

Rural

Rural Community

Neighborhood/Mixed- Use

Urban/Mixed-Use

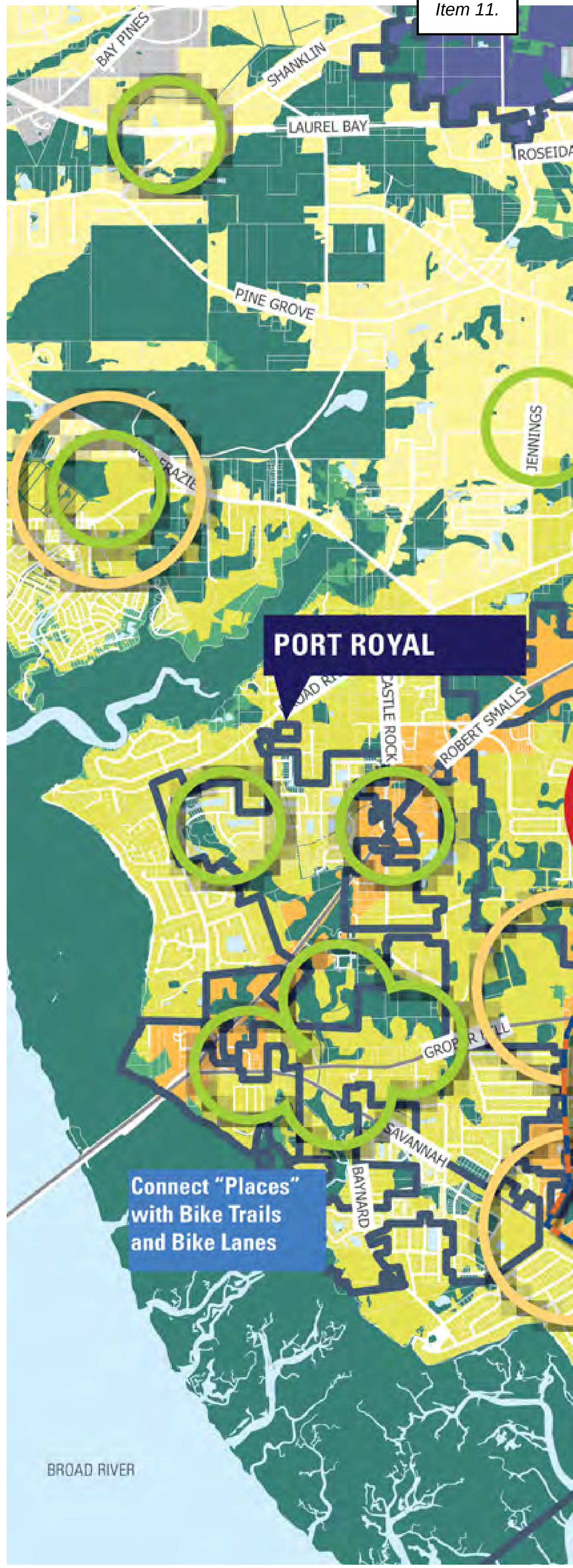
Community Commercial

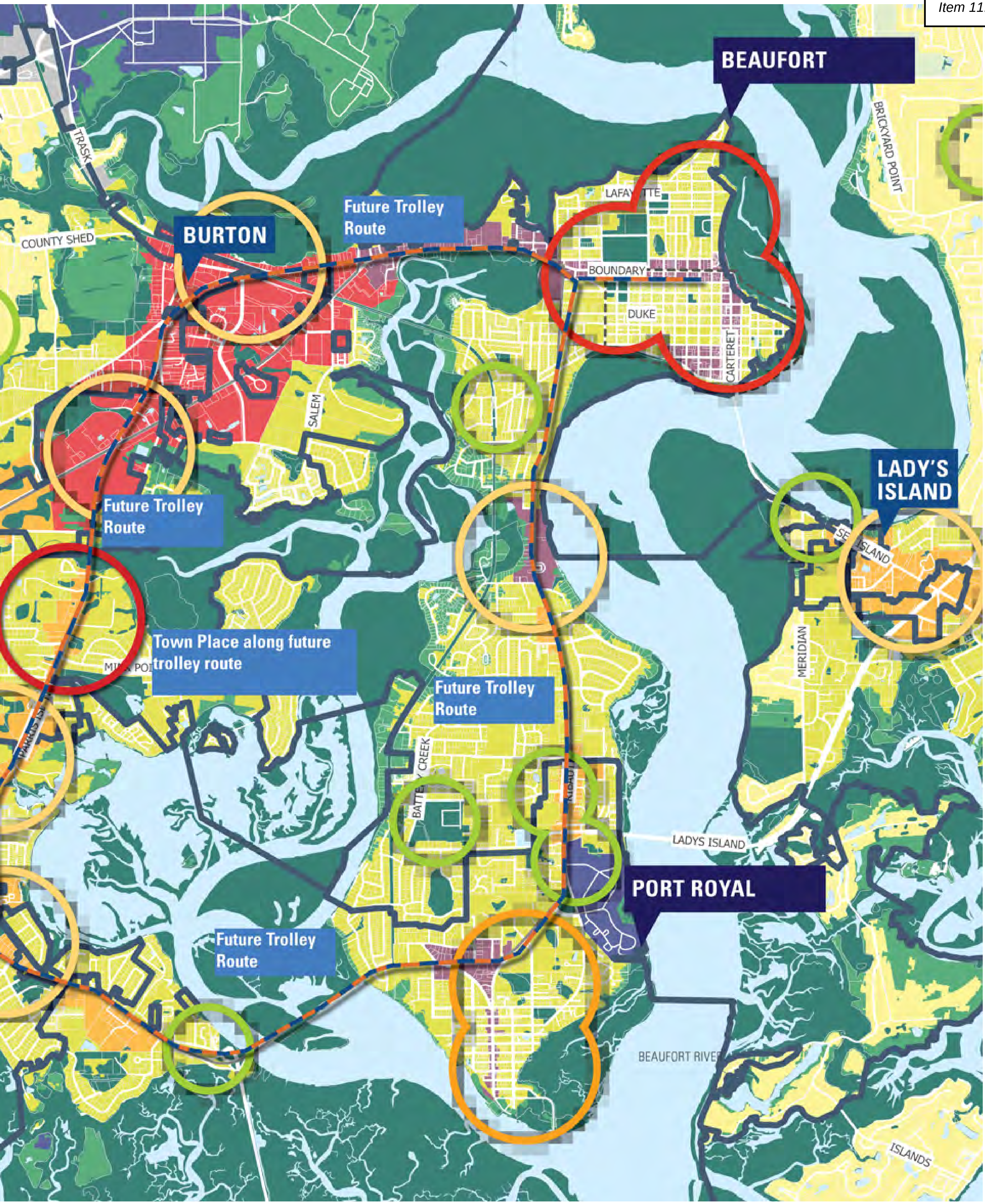
Regional Commercial

Core Commercial

Light Industrial

Military




BEAUFORT
BURTON
LADY'S ISLAND
PORT ROYAL
Future Trolley Route
Future Trolley Route
Town Place along future trolley route
Future Trolley Route
Future Trolley Route
TRASK
COUNTY SHED
LAFAYETTE
BOUNDARY
DUKE
CARTERET
SALEM
BRICKYARD POINT
MERIDIAN
LADYS ISLAND
BEAUFORT RIVER
ISLANDS


BEAUFORT
LADY'S ISLAND
PORT ROYAL
TRASK
COUNTY SHED
BROAD RIVER
ROBERT SMALLS
PARRIS ISLAND
BATTERY CREEK
RIBAUT
BRICKYARD POINT
MIDDLE
HOLLY HALL
LADYS ISLAND
BEAUFORT RIVER
ISLANDS

LADY'S ISLAND

The"Lady's Island Plan 2018" was adopted in April 2019. The plan was a collaborative effort between Beaufort County, the City of Beaufort, the Town of Port Royal, multiple community organizations, and local residents. The plan was prepared in response to the dramatic growth Lady's Island has experienced over the last two decades, resulting in traffic congestion, threats to natural resources, and a loss of local character. The plan, adopted by both the County and the City of Beaufort, is especially important given that a good deal of land on Lady's Island, particularly within the Island's main commercial corridor, is in the City of Beaufort's jurisdiction

Success is dependent on commitment and coordinated implementation between the County and the City of Beaufort, particularly for a master planning effort for the Village Center area to leverage the public improvements proposed for Sea Island Parkway.

The Lady's Island Plan sets out four common goals that are developed into several planning themes:

- Manage growth
- Create a Walkable Lady's Island Center
- Strengthen Neighborhoods
- Manage Traffic Congestion
- Improve the Bicycle and Pedestrian System
- Require Adequate Public Infrastructure
- Improve Transparency in Decision Making

BASE MAP LEGEND

Greenprint Overlay

Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes and Wetlands)

Historic Districts

Fishing Villages

Palmetto Breeze Route

Place Type Overlays

Rural Crossroads

Hamlets

Villages

Towns

Cities

ProposedTrolley Route

Proposed Bus Route

Existing Northern County Growth Boundary

Future Land Use

Rural

Rural Community

Neighborhood/Mixed- Use

Urban/Mixed-Use

Community Commercial

Regional Commercial

Core Commercial

Light Industrial

Military

ST. HELENA ISLAND

St. Helena Island is one of Beaufort County's greatest cultural and environmental assets and the people who live there want to ensure it remains that way. Planning for St. Helena must be a community-based process in order to protect the area's unique Gullah / Geechee culture. Plans and programs must be developed carefully and thoughtfully so that the island way of life is maintained, while improving health, safety, and economic outcomes by ensuring the equitable delivery of community services.

Place Types have already been established, coinciding with logical places on the Island where people can gather, shop, eat, and recreate. Rural zoning also limits the nature, density, and type of development that can be considered. The Greenprint Overlay Map also supports the locations of the Place Types as well as the need to protect the natural environment and rural character. Opportunities do exist, so long as they are desired by the community, to better connect St. Helena with bike lanes, trails, greenways, water access points, and better bus service.

BASE MAP LEGEND

Greenprint Overlay

Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes and Wetlands)

Historic Districts

Fishing Villages

Palmetto Breeze Route

Place Type Overlays

Rural Crossroads

Hamlets

Villages

Towns

Cities

ProposedTrolley Route

Proposed Bus Route

St. Helena Cultural Overlay

Existing Northern County Growth Boundary

Future Land Use

Rural

Rural Community

Neighborhood/Mixed- Use

Urban/Mixed-Use

Community Commercial

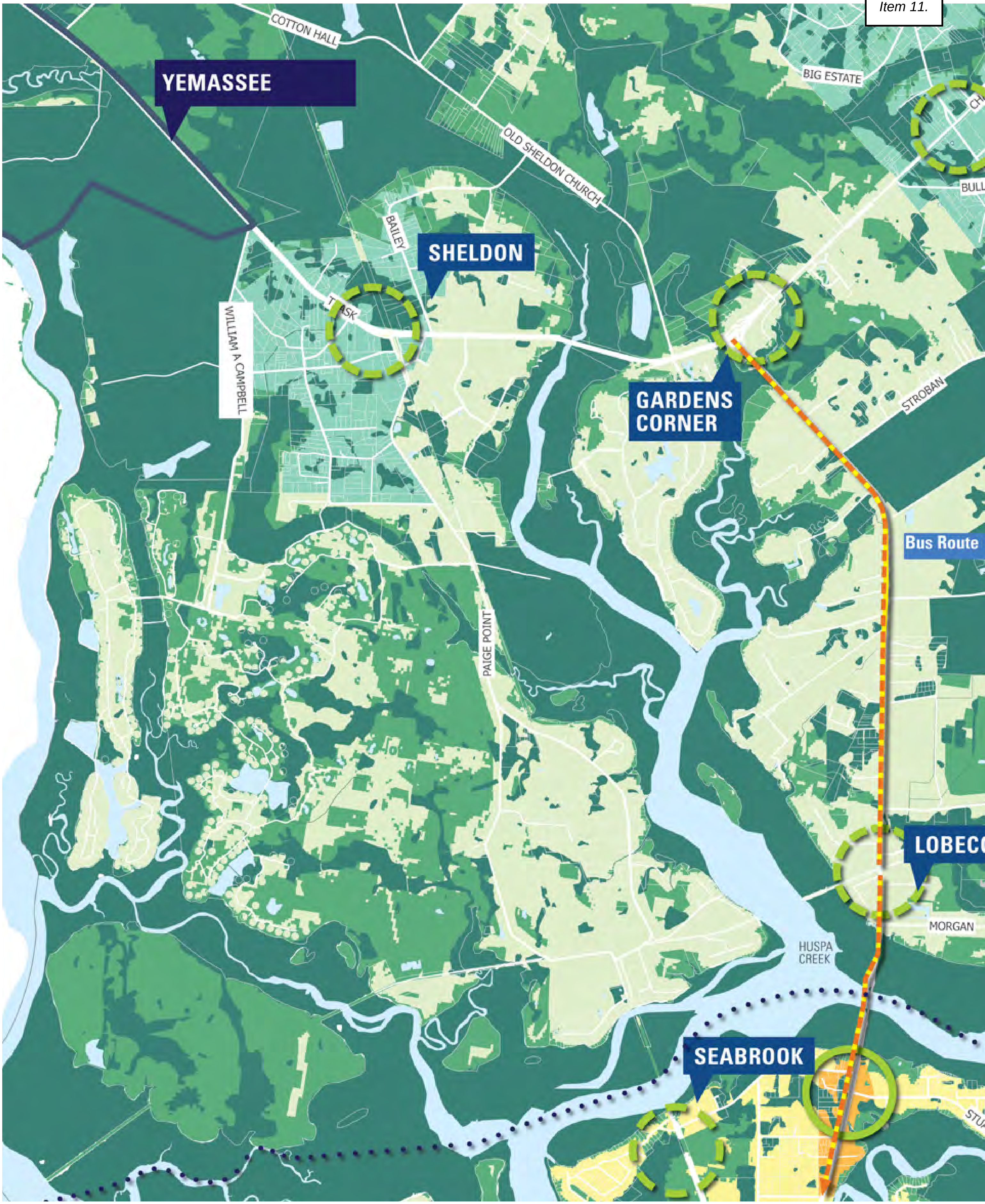
Regional Commercial

Core Commercial

Light Industrial

Military


MORGAN RIVER
EDDINGS POINT
DULAMO
SEA ISLAND
ST. HELENA ISLAND
BALL PARK
HUNTING ISLAND
HARBOR RIVER
SEASIDE
Connect "Places" with Bike Trails and Bike Lanes
FRIPP ISLAND
PRITCHARDS ISLAND
TRENCHARDS INLET


COTTON HALL
YEMASSEE
BIG ESTATE
OLD SHELDON CHURCH
BULL
BAILEY
SHELDON
TRASK
WILLIAM A CAMPBELL
GARDENS CORNER
STROBAN
Bus Route
PAIGE POINT
LOBECO
MORGAN
HUSPA CREEK
SEABROOK

SHELDON, DALE, GARDENS CORNER & LOBECO

The northern portion of Beaufort County is intentionally rural. Conservation efforts, zoning protections, sewer agreements, and growth boundaries have been put in place to protect the area from sprawling development. These efforts were taken to further the vision local residents had developed for their community's future.

Yet, as Yemassee expands and develops, coordination between the Town and County will be essential to protecting the character and natural resources of the Sheldon and Gardens Corner area. Working with the Town to establish an urban growth boundary is an important first step in developing a successful growth management strategy for the area.

Furthermore, while the vision for Northern Beaufort County is to maintain its rural character, it should be noted that the land area that support the Place Types are also suitable for development based on the Land Suitability Analysis.

BASE MAP LEGEND

Greenprint Overlay

- Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes and Wetlands)
- Historic Districts
- Fishing Villages
- Palmetto Breeze Route

Place Type Overlays

- Rural Crossroads
- Hamlets
- Villages
- Towns
- Cities
- ProposedTrolley Route
- Proposed Bus Route
- Existing Northern County Growth Boundary

Future Land Use

- Rural
- Rural Community
- Neighborhood/Mixed- Use
- Urban/Mixed-Use
- Community Commercial
- Regional Commercial
- Core Commercial
- Light Industrial
- Military

YEMASSEE

With the recent annexations of Cotton Hall and Tomotley Plantations, it is clear that the Town of Yemassee plays an important role in the future growth of the region of the county located north of US 17.

Establishing a growth boundary and shared land use vision between Beaufort County and the Town of Yemassee are key components to a successful growth management strategy that allows the Town to grow and thrive while protecting historic properties and valuable natural resources that make up the ACE Basin. This plan proposes establishing rural crossroads along US 17 that would allow compatible commercial development to serve local residents along with visitors travelling through the region. The plan also identifies land located between Cotton Hall Road and the county line that has direct rail access and close proximity to Interstate 95. This property is well suited for industrial development.

Finally, a shared vision should include building on the region's natural and historic assets. This includes protecting the scenic qualities of Old Sheldon Church Road, improving public access to the water, protecting environmentally sensitive and historic properties in the ACE Basin.

BASE MAP LEGEND

Greenprint Overlay

Highest Priority for Conservation: Developable with Restrictions 2 (light green) and Least Developable (dark green, including Marshes, Wetlands and Preserved Lands)

Historic Districts

Fishing Villages

Palmetto Breeze Route

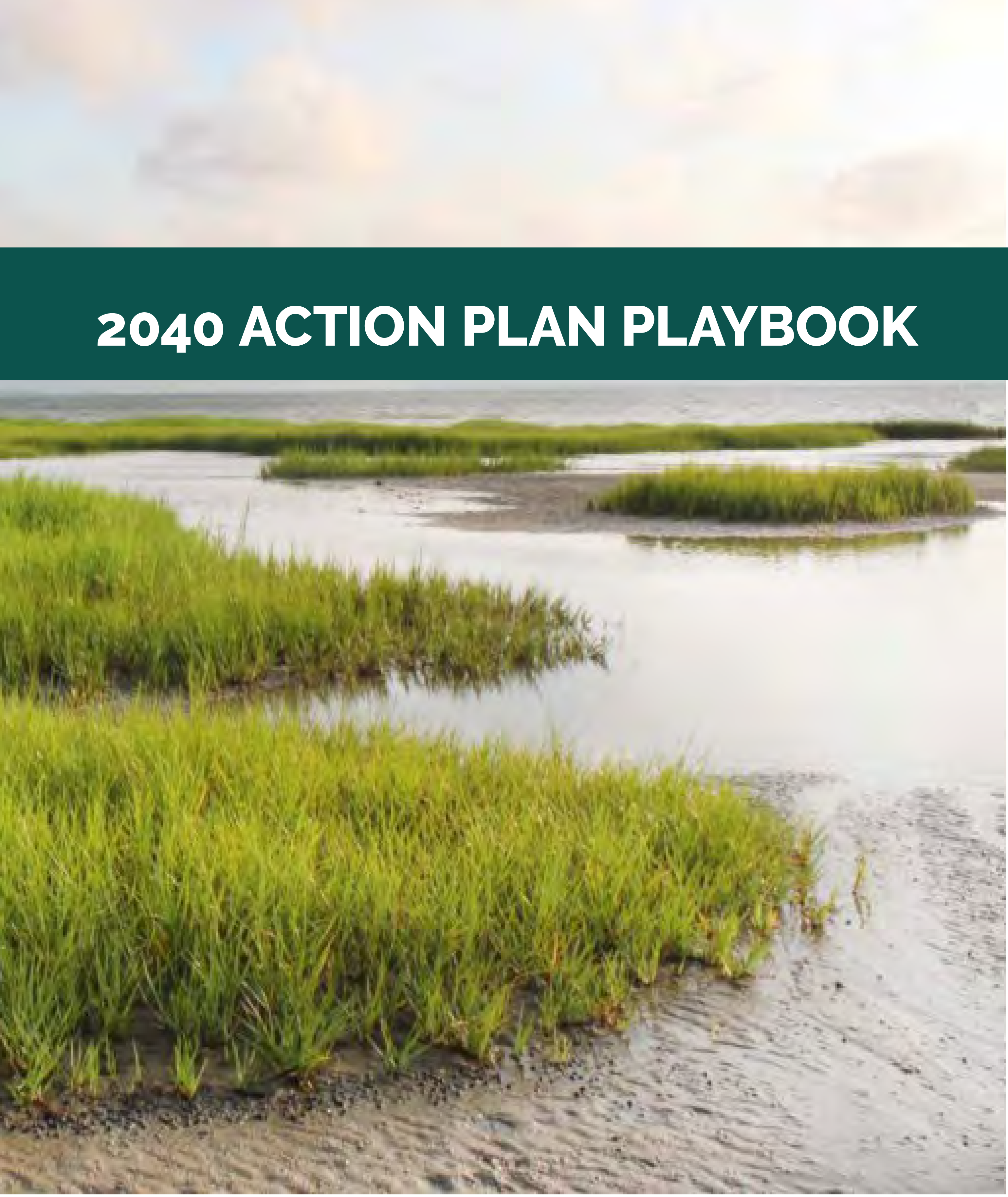
Place Type Overlays

Rural Crossroads
Hamlets
Villages
Towns
Cities
ProposedTrolley Route
Proposed Bus Route
Proposed Urban Growth Boundary

Future Land Use

Rural
Rural Community
Neighborhood/Mixed- Use
Urban/Mixed-Use
Community Commercial
Regional Commercial
Core Commercial
Light Industrial
Military


ater
Scenic Highway
RIVER
OLD SHELDON CHURCH
HALL
BIG ESTATE
CHARLESTON
BIG
ESTATE
JENKINS
SHELDON
BAILEY
TRASK
KINLOCH
PAIGE POINT
WASHINGTON FARM
Bus Route



2040 ACTION PLAN PLAYBOOK

THE 2040 ACTION PLAN

The 2040 Comprehensive Plan, once adopted, establishes the vision and shared direction for County economic, social, cultural, and environmental actions. It will serve as the foundation on which future plans and policies are grounded. It will act as the County's "playbook" and be referred to regularly as each department establishes its work plans for the year. It will guide the County's budget and be a tool to communicate goals to residents and investors who seek to further quality of life and strengthen the standard of living of Beaufort County. The Comprehensive Plan should be a living document, "dog eared" due to constant use and added to regularly by successive County Councils through ongoing community outreach.

Consistency with State Requirements

A comprehensive plan is required by state law in all jurisdictions that have zoning. The comprehensive plan sets out a vision for the future, establishes goals, and recommends actions to achieve those goals. It links long range vision with local programs and policies.

The comprehensive plan informs County government activities to ensure Beaufort County maintains its high quality of life, unique landscape, access to nature, and Lowcountry aesthetic, and expands economic opportunities. When implemented, the comprehensive plan will enable the County to reap the rewards of its ongoing success and to build a community that attracts people to live, work, and play.

This plan looks out into the future 20 years. After five years, the plan should be reviewed and updated. Consistent with state statute requirements, the Beaufort Comprehensive Plan Update includes consideration for the nine required elements that must be addressed in the development of a Comprehensive Plan.

These include:

- Population and demographics
- Economic development, labor, and workforce
- Natural resources
- Cultural resources
- Community facilities; water, sewer, fire, EMS, education, etc.
- Housing inventory, condition, types, and affordability
- Future land use
- Transportation, improvements, efficiency, safety
- Priority investments, immediate & long term public needs

The Beaufort County Comprehensive Plan Update, however, is formatted differently than a traditional comprehensive plan to better recognize and articulate the natural interrelationship and synergies between the required elements described above. The format chosen for the Plan is based on holistic "themes", inspired by the American Planning Association (APA) in its Sustaining Places: Best Practices for Comprehensive Plans. By doing that, the state required elements listed above are woven into the goals, strategies and actions of the themes that were created for the Plan and within the chapters that were created for each theme and not divided into their own individual chapters like they usually are.

Steps to Initiate Implementation of the Plan

- Once adopted, display the Plan it where it is easily accessible for day to day use.
- Conduct necessary educational discussions and create alignment between Staff, Departments, Planning Commission and County Council with the recommendations of the Comprehensive Plan.
- Advance the Action Plan by creating work plans, schedules, and responsibilities.
- Coordinate the Plan with Capital Improvement Plans (CIP) and the Strategic Plan.
- Coordinate the Action Plan with existing plans and studies or ones currently being created.
- Identify "low-hanging fruit" to enable items to be more readily implemented to establish momentum.
- Regularly set priorities for short, medium, and long-term actions based on yearly financial capabilities, the emergence of opportunities and ongoing community support.
- Manage the execution of the Action Plan by establishing a single point of contact who will oversee its implementation and identify key leaders from every department to champion it.
- Establish a method to monitor the progress of the Plan including a "dash board" and adherence to metrics.
- Conduct an annual report to County Council on the ongoing progress on the Plan.
- Evaluate and appraise the Plan every 5 years as required.
- Use the vision, goals and strategies of the Comprehensive Plan to influence future planning efforts.
- Coordinate the Plan with regional jurisdictions, towns, cities and counties.

Priority Investment Element Actions

The Priority Investment Act (Act No. 31 of 2007) requires the "analysis of federal and state funding for public infrastructure that may be available" to support the expenditures needed to implement the Plan. The funding needs required for implementation will be determined and prioritized through the CIP process. As described below, there are many ways that the Actions of the Plan can and will be funded. The following list describes possible revenue sources, both existing and potential, for how items described in the Action Plan might be funded:

- Real and Personal Property Taxes
- County Sales Taxes
- Capital Project Sales Taxes (CPST
- Local Option Sales Taxes (LOST)
- Vehicle Taxes
- Utility User Charges (rates)
- Stormwater Utility Fees
- Business License Fees
- Utility Impact and Connection Fees
- Fees In Lieu of Development (parks)
- Permitting Fees (building and development)
- Development Agreements
- Tax Increment Financing (TIF)
- Revenue and General Obligation Bonds
- State and Federal Grant Funding
- Hospitality and Accommodations Tax

Implementing and Updating the 2040 Comprehensive Plan

The Comprehensive Plan Update, as well as the Action Plan located within it, should be viewed as a high-level document that provides broad guidance. It is not intended to be a rigid prescription for how to accomplish the vision or each goal or strategy. It is also a long term plan that will span several election and economic cycles. To this end, it allows those in charge of its implementation to determine the most appropriate courses of action to achieve it's implementation, based on current best practices, staffing, funding, the nature of the task and current conditions. As to be expected, given their complexity, many of the goals and strategies of the Plan will require additional actions, prioritization, planning, community involvement, and funding, as well as ongoing review and evaluation.

The Comprehensive Plan will be reviewed at least every five years and updated at least every ten years as required. When the County conducts a review or update to the Plan, it will evaluate the need to update any or all of the required elements of the Plan, based on conditions at the time. To the extent the review necessitates an amendment to the Priority Investment Element or the other relevant elements of the Plan, the County will coordinate with adjacent and relevant jurisdictions and agencies, as required by the South Carolina Planning Enabling Act.

The Action Plan

The Action Plan describes essential items to be acted upon and provides the Planning Commission and County Council a guide for future funding, planning and investment. The Action Plan focuses on tasks, derived from the process, that can chart a positive course for the County's future. Its plans and policies, near mid and long-term actions, and the identification of departmental responsibilities. It establishes the initial "Playbook" to follow to achieve the vision of the Plan. The following pages provide the actions that are being committed to for each Theme as part of the Action Plan of the 2040 Comprehensive Plan.

COORDINATION WITH THE CIP

By implementing the Comprehensive Plan in coordination with it's Capital Improvement Plan (CIP) and the County Council Strategic Plan– the County will maintain alignment around prioritizing investment and expenditures, land use and growth management policies, economic development strategies, housing policies, delivery of services, infrastructure development, shared commitment and focus, as well as compatibility between the County's growth policies and those of the region, the Council of Government, and other units of local government and agencies with whom coordination is important.

COORDINATION WITH COUNTY COUNCIL STRATEGIC PLAN

The Comprehensive Plan should also be the inspiration for the Strategic Plan created annually by County Council, so that all three items - the Comprehensive Plan, the CIP and the Strategic Plan are working together to guide the County's actions, expenditures and priorities. In that respect, the Strategic Plan should be the tool that prioritizes the actions of the Comprehensive Plan each time one is created.

COORDINATION WITH OTHER PLANNING DOCUMENTS

BEAUFORT COUNTY ATLAS

A living document in a simple template that can be updated over time. The starting reference point for current and future Beaufort County planning projects.

PEOPLE OF BEAUFORT COUNTY

County Comprehensive Plan references County Atlas.

BEAUFORT COUNTY COMPREHENSIVE PLAN

A simple and visual comprehensive plan update with succinct analysis and concrete recommendations organized by theme.

County Comprehensive Plan and Green Print Plan reference each other.

GREENPRINT PLAN

A simple and visual Green Print Plan update with succinct analysis and concrete recommendations organized by theme.

MUNICIPAL COMP PLANS

PARKS AND RECREATION PLANS

SOUTHERN LOWCOUNTY ORDINANCE AND DESIGN MANUAL

TRANSPORTATION PLANS

2040 ACTION PLAN: NATURAL ENVIRONMENT

	NE 1.1.	NE 1.2.	NE 1.3.	NE 1.4.	NE 1.5.
	NE 1.1. Monitor effectiveness of existing ordinances and programs and update as necessary to protect water quality and natural resources.	**NE 1.2.** Seek referendums on additional funding for the Rural and Critical Lands Preservation Program every four years.	**NE 1.3.** Require new developments and encourage existing developments to adopt a tree management plan.	**NE 1.4.** Support Port Royal Sound Foundation's application to the EPA's National Estuary Program. Seek partnership with Port Royal Sound Foundation to monitor water quality and provide educational opportunities for the community about the importance of keeping our waterways healthy.	**NE 1.5.** Evaluate the time period that a property owner must wait after clear cutting property before applying for a development permit.
INVESTMENT	Medium	Low	High	Medium	Low
TIMING	3-6 years	Ongoing	1-3 Years	1-3 Years	1-3 Years
ENTITY	0CRM; Beaufort County Stormwater Utility, Water Quality Monitoring Program; County Planning & Zoning Department	County Council, Natural Resources Committee; Beaufort County Open Land Trust	County Planning & Zoning Department	Port Royal Sound Foundation; Beaufort County Stormwater Utility, Water Quality Monitoring Program; County Council	County Planing and Zoning

NE 2.1. Provide critical environmental systems maps on the County website.	**NE 2.2.** Update environmental systems mapping (five-year cycle) to reflect ongoing research and actual conditions of flooding and sea level rise.	**NE 3.1.** . Install and monitor tidal gauges at several locations in Beaufort County to provide a thorough representation of tidal activity across the county.	**NE 3.2.** Install groundwater monitoring wells at various locations including agricultural areas and low-lying communities that rely on septic systems.	**NE 3.3.** Adopt comprehensive water plans for vulnerable areas of the County by studying and analyzing how stormwater, sea level rise, and storm surge interact in an area determined by geographic and geological conditions.
Medium	Medium	High	High	High
1-3 Years	Ongoing	1-3 Years	1-3 Years	3-6 Years
County Planning & Zoning Department; County Floodplain Manager; SC Sea Grant Consortium; GIS Department	County Planning & Zoning Department; County Floodplain Manager; SC Sea Grant Consortium; GIS Department	DNR; NOAA; SC Sea Grant Consortium; LCOG; US DOD	DHEC, USGS	DHEC; USGS; County Planning & Zoning Department

2040 ACTION PLAN: NATURAL ENVIRONMENT

	NE 3.4. Engage residents in the Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS) program through collaboration with the Office of the State Climatologist and the National Weather Service.	NE 4.1. Adopt a coastal resilience overlay district to require notification prior to real estate closings of the vulnerability of property to coastal flooding in low lying areas.	NE 4.2. Adopt additional feet of freeboard above BFE as well as uniform policies for adjacent properties outside the flood area.	NE 4.3. Review the County's Community Rating Service (CRS) program and make changes to regulations and programs as appropriate with the goal of improving the County's CRS rating. Every improvement in the CRS rating saves flood policy holders 5% in premiums.
INVESTMENT	Low	Low	Low	Medium
TIMING	Ongoing	1-3 years	1-3 years	3-6 years
ENTITY	DNR; Beaufort County Floodplain Manager	County Planning & Zoning Department	County Planning & Zoning Department	County Planning & Zoning Department; County Floodplain Manager

NE 5.1. Develop a flood, sea level rise, and climate change roadshow program to connect with community groups, homeowners' associations, professional organizations not already served by existing programs, and other similar organizations for community outreach and education.	**NE 5.2.** Maintain an ongoing collaborative working group, similar to the Sea Level Rise Task Force, for discussions and feedback involving recommendations and other proactive activities related to sea level rise and resilience.	**NE 5.3.** Hire a Resilience Officer to oversee hazard mitigation planning in the county, including, but not limited to, assisting vulnerable communities, applying for grants, creating outreach education programs, and continually assessing hazard risks and creating policies to mitigate them.	**NE 6.1.** Develop a county- level website that houses Beaufort County specific flooding and sea level rise information, including housing reports, outreach materials, the GIS portal that has sea level rise mapping, and other data sources. This website can potentially count as Community Rating System outreach credit if National Flood Insurance Program information is included.
Low	Low	High	Medium
3-6 years	Ongoing	1-3 years	1-3 years
County Floodplain Manager; Port Royal Sound Foundation; Gullah/ Geechee Sustainability Think Tank; SC Sea Grant Consortium	County Planning & Zoning Department; County Floodplain Manager; SC Sea Grant Consortium; municipalities	County Council	County Planning & Zoning Department; County Floodplain Manager; County Public Works Department; GIS Department

2040 ACTION PLAN: CULTURE

	C 1.1. Improve access to the water at Fort Frederick, Jenkins Creek Boat Landing, and Station Creek Boat Landing..	C 1.2. Develop a comprehensive study of Beaufort County's boating needs. Develop a list of improvements necessary to accommodate existing and future requirements..	C 1.3. Build a kayak launch at Fort Frederick and develop a blueway trail on the Beaufort River and associated creeks.	C 2.1. Partner with the Town of Hilton Head Island to plan and implement the Historic Mitchelville Freedom Park.
INVESTMENT	High	Medium	High	Low
TIMING	1-3 Years	1-3 Years	3-6 Years	3-6 Years
ENTITY	County Public Works Department; County Passive Parks Manager; County Capital Projects Department	County Planning & Zoning Department; Beaufort Sail & Power Squadron; Gullah/Geechee Fishing Association; municipalities	County Planning & Zoning Department; County Capital Projects Department; County Passive Parks Manager	County Planning & Zoning Department; County Capital Projects Department; Town of HHI; County Passive Parks Manager

C 2.2. In partnership with community members, including the Gullah/Geechee Sea Island Coalition and the St. Helena Island Cultural Protection Overlay District Committee, conduct a baseline cultural resource inventory and vulnerability assessment of buildings, archaeological sites, traditionally used roads, waterways, water access points, fishing areas, burial sites, and sacred grounds to inform protection and stewardship practices for Gullah/ Geechee communities.	**C 3.1.** . Update the Beaufort County Above Ground Historic Resources Survey.	**C 4.1.** Use the Rural and Critical Land Preservation Program to promote active agriculture and the preservation of agricultural lands, and continue to target the purchase of development rights on active agricultural lands. See the Rural and Critical Land Preservation Program to promote active agriculture and the preservation of agricultural lands, and continue to target the purchase of development rights on active agricultural lands.
Medium	Medium	Low
3-6 Years	3-6 Years	Ongoing
County Planning & Zoning Department; Gullah/Geechee Sea Island Coalition; Gullah Geechee Cultural Heritage Corridor	County Planning & Zoning Department	County Planning & Zoning Department; Beaufort County Open Land Trust; Rural and Critical Lands Preservation Board; Clemson Cooperative Extension

2040 ACTION PLAN: CULTURE

	C 5.1. In conjunction with Clemson Extension, create a website with information on locally grown produce, and retail and restaurants using locally sourced food. The web site should promote organizations that advocate local foods such as Lowcountry Local First and Fresh on the Menu..	C 6.1. Periodically evaluate Beaufort County's rural land use policies, including family compound uses, to determine that they are accomplishing the policy goals of preserving the rural landscape and way of life, and that they are fair and equitable to local residents and property owners.	C 6.2. Develop a brochure designed to help small rural landowners understand how to subdivide and transfer land. The brochure should explain family compounds, policies for small rural landowners, home occupation and home business provisions, cottage industry provision, resources for heirs' property, etc..
INVESTMENT	Low	Low	Low
TIMING	Ongoing	1-3 Years	Ongoing
ENTITY	County Planning & Zoning Department; Clemson Extension	County Planning & Zoning Department; Planning Commission	County Planning & Zoning Department

2040 ACTION PLAN: ECONOMY

E 1.1. Seek partnership with Port Royal Sound Foundation to educate the community about the Port Royal Sound as a critical economic driver for the community and the importance of keeping it healthy.	**E 2.1.** Continue to partner with the Marine Corps to preserve open space around MCAS to protect the facility from undesirable encroachment. This partnership expands the County's efforts to preserve rural and critical land while ensuring the ability of MCAS to remain militarily viable and vital to the national defense."	**E 2.2.** Implement transfer of development rights program to compensate affected property owners within the MCAS Airport Overlay District.	**C 2.3.** Support implementation of the recommendations of the Military Installation Resilience Review being conducted for the County's military facilities.
Low	Low	Medium	Low
Ongoing	Ongoing	3-6 Years	1-3 Years
Port Royal Sound Foundation, School District, Chamber of Commerce	County Planning & Zoning Department; BC Open Land Trust; Rural and Critical Lands Preservation Board; Marine Corps	County Planning & Zoning Department	County Planning & Zoning Department; Northern Regional Plan Implementation Committee; County Council; City of Beaufort; Town of Port Royal

2040 ACTION PLAN: ECONOMY

	C 3.1. Provide the Beaufort County Economic Development Corporation with a list of properties meeting locational requirements for office and light industrial uses on a regular basis..	E 3.2. Purchase approximately 30 acres in 3 or 6 acre tranches in each local jurisdiction within Beaufort County through the Beaufort County Economic Development Corporation, to provide ample spaces for companies wishing to expand or move to Beaufort County..	E 4.1. Provide more flexibility in commercial zoning districts to permit smaller non-retail commercial uses such as small assembly facilities and light industrial operations, or contractor's offices that do not adversely impact surrounding retail uses..
INVESTMENT	High	Low	Low
TIMING	Ongoing	6-10 Years	3-6 Years
ENTITY	County Planning & Zoning Department	County Council; Beaufort County Economic Development Corporation	County Planning & Zoning Department

E 4.2. Create incentives, such as an accelerated building permit process, height and density bonuses and fee reductions and waivers, for commercial and industrial projects that intend to meet either LEED or Energy Star standards.	**E 5.1.** Target land purchases to incentivize the location of new employers in walkable mixed-use communities such as Buckwalter Place.
Medium	High
3-6 Years	6-10 Years
County Planning & Zoning Department; Beaufort County Economic Development Corporation	Beaufort County Economic Development Corporation

2040 ACTION PLAN: MOBILITY

	M 1.1. Formally adopt a Complete Streets policy that requires all streets to be planned, designed, operated, and maintained to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. All future transportation projects should adhere to the Complete Streets policy in an appropriate urban, suburban, or rural context.	M 1.2. Prepare corridor master plans so that major arterial and state highways can evolve into complete streets.	M 2.1. Develop a funding strategy and implement the transportation projects in the 10-year Capital Improvements Program..	M 2.2. Update impact fees every five years to insure that future development is paying for its impact on the transportation network.
INVESTMENT	Low	High	High	Medium
TIMING	1-3 Years	3-6 Years	6-10 Years	Ongoing
ENTITY	County Planning & Zoning Department; County Capital Projects Department; SCDOT	County Planning & Zoning Department; County Capital Projects Department; SCDOT	County Planning & Zoning Department; County Capital Projects Department; County Council Finance Committee	County Capital Projects Department; County Council

M 2.3. Place an initiative on the 2022 ballot to reimpose a 1% capital project sales tax to fund transportation improvements that includes roads and multi-use pathways. Establish a regular schedule for future referendums.	**M 2.4.** Include needed transportation improvements in the LATS Long Range Transportation Plan to insure maximum utilization of Guideshare funding for county transportation projects.	**M 5.1.** Complete the Spanish Moss Trail and make continuous progress on the greenway, trail, sidewalk, and bicycle lane projects..	**M 5.2.** Dedicate a staff position to plan and implement bicycle and pedestrian facilities.
Medium	Low	High	Medium
1-3 Years	1-3 Years	6-10 Years	1-3 Years
County Capital Projects Department; County Council; County Transportation Committee; LCOG; municipalities	County Planning & Zoning Department; County Capital Projects Department	County Planning & Zoning Department; County Capital Projects Department; City of Beaufort; Town of Port Royal; Friends of the Spanish Moss Trail	County Council

2040 ACTION PLAN: MOBILITY

	M 5.3. Develop a funding strategy and implement the bicycle and pedestrian projects in the 10-year Capital Improvements Program..	M 5.4. Adopt "Beaufort County Connects 2021", the Bicycle/Pedestrian Plan for the County.	M 6.1. Increase the numbers of park and ride locations along major transportation routes that connect employees with their jobs.	M 6.2. Promote the use of transit to reduce seasonal and local traffic and provide opportunities for employees to access job opportunities
INVESTMENT	High	Low	High	Low
TIMING	6-10 Years	1-3 Years	6-10 Years	Ongoing
ENTITY	ts Department; County Engineering Department; Bike/Ped Task Force; County Planning & Zoning Department	County Council; Municipalities	County Capital Projects Department; Palmetto Breeze	County Council; Palmetto Breeze; Chambers of Commerce (Beaufort, Bluffton, and Hilton Head)

M 6.3. Support Palmetto Breeze's efforts to establish a fixed-route bus service between Hilton Head Island and Bluffton and in the Beaufort/Port Royal area. Consider adding stops in the Sheldon/Seabrook areas.	**M 6.3.** Incentivize "transit- ready" development projects that cluster moderate to high density residential development, retail, services and employment centers within walking distance of transit stops.	**M7.1** Implement the recommendations from the 2010 Airport Layout Plan and Master Plan for the Hilton Head Island Airport.	**M 7.2.** Implement the recommendations from the 2014 Airport Layout Plan for the Beaufort Executive Airport..
High	High	High	High
3-6 Years	3-6 Years	6-10 Years	6-10 Years
County Council; Palmetto Breeze; Chambers of Commerce (Beaufort, Bluffton, Hilton Head, Port Royal, Yemassee)	County Planning & Zoning Department	County Airports Department; Airports Board; Town of Hilton Head; County Council	County Airports Department; Airports Board; City of Beaufort; County Council

2040 ACTION PLAN: HOUSING

	H 1.1. Create affordable housing location criteria and weighting to refine affordable housing location mapping included in the Comprehensive Plan. Update every five years.	**H 2.1.** Work to eliminate barriers to developing affordable and workforce housing by periodically evaluating and updating the Community Development Code.	**H 2.2.** Expand on the existing density bonuses in the Community Development Code to incentivize the creation of affordable housing by the private sector. Consider expanding the required affordability period beyond 25 years.	**H 3.1.** In cooperation with local municipalities and Jasper County, create a Regional Affordable Housing Trust Fund and provide annual funding to support affordable housing needs in the Lowcountry.
INVESTMENT	Medium	Medium	High	High
TIMING	Ongoing	1-3 years	1-3 years	3-6 years
ENTITY	County Planning & Zoning Department; Human Services Department; County Housing Coordinator	County Planning & Zoning Department; Human Services Department; County Housing Coordinator; Area Homebuilders Associations	County Planning & Zoning Department; County Housing Coordinator; Area Home Builders Associations	County Planning & Zoning Department; Human Services Department, County Housing Coordinator; local municipalities; Jasper County

H 3.2. Consider establishing an Affordable Housing Land Trust to acquire and hold land. The land is leased to others to build affordable units, with the land remaining in ownership of the trust.	**H 3.3.** Hire a housing coordinator for Beaufort County to implement the policies of this plan.	**H 3.4.** Seek funding through the Home Investment Partnership Program (HOME) and the Community Development Block Grant (CDBG) Program to rehabilitate substandard housing and create new affordable housing.	**H 3.5.** Consider prohibiting short term rentals as the primary use of the property in certain residential zones; i.e., only permit short term rentals in conjunction with 4% properties.	**H 3.6.** Review zoning districts to determine if appropriate opportunities exist to incorporate more "missing middle housing."
High	High	Medium	Low	Low
3-6 years	1-3 Years	Ongoing	1-3 Years	1-3 years
County Planning & Zoning Department; Human Services Department, County Housing Coordinator; local municipalities	County Council	Human Services Department; County Housing Coordinator; County Council; LCOG	County Planning & Zoning Department; County Council	County Planning & Zoning Department; Area Home Builders Associations

2040 ACTION PLAN: COMMUNITY FACILITIES

	CF 1.1. Map and analyze locations of existing vulnerable critical infrastructure using projected future conditions. This includes developing an inventory of low-lying public facilities and critical infrastructure, including roads, sewer, water, public buildings, and stormwater infrastructure.	CF 1.2. Develop policies that require the design and location of future capital improvements and critical infrastructure to account for projected sea level rise and lifespan of structure.	CF 2.1. Conduct an energy audit for all County facilities (existing, undergoing renovation, and under design). The County should consider entering into an energy performance contract with an Energy Service Company to perform the audit and implement the improvements.	CF 2.2. Install electric vehicle charging stations at every Council facility that houses a sizeable workforce or has high public visitation.
INVESTMENT	High	Medium	High	High
TIMING	1-3 years	1-3 years	1-3 years	3-6 years
ENTITY	County Planning & Zoning Department; County Floodplain Manager; Stormwater Department	County Planning & Zoning Department; County Floodplain Manager; County Capital Projects	County Facility Management Department	County Facility Management Department; County Public Works Department

CF 3.1. Adopt county-wide policies that limit residential density for developments that are not served by public sewer.	**CF 3.2.** . Work with BJWSA to identify and prioritize areas with the highest concentration of on-lot septic systems for connection to sewer if these neighborhoods are within urbanized areas or within designated growth boundaries.	**CF 4.1.** Install trash compacting equipment to increase the efficiency and capacity of County high usage convenience centers.	**CF 4.2.** Design and implement a plan for sustainable waste removal and disposal for the County, including multiple disposal alternatives, like various recycilng streams and composting.
Low	High	High	Medium
1-3 years	6-10 years	3-6 years	1-3 years
County Planning & Zoning Department; County Council	County Planning & Zoning Department; DHEC; BJWSA	County Solid Waste and Recycle Department	County Solid Waste and Recycle Department

2040 ACTION PLAN: COMMUNITY FACILITIES

	CF 5.1. Review and update library Impact Fees every five years.	CF 5.2. Renovate and repair the Beaufort, Hilton Head Island, Lobeco, and Bluffton library facilities to meet current operational needs.	C 5.3. Develop two additional library facilities: one 12,000 - 15,000 square foot facility in the Okatie area, and one 3,000 - 5,000 square foot facility at Burton Wells Park..	CF 6.1. Establish "Safe Routes to Schools"standards and routing plans, consistent with recommendations of Bike and Pedestrian Task Force, that require a strong pedestrian orientation in residential areas so that pedestrian ways are available for children to safely walk to school.
INVESTMENT	Medium	High	High	High
TIMING	Ongoing	3-6 years	6-10 years	3-6 years
ENTITY	County Council, County Capital Projects Department, Beaufort County Library	County Capital Projects Department; County Facility Management Department; Beaufort County Library	County Capital Projects Department; County Facility Management Department; Beaufort County Library	County Planning & Zoning Department; Bike/Ped Task Force; Beaufort County Schools

CF 6.2. Adopt school impact fees for Southern Beaufort County.	**CF 7.1.** Renovate the existing Emergency Medical Services (EMS) headquarters on Depot Road to meet the needs of the administration for parking, training and storage. The facility's design, circulation, and security measures need to be context sensitive to the adjacent Spanish Moss Trail.	**CF 7.2.** Expand or replace the EMS station located at the shared Bluffton Fire District Station on William Pope Drive near Sun City to adequately accommodate EMS's personnel and operational space needs.	**CF 7.3.** Construct either an extension to the existing Detention Center facility or a new facility to accommodate anticipated operational demand. The facility needs to house specific special populations such as inmates with addiction or mental health issues. The operational costs of an additional facility should be studied to determine if a true benefit would be derived from adding to the existing facility or constructing a new one..
Low	High	High	High
1-3 years	3-6 years	3-6 years	6-10 years
County Planning & Zoning Department; County Capital Projects Department; Beaufort County Schools	County Capital Projects Department; County Facility Management Department; Beaufort County Emergency Medical Services	County Capital Projects Department; County Facility Management Department; Beaufort County Emergency Medical Services	County Capital Projects Department; County Facility Management Department; Beaufort County Detention Center

2040 ACTION PLAN: COMMUNITY FACILITIES

	CF 7.4. Construct a new Law Enforcement Center to ensure that there is adequate space to house existing and future law enforcement personnel.	CF 7.5. Build an appropriate facility to house the Emergency Management Department within or attached to the proposed Law Enforcement Center.	CF 7.6. Work with BJWSA to provide additional fire hydrants on Warsaw Island, extending and replacing lines as necessary. Apply for grant funding as appropriate, including CDBG. Identify other rural areas where lack of fire hydrants or water supply pose safety concerns. Request that BJWSA include water service improvements in rural areas in their CIP. Act on the recommendations of the Parks and Recreation Master Plan according to the prioritization and timeline outlined in the document.
INVESTMENT	High	High	High
TIMING	6-10 years	6-10 years	3-6 years
ENTITY	County Capital Projects Department; County Facility Management Department; Beaufort County Sheriff's Department	County Capital Projects Department; County Facility Management Department; Beaufort County Sheriff's Department; Beaufort County Emergency Management Services	BJWSA; DHEC; Lady's Island/St. Helena Fire District Commission; Burton Fire District Commission

CF 7.7. Work with BJWSA to install water lines and fire hydrants on Seabrook Road and Stuart Point Road on Port Royal Island. Apply for grant funding as appropriate, including CDBG.	**CF 8.1.** Create a Parks and Recreation Master Plan that establishes acceptable metrics for accessibility and programming. Ensure public participation from all areas of the County and segments of the community in the planning effort.	**CF 8.2.** Implement the recommendations of the Parks and Recreation Master Plan according to the prioritization and timeline outlined in the document.	**CF 8.3.** Maintain a passive parks manager position to oversee the development of passive parks on Rural and Critical Land Preservation properties. Actively pursue the development of passive parks.
High	High	High	Low
3-6 years	1-3 years	6-10 years	Ongoing
BJWSA; DHEC; Burton Fire District Commission; LCOG	County Planning & Zoning Department; County Parks and Recreation Department	County Planning & Zoning Department; County Parks and Recreation Department; County Council	County Planning & Zoning Department; Rural and Critical Lands Preservation Board

2040 ACTION PLAN: BUILT ENVIRONMENT

	BE 1.1. Regularly inventory platted vacant lots in existing PUDs and subdivisions, and create an inventory of lots ideal for infill development.	BE 1.2. Formalize a regional planning program between Beaufort County, Jasper County, and the City of Hardeeville that recognizes the mutual benefit of coordinated planning along jurisdictional boundaries.	BE 1.3. Develop a SC 170 Area Plan in conjunction with the City of Hardeeville and Jasper County that defines a growth framework for the corridor and addresses issues of joint concern such as transportation and environmental protection.
INVESTMENT	Medium	High	High
TIMING	Ongoing	3-6 years	3-6 years
ENTITY	County Planning & Zoning Department	County Planning & Zoning Department; County Council; Jasper County; City of Hardeeville	County Planning & Zoning Department; County Council; Jasper County Planning & Building Department; City of Hardeeville Planning & Development Department, LATS

BE 1.4. Work with the Town of Yemassee to develop a consistent growth management strategy for the area of the County north of US 17. The strategy should include a mutually agreed upon growth boundary.	**BE 2.1.** Update the Greenprint Plan every five years.	**BE 3.1.** Reevaluate the effectiveness of existing place-making implementation tools such as the Place Type Overlay District in the Community Development Code, and make revisions as necessary.	**BE 3.2.** Initiate a prototype community-based Place Type implementation plan that involves property owners, business owners, and other stakeholders to serve as a vision for other areas of the county where walkable urbanism is appropriate.
Medium	High	High	High
1-3 years	Ongoing	1-3 years	3-6 years
County Planning & Zoning Department, County Council, Yemassee Town Council, Yemassee Planning	County Planning & Zoning Department; Rural and Critical Lands Preservation Board	County Planning & Zoning Department; Planning Commission	County Planning & Zoning Department; Planning Commission

2040 ACTION PLAN: ST. HELENA ISLAND

	Reevaluate the CPO District by assessing whether additional land use restrictions are necessary to meet the intent of the district. Consider the addition of specific design standards that reinforce historic Gullah/Geechee development patterns and character." Include diverse representation on the steering committee that may be formed to guide the process. Ensure public input from all segments of the community.	In partnership with the Sea Level Rise Task Force, commission a comprehensive water study and plan for St. Helena Island that considers stormwater, sea level rise, and storm surge to better define the risks posed by climate change and new development and recommend strategies to protect against these threats. This study should be aligned with County-wide Gullah/Geechee cultural inventory and vulnerability assessments.	Support nonprofit organizations, such as the Center for Heirs' Property Preservation and PAFEN, with expertise in resolving heirs' property issues. Encourage establishment of local offices in Northern Beaufort County and expansion of their programs throughout the County. Consider partnering with the municipalities to provide support for these groups by applying for grant funds, Accommodations Tax and Hospitality Tax Revenues (if appropriate), and local funds to expand efforts in the area.
INVESTMENT	Medium	High	Medium
TIMING	1-3 years	3-6 years	Ongoing
ENTITY	County Planning & Zoning Department; St. Helena Island Cultural Protection Overlay (CPO) District Committee; Gullah/Geechee Sea Island Coalition	County Planning & Zoning Department; DHEC; DNR; Gullah/Geechee Sea Island Coalition; Sea Level Rise Task Force	Municipalities; Center for Heirs' Property Preservation; PAFEN; County Council; Gullah/Geechee Sea Island Coalition

Consider prohibiting Mining/Resource Extraction within the Cultural Protection Overlay zone and revising conditions for Mining in the CDC to require a spacing requirememt for mines and that the presence of Prime Farmland as defined by the USDA be considered in the decision to approve a permit for mining.	Ensure that St. Helena residents are included in the planning process for the Parks and Recreation Master Plan. Consider equity issues in development of that plan.	Assess the condition of existing recreation facilities on St. Helena Island. Develop plans for improvements and add funding costs to CIP. Apply for grant funding for improvements as appropriate.	Review recreation programs on St. Helena Island. Ensure that programs are addressing community needs and that programs are expanded beyond pre-pandemic levels.
Low	Low	High	Medium
1-3 years	1-3 years	3-6 years	1-3 years
County Planning & Zoning Department	County Parks and Recreation Department; County Public Information Officer; Gullah/ Geechee Sea Island Coalition	County Parks and Recreation Department; County Planning & Zoning Department; County Capital Projects Department	County Parks and Recreation Department

2040 ACTION PLAN: ST. HELENA ISLAND

	Work with Penn Center to develop an MOU and lease agreement in order for the County to take a more active role in maintaining MLK Park on St. Helena Island and including applying for grants for park improvements.	Work with DOT to address road and drainage conditions on state-owned roads on St. Helena Island.	Ask residents to develop a specific list of areas (addresses) where drainage is an issue. Have these areas assessed by the Stormwater Utility Board and projects developed as appropriate to address concerns. Consider grant funding, including CDBG and EPA, for projects.
INVESTMENT	High	High	Medium
TIMING	1-3 years	3-6 years	1-3 years
ENTITY	Penn Center; County Parks and Recreation Department	SCDOT; County Public Works Department	County Stormwater Department; Stormwater Utility Board

Develop a strategy to permanently address maintenance and safety improvements to “legacy roads” and private roads serving low-and moderate-income property owners. Consider grant programs and public service projects to address immediate maintenance needs.

High

3-6 years

County Public Works Department; County Engineering Department; County Transportation Committee

CAPITAL IMPROVEMENT PLAN

Beaufort County's Capital Improvement Plan (CIP) was developed by the Capital Projects Department collaborating with various departments County-wide to establish a complete list of capital needs. The plan was designed to identify major, infrequent, and nonrecurring projects over a 10-year period to include improvements to new and existing infrastructure along with maintenance of existing assets. The plan will be utilized to implement a capital improvement budget with development of the operating budget. County Council and staff will review the program, its direction, progress, and financing requirements on an annual basis.

The CIP is a living, breathing document. It is intended to be a guiding document to help program funding in a systematic approach. Different levels of funding are required for different stages of the project. The plan provides a holistic look of funding needs in the foreseeable future such that the Finance Department can implement the funding mechanisms needed for the right amount, at the right time, to successfully deliver the projects for Beaufort County. A successful plan not only provides a guide map but ensures the most efficient use of resources.

The Comprehensive Plan is updated every 10 years. It is Beaufort County's intent to update the Capital Improvement Plan every 5 years. This will allow the County to review the plan and assess whether projects are completed, new projects are warranted, and if projects need to be changed in scope or cost. Adjustments will be made on an annual basis to account for project development.

	Location	Estimated Cost
ADMINISTRATIVE OFFICE SPACE		
New Arthur Horne Building	100 Ribaut Road Beaufort, SC 29902	$ 6,000,000
Renovate New Arthur Horne Building	100 Ribaut Road Beaufort, SC 29902	$ 6,000,000
New Administrative Building - North	100 Ribaut Road Beaufort, SC 29902	$ 50,000,000
New Administrative Building - South	4819 Bluffton Pkwy Bluffton, SC 29910	$ 11,000,000
Renovate Existing Myrtle Park	4820 Bluffton Pkwy Bluffton, SC 29910	$ 5,000,000
Hilton Head Island Government Building Renovation	539 William Hilton Pkwy Hiton Head Island, SC 29925	$ 2,000,000
New Public Works Facilicty - Shanklin Road	120 Shanklin Road Beaufort, SC 29906	$ 16,000,000
New Public Works Camp - St. Helena	25 Langford Road, St. Helena SC 29920 (former waterslide park)	$ 250,000
Beaufort County Health Center Renovation	601 Wilmington Street Beaufort, SC 29902	$ 370,000
Lowcountry DHEC Office Renovation	1407 King Street Beaufort, SC 29902	$ 590,000
Daufuskie Island Renovation of Store and New Restrooms		$ 335,000
Pool Improvements - Energy Conservation and Saltwater Conversion	Various Locations	$ 570,000
Sheriff Office DNA Laboratory Addition		
Records Management Building Expansion	113 Industrial Village Rd. BIV #5	$ 1,925,000
Warehouse Expansion		
Construction of 7,000 sf addition to the RM Warehouse (estimate $250/ft2 and $175,000 FFE)		
Specialized Equipment Replace Archive Writer		$ 25,000
Voters Registration and Elections Building	113 Industrial Village Rd. BIV #4	
Additional Warehouse Space	John Galt Road	$ 300,000
Additional Parking for Voters	John Galt Road	$ 300,000
Human Services Renovation		$ 3,000,000
Sea Trowler Resturant Renovation	35 Fording Island Road	$ 3,000,000
Renovate Courthouse	100 Ribaut Road Beaufort, SC 29902	$ 20,000,000
Justice Center South	4820 Bluffton Pkwy Bluffton, SC 29910	$ 24,000,000
		$ 150,665,000
AIRPORT - BEAUFORT EXECUTIVE		
Runway Safety Area Improvements RW 7 and 25 (incl wetlands mit cost)	39 Airport Circle Ladys Island, SC 29907	$ 4,800,000
Taxiway Extension to Runway 25 (incl wetlands mit cost)	39 Airport Circle Ladys Island, SC 29907	$ 6,000,000
Terminal Renovations	39 Airport Circle Ladys Island, SC 29907	$ 500,000
Parking Lot Relocation	39 Airport Circle Ladys Island, SC 29907	$ 1,500,000
		$ 12,800,000
AIRPORT - HILTON HEAD ISLAND		
Commercial Service Terminal Renovation and Expansion	120 Beach City Road Hilton Head Isl., SC 29926	$ 40,000,000
Commercial Service Ramp Expansion	120 Beach City Road Hilton Head Isl., SC 29926	$ 4,700,000
New ARFF Vehicle	120 Beach City Road Hilton Head Isl., SC 29926	$ 730,000
Runway and Taxiway Strengthening	120 Beach City Road Hilton Head Isl., SC 29926	$ 12,000,000
Parking improvements	120 Beach City Road Hilton Head Isl., SC 29926	$ 20,000,000
		$ 77,430,000
BOAT LANDINGS		
County-wide Boat Landing Study		$ 150,000
Ihly Farm	Ihly Farm Road Beaufort, SC 29906	$ 1,500,000
		$ 1,650,000
DISABILITY AND SPECIAL NEEDS		
Remodeling Building C and laundry room in Building B	100 Clear Water Way, Beaufort, SC 29906	$ 65,000
Purchase/Build two new Community Training Homes	Various Locations South of Broad	$ 900,000
Replacement of HVAC in Building A	100 Clear Water Way, Beaufort, SC 29906	$ 50,000
Replacement of Irrigation	100 Clear Water Way, Beaufort, SC 29906	$ 15,000
		$ 1,030,000

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
$ 1,500,000	$ 1,000,000									GO Bond
				$ 3,500,000	$ 2,500,000					GO Bond
	$ 15,000,000	$ 30,000,000	$ 5,000,000							GO Bond
				$ 4,000,000	$ 7,000,000					GO Bond
						$ 5,000,000				GO Bond
		$ 2,000,000								GO Bond
			$ 2,000,000	$ 7,000,000	$ 7,000,000					GO Bond / Impact Fees
		$ 50,000	$ 75,000	$ 125,000						PW Budget over multiple years
					$ 370,000					GO Bond
						$ 590,000				GO Bond
							$ 335,000			GO Bond
								$ 570,000		GO Bond
$ 650,000	$ 850,000	$ 425,000								
										Impact Fees
										Impact Fees
	$ 25,000									Impact Fees
$ 150,000	$ 150,000									GO Bond/Grants for Critical Infrastructure
$ 150,000										GO Bond/Grants for Critical Infrastructure
						$ 3,000,000				GO Bond
		$ 3,000,000								GO Bond
						$ 2,000,000	$ 5,000,000	$ 10,000,000	$ 3,000,000	GO Bond
							$ 3,000,000	$ 15,000,000	$ 6,000,000	GO Bond
$ 100,000	$ 2,000,000	$ 2,400,000	$ 200,000							FAA,SCAC 95%, Airport 5%
				$ 1,000,000	$ 4,000,000	$ 1,000,000				FAA,SCAC 95%, Airport 5%
$ 100,000	$ 300,000	$ 100,000								Airport/County
			$ 250,000	$ 1,250,000						FAA,SCAC 95%, Airport 5%
$ 15,000,000	$ 18,000,000	$ 7,000,000								FAA,SCAC $21M, Airport $19M
$ 4,300,000										FAA,SCAC 95%, Airport 5%
$ 730,000										FAA,SCAC 95%, Airport 5%
	$ 2,000,000	$ 6,000,000	$ 4,000,000							FAA,SCAC 95%, Airport 5%
				$ 5,000,000	$ 5,000,000	$ 10,000,000				Airport/County/Fees
$ 150,000										A/H Tax
						$ 700,000	$ 800,000			GO Bond / Grants
$ 65,000										DSN Fund
		$ 450,000		$ 450,000						GO Bond / Grants
	$ 50,000									DSN Fund
$ 15,000										DSN Fund

	Location	Estimated Cost
FACILITIES MANAGEMENT		
ADA modifications to facilities	Various Locations	$ 240,000
Administration Building	100 Ribaut Road	
Fire alarm replacement		$ 65,000
Barker Field-restroom renovations	70 Baygall Road	$ 66,000
Beaufort Library-paint exterior/repair windows	311 Scott Street	$ 90,000
BIV#3-generator	106 Industrial Village Road	$ 70,000
BIV#1, 2 and 3-replace carpet	102 Industrial Village Road	$ 60,000
BIV# 5-HVAC	113 Industrial Village Road	$ 90,000
Courthouse	102 Ribaut Road	
Painting/finishes		$ 65,000
Ceremonial courtroom bench millwork repairs		$ 36,000
Replace acoustical tiles/panels/hard surfaces		$ 135,000
HVAC/Energy management system		$ 610,000
Led lighting		$ 65,000
Generator		$ 270,000
Daufuskie Island-restroom renovations	15 Haig Point Road	$ 17,000
Detention Center	106 Ribaut Road	
Fire alarm upgrade		$ 70,000
Misc. lock replacement/repairs		$ 100,000
Replace VCT/flooring covering		$ 250,000
Walk-in/refrigerator replacement		$ 160,000
Stucco repairs		$ 75,000
Repainting		$ 170,000
EMS-carpet/painting	2727 Depot Road	$ 56,000
FVS Garage-replace bay doors/roof repairs	120 Shanklin Road	$ 140,000
HH Government Center-replace roof	539 William Hilton Parkway	$ 70,000
Human Services Building	1905 Duke Street	
Repoint and seal brick veneer		$ 300,000
Painting, lighting, flooring		$ 160,000
Law Enforcement Center-replace flooring/renovate restrooms	2001 Duke Street	$ 95,000
Mosquito Control Building-Minor renovations, roof replacement	84 Shanklin Road	$ 150,000
Myrtle Park Building	4819 Bluffton Parkway	
Replace carpet		$ 65,000
HVAC improvements		$ 580,000
Generator		$ 330,000
BWSAR Building-minor renovations	817 Paris Ave.	$ 55,000
Public Works Building	120 Shanklin Road	
Roof replacement		$ 330,000
HVAC replacement		$ 65,000
Public Works Open Storage Building-replace roof	120 Shanklin Road	$ 65,000
Senior Center-interior renovations	1408 Paris Ave.	$ 40,000
DSN Clearwater-HVAC system	100 Clearwater Way	$ 125,000
Burton Wells Center-HVAC/Energy Mgmt System	One Middleton Rec Drive	$ 180,000
Buckwalter Rec Center-HVAC	900 Buckwalter Parkway	$ 90,000
Lind Brown Center-flooring	1001 Hamar Street	$ 60,000
S. O. Special Ops-Replace roof HVAC	1021 Okatie Highway	$ 45,000
DNA Lab-replace roof, HVAC	111 Industrial Village Road	$ 80,000
St. Helena Library-Replace HVAC	6355 Jonathan Francis Sr. Road	$ 70,000
ECM's-LED lighting, HVAC Energy Mgmt	Various locations	$ 250,000
		$ 6,105,000

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000					
		$ 65,000									
			$ 66,000								
		$ 90,000									
		$ 70,000									
						$ 60,000					
						$ 90,000					
		$ 65,000									
		$ 36,000									
			$ 135,000								
		$ 610,000									
		$ 65,000									
					$ 270,000						
	$ 17,000										
	$ 70,000										
		$ 50,000		$ 50,000							
	$ 250,000										
	$ 160,000										
	$ 75,000										
	$ 170,000										
	$ 56,000										
	$ 140,000										
		$ 70,000									
						$ 300,000					
						$ 160,000					
						$ 95,000					
	$ 150,000										
	$ 65,000										
	$ 580,000										
		$ 330,000									
						$ 55,000					
	$ 330,000										
	$ 65,000										
		$ 65,000									
						$ 40,000					
				$ 125,000							
			$ 180,000								
						$ 90,000					
			$ 60,000								
						$ 45,000					
						$ 80,000					
						$ 70,000					
	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000						

	Location	Estimated Cost
IT INFRASTRUCTURE		
Virtual Server Environment	Beaufort County IT Datacenter	$ 317,000
Network Storage Environment	Beaufort County IT Datacenter	$ 290,000
Core Routers	Beaufort County IT Datacenter	$ 110,000
County Infrastructure Firewalls	`	$ 117,000
Infrastructure Switching	Beaufort County IT Datacenter	$ 715,000
County Infrastruture Compute	Beaufort County IT Datacenter	$ 3,000,000
Infrastructure Phone System	Beaufort County IT Datacenter	$ 200,000
County Infrastructure Wireless	Beaufort County IT Datacenter	$ 340,000
Datacenter Switching	Beaufort County IT Datacenter	$ 182,000
		$ 5,271,000
LIBRARIES		
System-wide Improvements	Various Locations	
Replace Self-Checkout Machines		$ 135,000
Install Public Computer Reservation and Print Vending Solution		$ 100,000
Security Camera Installation		$ 80,000
Replace/Upgrade all public and staff computers		$ 120,000
Pritchardville/New Riverside - New Branch	May River / Buckwalter / New Riverside Area	$ 6,700,000
Construction of 15,000 sf facility (estimate $350/ft2 and $750,000 FFE)		
Bluffton Branch Library	120 Palmetto Way Bluffton, 29910	$ 500,000
Phase II of renovations based on 2019 Space Study		
Hilton Head Branch Library	11 Beach City Road HHI, 29926	$ 1,000,000
Renovations based on 2019 Space Study		
Renovation at Beaufort Branch Library Phase III	311 Scott Street Beaufort, SC 29902	$ 75,000
Renovations/Add-on/Parking		
Replace Bookmobile South	11 Beach City Road HHI, 29926	$ 150,000
Based on a 10 year lifespan, Bookmobile South (acquired in 2018) may need to be replaced in 2028/2029		
Replace Bookmobile North	311 Scott Street Beaufort, SC 29902	$ 150,000
Based on a 10 year lifespan, Bookmobile North (acquired in 2017) may need to be replaced in 2027/2028		
Lobeco Branch Library	1862 Trask Parkway Seabrook, SC 29940	TBD
Existing lease agreement with Beaufort County School District expires December 31, 2025		
Burton Wells	64 Burton Wells Road Beaufort, SC 29906	$ 3,000,000
Construction of 5,000 sf addition to Burton Wells Rec Center		
		$ 12,010,000

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
	$ 317,000										GO Bond
		$ 290,000									GO Bond
				$ 110,000							GO Bond
		$ 117,000									GO Bond
									$ 715,000		
		$ 375,000	$ 375,000	$ 375,000	$ 375,000		$ 375,000	$ 375,000	$ 375,000	$ 375,000	IT General Fund
		$ 200,000									Go Bond
			$ 170,000						$ 170,000		GO Bond
	$ 182,000										GO Bond
					$ 85,000	$ 50,000					Impact Fees
									$ 50,000	$ 50,000	Impact Fees
							$ 80,000				Impact Fees
				$ 120,000							County IT/Library
	$ 100,000	$ 1,900,000	$ 4,700,000								GO Bond / Impact Fees
					$ 500,000						GO Bond/ Impact Fees
				$ 1,000,000							GO Bond/Impact Fees
									$ 75,000		County Facilities
								$ 150,000			Impact Fees
							$ 150,000				Impact Fees
					TBD						County Facilities
							$ 800,000	$ 1,700,000	$ 500,000		GO Bond / Impact Fees

	Location	Estimated Cost
IT INFRASTRUCTURE		
Virtual Server Environment	Beaufort County IT Datacenter	$ 317,000
Network Storage Environment	Beaufort County IT Datacenter	$ 290,000
Core Routers	Beaufort County IT Datacenter	$ 110,000
County Infrastructure Firewalls	`	$ 117,000
Infrastructure Switching	Beaufort County IT Datacenter	$ 715,000
County Infrastruture Compute	Beaufort County IT Datacenter	$ 3,000,000
Infrastructure Phone System	Beaufort County IT Datacenter	$ 200,000
County Infrastructure Wireless	Beaufort County IT Datacenter	$ 340,000
Datacenter Switching	Beaufort County IT Datacenter	$ 182,000
		$ 5,271,000
LIBRARIES		
System-wide Improvements	Various Locations	
Replace Self-Checkout Machines		$ 135,000
Install Public Computer Reservation and Print Vending Solution		$ 100,000
Security Camera Installation		$ 80,000
Replace/Upgrade all public and staff computers		$ 120,000
Pritchardville/New Riverside - New Branch	May River / Buckwalter / New Riverside Area	$ 6,700,000
Construction of 15,000 sf facility (estimate $350/ft2 and $750,000 FFE)		
Bluffton Branch Library	120 Palmetto Way Bluffton, 29910	$ 500,000
Phase II of renovations based on 2019 Space Study		
Hilton Head Branch Library	11 Beach City Road HHI, 29926	$ 1,000,000
Renovations based on 2019 Space Study		
Renovation at Beaufort Branch Library Phase III	311 Scott Street Beaufort, SC 29902	$ 75,000
Renovations/Add-on/Parking		
Replace Bookmobile South	11 Beach City Road HHI, 29926	$ 150,000
Based on a 10 year lifespan, Bookmobile South (acquired in 2018) may need to be replaced in 2028/2029		
Replace Bookmobile North	311 Scott Street Beaufort, SC 29902	$ 150,000
Based on a 10 year lifespan, Bookmobile North (acquired in 2017) may need to be replaced in 2027/2028		
Lobeco Branch Library	1862 Trask Parkway Seabrook, SC 29940	TBD
Existing lease agreement with Beaufort County School District expires December 31, 2025		
Burton Wells	64 Burton Wells Road Beaufort, SC 29906	$ 3,000,000
Construction of 5,000 sf addition to Burton Wells Rec Center		
		$ 12,010,000

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
	$ 317,000										GO Bond
		$ 290,000									GO Bond
				$ 110,000							GO Bond
		$ 117,000									GO Bond
									$ 715,000		
		$ 375,000	$ 375,000	$ 375,000	$ 375,000		$ 375,000	$ 375,000	$ 375,000	$ 375,000	IT General Fund
		$ 200,000									Go Bond
			$ 170,000						$ 170,000		GO Bond
	$ 182,000										GO Bond
					$ 85,000	$ 50,000					Impact Fees
									$ 50,000	$ 50,000	Impact Fees
							$ 80,000				Impact Fees
				$ 120,000							County IT/Library
	$ 100,000	$ 1,900,000	$ 4,700,000								GO Bond / Impact Fees
					$ 500,000						GO Bond/ Impact Fees
				$ 1,000,000							GO Bond/Impact Fees
									$ 75,000		County Facilities
								$ 150,000			Impact Fees
							$ 150,000				Impact Fees
					TBD						County Facilities
							$ 800,000	$ 1,700,000	$ 500,000		GO Bond / Impact Fees

PATHWAYS PROJECTS	Location	Estimated Cost
Stuart Point Road		$ 1,500,000
Big Estate Road		$ 2,000,000
Middle Road		$ 1,500,000
Dr. Martin Luther King, Jr. Road		$ 1,500,000
Meridian Road		$ 1,750,000
Broad River Drive		$ 2,000,000
Ribaut Road to Parris Island Gateway		$ 750,000
Depot Road		$ 725,000
Salem Road/Old Salem Road		$ 1,500,000
Broad River Blvd/Riley Road		$ 750,000
Burton Hill/Old Salem Road		$ 2,000,000
Burnt Church Road		$ 1,500,000
Bluffton Parkway		$ 250,000
Ulmer Road/Shad Road		$ 2,000,000
Laurel Bay Road Pathway Widening		$ 3,900,000
Joe Frazier Road		$ 1,800,000
Lake Point Drive and Old Miller Road Pathway Connection		$ 3,000,000
Alljoy Road		$ 750,000
Spanish Moss Trail Extension		$ 750,000
Pine Grove Road/Burton Wells Road		$ 1,000,000
Seabrook Road		$ 1,000,000
US 17 Pathway Extension		$ 1,000,000
Bruce K Smalls		$ 750,000
Big Road		$ 1,500,000
Detour Road		$ 1,500,000
New River Liner Trail from Hwy 46 South to New River (paving)		$ 750,000
SC46 from New River Park to New River Linear Trail		$ 300,000
Buck Island Road from Bluffton Pkwy to US 278		$ 500,000
Sams Point Road from Wallace Road to southern termini of Middle Road Pathway		$ 550,000
Russel Bell Bridge from Spanish Moss Trail to Broad River Drive		$ 650,000
Lady's Island Drive to Port Royal Elementary / Live Oaks Park via Old Shell Road / 14th Street		$ 650,000
Rugrack Road from Joseph Shanklin Elementary to Laurel Bay Road (sidewalk)		$ 150,000
Spanish Moss Trailfrom Clarendon to Whale Branch		$ 1,500,000
New River Linear Trail from SC46 to Del Webb Trailhead (paving)		$ 900,000
Sawmill Creek Road (sidewalk)		$ 350,000
Okatie Center Blvd N & S and US278 from SC170 to University Blvd		$ 1,100,000
Dr. Martin Luther King, Jr. Road to St. Helena Elementary School		$ 400,000
Wallace Road and Sunset Blvd		$ 750,000
Sams Point Road from traffic circle to Springfield Road		$ 1,250,000
Burton Wells Park to Habersham Market		$ 250,000
Shell Point Road from Broad River Drive to Savannah Hwy		$ 800,000
US21 from Seabrook Road to Keans Neck Road		$ 850,000
US21 from Detour Road to Seabrook Road (sidewalk)		$ 480,000
McTeer Bridge Protected Bike Lanes		$ 300,000
SC46 from traffic circle to Buckwalter Parkway		$ 2,400,000
Northbound side of SC170 from SC46 to Bluffton Parkway		$ 1,700,000
US21 from Sams Point Way to Airport Circle		$ 400,000
Chowan Creek Bluff from US21 to Lady's Island Elementary		$ 230,000
Old Miller Road / Lake Point Drive Connection		$ 200,000
Marsh Road from Duke Street to Boundary Street (a portion to be boardwalk for marsh protection)		$ 150,000
		$ 54,235,000

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
		$ 1,500,000									Sales Tax
					$ 2,000,000						To be determined
			$ 1,500,000								Sales Tax
		$ 1,500,000									Sales Tax
					$ 1,750,000						To be determined
					$ 2,000,000						To be determined
		$ 750,000									Sales Tax
		$ 725,000									Sales Tax / Grants
			$ 1,500,000								Sales Tax
				$ 750,000		$ 1,500,000					To be determined
						$ 2,000,000					To be determined
					$ 1,500,000						Impact Fees
		$ 250,000									Sales Tax
							$ 2,000,000				To be determined
					$ 3,900,000						To be determined
							$ 1,800,000				To be determined
							$ 3,000,000				To be determined
			$ 750,000								Sales Tax
			$ 750,000								To be determined
			$ 1,000,000								To be determined
				$ 1,000,000							To be determined
				$ 1,000,000							To be determined
				$ 750,000							To be determined
				$ 1,500,000							To be determined
				$ 1,500,000							To be determined
				$ 750,000							To be determined
			$ 300,000								To be determined
					$ 500,000						To be determined
			$ 550,000								To be determined
			$ 650,000								To be determined
		$ 650,000									To be determined
		$ 150,000									To be determined
					$ 1,500,000						To be determined
							$ 900,000				To be determined
									$ 350,000		To be determined
										$ 1,100,000	To be determined
						$ 400,000					To be determined
							$ 750,000				To be determined
									$ 1,250,000		To be determined
						$ 250,000					To be determined
								$ 800,000			To be determined
								$ 850,000			To be determined
						$ 480,000					To be determined
								$ 300,000			To be determined
									$ 2,400,000		To be determined
										$ 1,700,000	To be determined
							$ 400,000				To be determined
							$ 230,000				To be determined
										$ 200,000	To be determined
						$ 150,000					To be determined
											To be determined

	Location	Estimated Cost
PARKS AND RECREATION		
New Okatie Recreational Complex		$ 530,000
Buckwalter Recreation Athletic Complex Expansion	905 Buckwalter Pkwy Bluffton, SC 29910	$ 12,000,000
Buckwalter Recreation Center Improvements	905 Buckwalter Pkwy Bluffton, SC 29910	$ 230,000
Bluffton Center Improvements	905 Buckwalter Pkwy Bluffton, SC 29910	$ 565,000
Bluffton Pool Improvements	55 Pritchard Road Bluffton, SC 29910	$ 650,000
MC Riley Complex Reconfiguration and Improvements	185 Goethe Road Bluffton, SC 29910	$ 1,300,000
Agnes Major Improvements	21 Agnes Major Road Seabrook, SC 29940	$ 555,000
Basil Green Complex Improvements	15000 Rodgers Street Beaufort, SC 29902	$ 4,000,000
Battery Creek Pool Improvements	1 Blue Dolphin Dr. Beaufort, SC 29906	$ 650,000
Beaufort High School Pool Improvements	84 Sea Island Pkwy Beaufort, SC 29907	$ 650,000
Booker T. Washington Improvements	182 Booker T. Washington Circle Yemassee, SC 29945	$ 225,000
Broomfield Ballfield Improvements	205 Brickyard Point Road N. Beaufort, SC 29907	$ 225,000
Burton Wells Master Plan	64 Burton Wells Road Beaufort, SC 29906	$ 12,000,000
Burton Wells Improvements	64 Burton Wells Road Beaufort, SC 29906	$ 75,000
Coursen Tate Improvements	9 Springfield Road Beaufort, SC 29907	$ 800,000
Dale Center Improvements	15 Community Center Road Seabrook, SC 29940	$ 365,000
Downtown Tennis Court Improvements	1105 Bladen Street Beaufort, SC 29902	$ 340,000
Gloria Potts Improvements	130 Seaside Road St. Helena, SC 29920	$ 170,000
Lind Brown Improvements	1001 Hamar Street Beaufort, SC 29902	$ 2,585,000
Metz Improvements	1812 National Street Beaufort, SC 29902	$ 220,000
Port Royal Park Improvements		$ 555,000
Scott Park Improvements	242 Scott Hill Road St. Helena, SC 29920	$ 205,000
Shell Point Park Improvements	381 Broad River Road Beaufort, SC 29906	$ 190,000
Southside Park Improvements	1408 Battery Creek Road Beaufort, SC 29902	$ 110,000
Wesley Felix Improvements	179 Ball Park Road St. Helena, SC 29920	$ 165,000
Lady's Island Community Park Phase II		$ 1,800,000
		$ 41,160,000
PASSIVE PARKS		
Fort Fremont Park Phase II - Interpretive Center	1126 State Road S-7-45 St. Helena, SC 29920	$ 2,000,000
Widgeon Point Park	43 Okatie Hwy Okatie, SC 29909	$ 1,300,000
Okatie Park Development		$ 5,000,000
Develop Jones Tract Park		$ 5,000,000
Develop Okatie Preserve	Hwy 278/170 Bluffton, SC 29910	$ 4,000,000
		$ 17,300,000

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
			$ 530,000								PALS Impact Fees / Grants / Bonds
300000	$ 900,000	$ 5,600,000	$ 3,200,000	$ 2,000,000							PALS Impact Fees / Grants / Bonds
				$ 150,000			$ 80,000				PALS Impact Fees / Grants / Bonds
		$ 25,000	$ 20,000		$ 80,000	$ 80,000	$ 350,000	$ 10,000			PALS Impact Fees / Grants / Bonds
		$ 100,000	$ 400,000	$ 100,000	$ 50,000						PALS Impact Fees / Grants / Bonds
				$ 500,000	$ 400,000	$ 100,000	$ 300,000				PALS Impact Fees / Grants / Bonds
		$ 15,000	$ 80,000		$ 300,000	$ 160,000					PALS Impact Fees / Grants / Bonds
		$ 800,000	$ 1,500,000	$ 900,000	$ 800,000						PALS Impact Fees / Grants / Bonds
				$ 200,000	$ 350,000	$ 100,000					PALS Impact Fees / Grants / Bonds
					$ 200,000	$ 350,000	$ 100,000				PALS Impact Fees / Grants / Bonds
			$ 15,000		$ 60,000	$ 150,000					PALS Impact Fees / Grants / Bonds
			$ 15,000				$ 150,000		$ 60,000		PALS Impact Fees / Grants / Bonds
					$ 1,500,000	$ 3,000,000	$ 3,000,000	$ 2,500,000	$ 1,200,000	$ 800,000	Funds Needed
		$ 20,000	$ 25,000	$ 30,000							PALS Impact Fees / Grants / Bonds
		$ 600,000				$ 80,000		$ 120,000			PALS Impact Fees / Grants / Bonds
				$ 25,000	$ 40,000		$ 80,000	$ 200,000	$ 20,000		PALS Impact Fees / Grants / Bonds
	$ 60,000	$ 200,000	$ 80,000								PALS Impact Fees / Grants / Bonds
					$ 80,000		$ 30,000	$ 60,000			PALS Impact Fees / Grants / Bonds
				$ 25,000		$ 700,000	$ 500,000	$ 1,200,000	$ 160,000		PALS Impact Fees / Grants / Bonds
					$ 220,000						PALS Impact Fees / Grants / Bonds
					$ 250,000	$ 100,000	$ 80,000	$ 125,000			PALS Impact Fees / Grants / Bonds
				$ 65,000	$ 80,000		$ 60,000				PALS Impact Fees / Grants / Bonds
				$ 50,000			$ 80,000		$ 60,000		PALS Impact Fees / Grants / Bonds
				$ 50,000					$ 60,000		PALS Impact Fees / Grants / Bonds
				$ 65,000					$ 100,000		PALS Impact Fees / Grants / Bonds
						$ 1,000,000	$ 800,000				PALS Impact Fees / Grants / Bonds
$ 1,700,000	$ 300,000										Rural & Critical
$ 1,000,000	$ 300,000										Rural & Critical
	$ 1,000,000	$ 3,000,000	$ 1,000,000								
			$ 800,000	$ 3,200,000	$ 1,000,000						GO Bonds
				$ 2,000,000	$ 2,000,000						GO Bonds

	Location	Estimated Cost
PUBLIC SAFETY		
New EMS Facilities	Various Locations	$ 3,388,000
North Shanklin Facility		
South Station 31 Facility		
Cherry Point New Facility		$ 1,300,000
Ladys Island/St Helena New Facility		$ 1,300,000
Palmetto Bluff New Facility		$ 1,300,000
Big Estate/Gardens Corner New Facility		$ 1,425,000
Base Headquarters - Depot		$ 6,000,000
Sun City Station	Various Locations	$ 1,000,000
EMS Facility Renovations		
Parris Island Gateway, Burton FD		$ 125,000
Kean Neck Road, Sheldon FD		$ 100,000
Sea Island Parkway, Ladys Island/St Helena FD		$ 50,000
Sam's Point Road, Ladys Island/St Helena FD		$ 75,000
Shanklin Road Facility		$ 25,000
Detention Center Expansion - Property Acquisition	100 Ribaut Road Beaufort, SC 29902	$ 6,000,000
Transform Pre-class 16-bed open bay unit into modular cells	100 Ribaut Road Beaufort, SC 29902	$ 250,000
Retrofit cell doors w/food pass entry	100 Ribaut Road Beaufort, SC 29902	$ 485,000
Detention Center Expansion	100 Ribaut Road Beaufort, SC 29902	$ 92,000,000
LEC, EM Complex	TBD	$ 111,000,000
30 Acres for LEC, EM, EMS and MIS Complex		
Construction of 70,000 sf for LEC & EM Facility		
Sheriff's Office (50,000 sf)		
Emergency Management Center (20,000 sf)		
Sale of Depot Road Facility		$ (500,000)
Station Alerting System	2001 Duke Street Beaufort, SC 29902	$ 2,500,000
Old Federal Courthouse Renovation	1501 Bay Street Beaufort, SC 29901	$ 3,000,000
Special Ops Building	HWY 170 Okatie, SC 29909	$ 7,000,000
		$ 237,823,000
PUBLIC WORKS		
Public Works		
Countywide Parking lot study analysis/assessment - Phase I (Study only)	Various Locations	$ 100,000
Countywide Parking lot study analysis/assessment - Phase II (Repairs)	Various Locations	$ 2,000,000
Mosquito Control	84 Shanklin Road Beaufort, SC 29906	
Biosafety Level 2 Surveillance Laboratory		$ 600,000
10-Bay Pole Shelter		$ 165,000
Stormwater		
Brewer Memorial Park Demonstration Wet Pond Project Feasibility		$ 672,459
Salt Creek South M1		$ 2,117,730
Shanklin Road M2		$ 3,458,787
Mossy Oaks Watershed		$ 220,404
Evergreen Tract Detention Basin		$ 1,060,806
Rock Springs Creek 1		$ 430,524
Lucy Point Creek (Tuxedo)		$ 438,293
Albergotti Creek 2		$ 602,447
Factory Creek I		$ 68,727
Factory Creek II		$ 66,390
Graves/Pepper Hall P3		$ 500,000
Shell Point		$ 98,000
Huspah Creek		$ 595,000
Traffic Operations		
Traffic Operations ITS		$ 65,000
Traffic Sign Shop	23 Shelter Church Road Beaufort, SC 29906	$ 250,000
		$ 13,509,567

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
2,257,500	$ 967,500	$ 163,000									GO Bond
		$ 1,300,000									GO Bond
		$ 1,300,000									GO Bond
				$ 1,300,000							GO Bond
								$ 1,425,000			GO Bond
		$ 1,500,000	$ 2,200,000	$ 2,300,000							
	30,000	$ 500,000	$ 470,000								GO Bond / BTFD
											GO Bond
			$ 125,000								GO Bond
				$ 100,000							GO Bond
			$ 50,000								GO Bond
				$ 75,000							GO Bond
		$ 25,000									Budget
			$ 1,500,000	$ 3,200,000	$ 1,300,000						GO Bond
		$ 250,000									GO Bond
		$ 485,000									GO Bond
									$ 500,000	$ 3,000,000	GO Bond
								$ 6,000,000	$ 80,000,000	$ 25,000,000	
											GO Bond
											GO Bond
					$ (500,000)						
				$ 1,500,000	$ 1,000,000						
	$ 3,000,000										
							$ 7,000,000				
			$ 100,000								Public Works General Fund
				$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000			GO Bond / Grant
			$ 200,000	$ 400,000							Mos. Control General Fund
		$ 165,000									Mos. Control General Fund
10,760	$ 643,106										Stormwater Fees
36,098	$ 248,496	$ 823,424	$ 823,424								Stormwater Fees
70,356	$ 341,820	$ 1,100,000	$ 1,100,000								Stormwater Fees
15,404	$ 205,000										Stormwater Fees
32,726	$ 840,000										Stormwater Fees
	$ 43,052		$ 86,105	$ 301,367							Stormwater Fees
		$ 87,659	$ 350,634								Stormwater Fees
						$ 120,489	$ 481,958				Stormwater Fees
	$ 327										Stormwater Fees
	$ 20,551										Stormwater Fees
	$ 500,000										Stormwater Fees
43,750	$ 54,250										Stormwater Fees
		$ 227,000	$ 368,000								Stormwater Fees
		$ 65,000									1% Sales Tax
	$ 100,000	$ 150,000									General Fund

	Location	Estimated Cost	
ROAD PROJECTS			
US 278 Bridge Widening 6-lane from Bluffton 5A to Jenkins Island		$ 245,000,000	$
US 278/SC170 Interchange - Ramp reconfiguration for added capacity		$ 25,000,000	
US 278 Access Management		$ 12,600,000	
SC 170 (US 278 to Tide Watch Dr.)		$ 41,000,000	
SC 170 (Tide Watch Dr to Argent Blvd)		$ 40,000,000	
SC 170 (Argent Blvd to SC 462)		$ 10,000,000	
Buckwalter Parkway Access Management - Roadway Connectivity		$ 10,000,000	
Bluffton Parkway Access Management - Roadway Connectivity		$ 20,000,000	
SC 46 Widening (Jasper County Line to SC 170)		$ 45,000,000	
SC 46 Widening (SC 170 to Buck Island Road)		$ 40,000,000	
Burnt Church Road Widening (Bluffton Pkwy to Alljoy Road)		$ 15,000,000	
Buck Island Road Widening (US 278 to Bluffton Parkway)		$ 10,000,000	
Lake Point Drive / Old Miller Road Connection		$ 2,000,000	
Innovation Drive		$ 2,500,000	
16 Traffic Signals		$ 8,000,000	
Rose Hill to Buck Island Road Connection		$ 4,000,000	
Bruin Road Extension (Burnt Church Rd to Buckingham Plantation)		$ 20,000,000	
Foreman Hill Road Improvements		$ 1,000,000	
Bluffton Parkway 5B		$ 50,000,000	
US 278 Widening (SC 170 to Jasper County Line)		$ 20,000,000	
H.E. McCracken Circle		$ 5,000,000	
Hampton Parkway Realignment		$ 6,000,000	
Gum Tree Road (US 278 to Squire Pope Road)		$ 20,000,000	
Gum Tree Interchange		$ 35,000,000	
US 278 Access Road (Squire Pope Road to Gum Tree Road)		$ 80,000,000	
Wilburn Rd/Bus Dr Improvements		$ 6,000,000	
US 21/SC 802 Connector SE (Hazel Farms Road)		$ 5,244,000	$
US 21/SC 802 Connector NW (Sunset/Miller Road)		$ 6,500,000	$
US 21/SC 802 Intersection Improvement (Sea Island Pkwy/Sams Pt. Road)		$ 2,500,000	$
Sea Island Parkway Improvements		$ 40,000,000	$
Joe Frazier Road Improvements		$ 7,000,000	
US 21 at US 128 (Savannah Hwy) Intersection Improvement		$ 1,000,000	
US 21/SC 128 Intersecion Improvement (Ribaut Road/Lady's Island Drive)		$ 1,000,000	
Spine Road-Port Royal Port		$ 5,000,000	
10 Traffic Signals		$ 5,000,000	
Port Royal Road Interconnectivity (Ribaut Rd to WestvVine Dr)		$ 2,000,000	
Boundary Street Connectivity (Polk St. Parallel Road)		$ 6,000,000	
Calhoun Street		$ 2,500,000	$
Duke Street		$ 1,750,000	
Boundary Street Improvements - Phase 2 (Neil Road to Albergotti Creek Bridge)		$ 60,000,000	
Ribaut Road Improvements (Boundary Street to Parris Island Bridge)		$ 60,000,000	
US 21 (Carteret St) Upgrades (Ribaut Rd to Woods Memorial Bridge)		$ 10,000,000	
US 21 (Lady's Island Drive) Improvements (Lady's Island Bridge to US 21/Sea Island Parkway)		$ 10,000,000	
US21 Improvements (Trask Parkway to Parris Island Bridge)		$ 10,000,000	
SC 170 Access Management Connectivity NOB		$ 4,000,000	
SC 170/US 21 Intersection Improvement		$ 5,000,000	
US 21/SC 128 Intersecion Improvement (Ribaut Road/Old Savannah Hwy)		$ 5,000,000	
SC 170 Robert Smalls Parkway (Boundary Street to Broad River Bridge)		$ 8,000,000	
US 17A By-Pass (Yemassee)		$ 10,000,000	
SC 68 Improvements (I-95 to US 17A)		$ 5,000,000	
I-95 Exit 38 Improvements		$ 5,000,000	
Beaufort - Yemassee Rail Trail		$ 15,000,000	
		$ 1,065,594,000	

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Funding Sources
2,000,000	$ 11,000,000	$ 25,000,000	$ 67,000,000	$ 80,000,000	$ 60,000,000						1% Sales Tax/SIB
		$ 15,000,000	$ 10,000,000								1% Sales Tax/SIB
						$ 12,600,000					Impact Fees / Grants
	$ 2,000,000	$ 15,000,000	$ 24,000,000								Impact Fees / Grants
	$ 2,000,000	$ 13,000,000	$ 12,500,000	$ 12,500,000							Impact Fees / Grants
		$ 2,000,000	$ 4,000,000	$ 4,000,000							
		$ 2,000,000		$ 2,000,000		$ 2,000,000		$ 2,000,000		$ 2,000,000	Impact Fees / Grants
	$ 4,000,000		$ 4,000,000		$ 4,000,000		$ 4,000,000		$ 4,000,000		
								$ 10,000,000	$ 25,000,000	$ 10,000,000	
				$ 10,000,000	$ 20,000,000	$ 10,000,000					
	$ 3,000,000	$ 7,000,000	$ 5,000,000								Impact Fees / Grants
		$ 1,000,000	$ 6,000,000	$ 3,000,000							Impact Fees / Grants
		$ 2,000,000									Impact Fees / Grants
	$ 2,500,000										Impact Fees / Grants
	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000			
					$ 2,000,000	$ 2,000,000					
								$ 3,000,000	$ 12,000,000	$ 5,000,000	
							$ 1,000,000				
					$ 5,000,000	$ 20,000,000	$ 20,000,000	$ 5,000,000			
		$ 3,000,000	$ 12,000,000	$ 5,000,000							
					$ 1,000,000	$ 4,000,000					
						$ 1,500,000	$ 4,500,000				
		$ 3,000,000	$ 12,000,000	$ 5,000,000							
				$ 5,000,000	$ 20,000,000	$ 10,000,000					
							$ 10,000,000	$ 30,000,000	$ 30,000,000	$ 10,000,000	
				$ 1,000,000	$ 5,000,000						
744,000	$ 3,500,000	$ 1,000,000									
500,000	$ 3,000,000	$ 3,000,000									
500,000	$ 2,000,000										
1,000,000	$ 5,000,000	$ 15,000,000	$ 15,000,000	$ 4,000,000							
			$ 1,000,000	$ 4,000,000	$ 2,000,000						
			$ 1,000,000								
		$ 1,000,000									
	$ 5,000,000										
	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	
	$ 2,000,000										
	$ 1,000,000	$ 5,000,000									
500,000	$ 2,000,000										
	$ 250,000	$ 1,500,000									
					$ 6,000,000	$ 25,000,000	$ 20,000,000	$ 9,000,000			
		$ 6,000,000	$ 25,000,000	$ 20,000,000	$ 9,000,000						
				$ 4,000,000	$ 6,000,000						
					$ 4,000,000	$ 6,000,000					
						$ 4,000,000	$ 6,000,000				
				$ 2,000,000				$ 2,000,000			
							$ 5,000,000				
				$ 5,000,000							
					$ 4,000,000	$ 4,000,000					
							$ 3,000,000	$ 7,000,000			
					$ 1,000,000	$ 4,000,000					
									$ 5,000,000		
					$ 1,500,000	$ 1,500,000	$ 6,000,000	$ 6,000,000			

SOLID WASTE AND RECYCLING			
Bluffton Convenience Center Improvements	104 Simmonsville Road, Bluffton, SC	$	650,000
Hilton Head Convenience Center Improvements	26 Summit Drive, Hilton Head, SC	$	650,000
Shanklin Convenience Center Improvements	80 Shanklin Road, Beaufort SC	$	650,000
St. Helena Convenience Center Improvements	639 Sea Island Parkway, St. Helena Island SC	$	650,000
Household Hazardous Waste Facility	108 Shanklin Road, Beaufort SC	$	500,000
Upgrade White Goods Collection Area	80 Shanklin Road, Beaufort SC	$	250,000
MRF Facility - Phase 1 (Dual Stream)	104 Simmonsville Road, Bluffton, SC	$	2,000,000
New Tire Facility - South	104 Simmonsville Road, Bluffton, SC	$	300,000
MRF Facility - Phase 2 (Single Stream)	104 Simmonsville Road, Bluffton, SC	$	5,250,000
LCD Compost Site	TBD	$	2,500,000
MSW Transfer Facility	TBD	$	10,000,000
C&D Transfer Facility	TBD	$	10,000,000
Waste to Energy Facility	TBD	$	30,000,000
		$	63,400,000

					$ 650,000						Enterprise Fund
					$ 650,000						Enterprise Fund
					$ 650,000						Enterprise Fund
					$ 650,000						Enterprise Fund
			$ 500,000								Enterprise Fund
		$ 250,000									Enterprise Fund
	$ 2,000,000										Enterprise Fund
	$ 300,000										Enterprise Fund
				$ 5,250,000							Enterprise Fund
			$ 2,500,000								Enterprise Fund
			$ 10,000,000								Enterprise Fund
							$ 10,000,000				Enterprise Fund
						$ 30,000,000					Enterprise Fund
14,722,714	$ 87,343,228	$ 190,151,215	$ 292,251,301	$ 212,843,511	$ 201,017,150	$ 176,277,645	$ 137,279,120	$ 100,862,168	$ 190,127,174	$ 68,737,180	

APPENDIX

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE A MODIFICATION OF DRAINAGE EASEMENT ASSOCIATED WITH PARCEL R112-031-000-0628-0000

MEETING NAME AND DATE:

County Council Meeting 9-27-21

PRESENTER INFORMATION:

Jared Fralix, P.E., Assistant County Administrator, Engineering

Neil J. Desai, P.E., Public Works Director

(5 Minutes)

ITEM BACKGROUND:

Unanimously Approved at PFC on 9-20-21

Beaufort County was granted a 40' drainage easement by William D. Trask and Harold E. Trask, Jr, recorded in Deed Book 567 on Pages 1768-1769 on 12- 28-1990. The existing drainage ditch does not lie in the area depicted on the Original Easement Plat, and a portion of the Original Drainage Easement associated with parcel R112-031-000-0628-0000 was abandoned. Ditch is located off Hwy 170 near Ashton Overlook Dr.

PROJECT / ITEM NARRATIVE:

A Modification to the original easement will correct the drainage easement location to the existing ditch location.

FISCAL IMPACT:

N/A

STAFF RECOMMENDATIONS TO COUNCIL:

Staff recommends approving County Administrator to execute Modification of Drainage Easement associated with Parcel R112-031-000-0628-0000

OPTIONS FOR COUNCIL MOTION:

Motion to approve/Deny County Administrator to execute Modification of Drainage Easement associated with Parcel R112-031-000-0628-0000.

(Next Step) Move forward with ordinance process

STATE OF SOUTH CAROLINA	**)**	**MODIFICATION OF**
	)	**DRAINAGE EASEMENT**
	)	**(ORB 567 PAGE 1768)**
COUNTY OF BEAUFORT	**)**	**(PB 40 PAGE 52)**

THIS MODIFICATION OF DRAINAGE EASEMENT ("Modification") is made effective August 1, 2021, by and between ASHTON POINTE PROPERTY LIMITED PARTNERSHIP, a Virginia limited partnership ("Owner"), and BEAUFORT COUNTY, a body politic and political subdivision of the State of South Carolina ("County").

WHEREAS, the Owner owns real property located in the Town of Port Royal, Beaufort County, South Carolina more particularly described on Exhibit A attached hereto and incorporated herein ("Burdened Property"); and

WHEREAS, the Owner's predecessor in interest granted to the County a drainage easement over certain portions of the Burdened Property by that certain Drainage Easement dated September 7, 1990 and recorded in the Office of the Beaufort County Register of Deeds in Book 567 at Page 1768 (the "Original Drainage Easement"); and

WHEREAS, the Original Drainage Easement referenced a Sketch Map titled "Drainage Canal Easement Across the Lands Between S.C. Hwy. 20 and S.C. Hwy. 802", which such Sketch Map was later recorded in the Beaufort County Register of Deeds' Office in Plat Book 40 at Page 52 (said Sketch Map, the "Original Easement Plat") and

WHEREAS, because (i) the existing drainage ditch on the Burdened Property, as constructed, does not lie in the area depicted on the Original Easement Plat, and (ii) a portion of the Original Drainage Easement was abandoned by the County, the parties hereof have agreed to this Modification to amend the terms of the Original Drainage Easement to correctly depict and describe the location of the Revised Drainage Easement, as defined and as set forth below.

NOW, THEREFORE, for Ten Dollars and no other consideration, the legal sufficiency of which the parties expressly acknowledge, the parties agree as follows:

1. **Grant of Drainage Easement**. Owner hereby grants, conveys and releases, and by these presents does grant, convey, and release unto the County, its successors and assigns, a drainage easement in, over, and through those areas within the Burdened Property labeled as "Proposed 40' Ditch Esmt. ("Revised Drainage Easement") on that certain plat entitled "Subdivision Plat Also Showing New Wetland Buffers & Ditch Easement" prepared by Beaufort Surveying, Inc. dated February 14, 2006, last revised January 30, 2008, and attached hereto as Exhibit B ("Revised Drainage Easement Plat"). The County shall not materially disrupt nor unreasonably interfere with Owner, or its tenants, invitees, agents, lessees or principals' use of the Burdened Property while exercising its rights hereunder, nor shall Owner materially or unreasonably interfere or impede the County's easement rights hereunder.

2. **Modification of Original Easement and Original Easement Plat**. The Original Drainage Easement is hereby modified by removing all references to the Original Easement Plat and replacing the same with the Revised Drainage Easement Plat. The Original Easement Plat is replaced by the Revised Drainage Easement Plat. The depiction and location of the Original Drainage Easement on the Burdened Property, as shown on the Original Easement Plat, is hereby replaced with the Revised Drainage Easement as depicted on the Revised Drainage Easement Plat. To the extent the Original Drainage Easement granted to the County easement rights over the Burdened Property not located within Revised Drainage Easement as shown on the Revised Drainage Easement Plat, such easement rights are hereby terminated and abandoned, including without limitation, any easement rights located within the hatched area on the Revised Drainage Easement Plat labeled as "To Be Filled 0.639 acres".

3. **Modification of Original Easement Terms**. The provisions and terms set forth in the Original Drainage Easement are hereby modified as follows:

a. All County inspection and maintenance work to the Revised Drainage Easement shall be conducted between the hours of 9:00 a.m. and 5:00 p.m., Monday through Friday. Notwithstanding the preceding, the County may access the Revised Drainage Easement at any time and any day in the event of emergency to conduct emergency repairs or maintenance. The County shall maintain the Revised Drainage Easement to accommodate the flow of drainage and prevent the growth of weeds and underbrush within the Revised Drainage Easement.

b. The County's access to the Revised Drainage Easement is limited to the roadways within the Burdened Property.

c. Section 4 "Special Provisions" of the Original Drainage Easement is no longer applicable and is hereby deleted in its entirety.

d. The Owner shall have the right to maintain, repair and reconstruct the existing Ashton Overlook Drive that crosses the Revised Drainage Easement.

e. The Owner shall have the right to use the Burdened Properly, so long as said use does not impede drainage through the Revised Drainage Easement or damage or compromise any drainage infrastructure installed by the County. Such rights shall include the right to run conduits for electrical, cable, internet, telephone and other utility wiring across the Revised Drainage Easement.

4. **Severability**. In the event any provision hereof is held to be invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of any other provision hereof and this Modification shall be construed in all respects as if such invalid or unenforceable provision were omitted.

5. **Remedies**. In the event of any breach of the terms and conditions of this Modification, the non-breaching party shall be entitled to bring an action in law or in equity against the breaching party. All remedies shall be available to the non-breaching party including, but not limited to, specific performance and actual damages.

6. **Attorney's Fees and Costs**. In the event it is necessary for any party to this Modification to initiate any legal proceeding whatsoever for the purpose of enforcing its rights under this Modification, the prevailing party is entitled to recover any and all expenses, including but not limited to. court costs and reasonable attorney's fees incurred in connection therewith, from the non-prevailing party.

7. **Governing Law**. This Agreement shall be construed, governed and interpreted in accordance with the laws of State of South Carolina.

8. **Successors and Assigns**. This Modification shall run with the Burdened Property and shall be binding upon the Owner and the County, and their respective successors and assigns.

9. **Miscellaneous**. This Modification shall be recorded in the Beaufort County Register of Deeds Office.

10. **Amendments to be Written**. There are no oral understandings, terms or conditions, or no party hereto has relied any representations, express or implied, not contained in this Modification. This Modification may not be amended or further modified except by written modification executed by the parties hereto.

WITNESS our hands and seals effective as of the date first written above

WITNESSES:

Ashton Pointe Property Limited Partnership, a Virginia limited partnership

By: HHHunt Corporation
Its: General Partner

_________________________ _____________________________________
By: Brian C. Myers
Its: Vice President

____

STATE OF NORTH CAROLINA)
) NOTARY ACKNOWLEDGMENT
COUNTY OF WAKE)

I, the undersigned ____ _________________________, a Notary Public for the State of North Carolina, do hereby certify that Brian C. Myers, Vice President of HHHunt Corporation, the general partner of Ashton Pointe Property Limited Partnership, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this the ___________________________ day of ______, 2021.

_______________________________(SEAL)
Notary Public
My commission expires:

WITNESSES:	Beaufort County, a body politic and a political subdivision of the State of South Carolina
________________________	____________________________________ By: Eric L. Greenway Its: County Administrator
________________________	

STATE OF SOUTH CAROLINA)
) NOTARY ACKNOWLEDGMENT
COUNTY OF BEAUFORT)

I, the undersigned ____ ________________________, a Notary Public for the State of North Carolina, do hereby certify that ____, _____ ____ of Beaufort County, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this the __________________________ day of _____, 2021.

______________________________(SEAL)
Notary Public
My commission expires:

EXHIBIT A

Legal Description of Burdened Property

ALL that certain piece, parcel or tract of land, situate, lying and being in the Town of Port Royal, Beaufort County, South Carolina, measuring and containing 16.590 acres, more or less, as more particularly shown and designated as "PARCEL 'B', 16.590 ACRES" on that certain plat entitled, "SUBDIVISION PLAT ALSO SHOWING NEW WETLAND BUFFERS & DITCH EASEMENT PREPARED FOR ASHTON POINTE PROPERTY LIMITED PARTNERSHIP MU1 PORTION OF TRASK PROPERTY (P.O. 112-31-595) BEAUFORT COUNTY, SOUTH CAROLINA 31.619

ACRES TOTAL" prepared by David C. Youmans dated February 14, 2006 and recorded in the ROD Office for Beaufort County in Plat Cabinet 111 at page 189 (the "Plat"). Said tract of land having such size, shape, buttings and boundings as will by reference to said plat more fully appear.

BEING THE SAME property conveyed by Grantors here in to Ashton Pointe Property Limited Partnership, a Virginia limited partnership by deed dated February 22, 2006 and recorded February 24, 2006 in Deed Book 2325, Page 2557-2566 in the ROD Office for Beaufort County as previously conveyed to the Grantors herein by deed recorded on February 24, 2005, in the ROD Office for Beaufort County in Book 1418, at page 2203 in the ROD Office for Beaufort County.

TMS# R112-031-00-0628-0000-00

Exhibit "B"

VICINITY MAP NOT TO SCALE

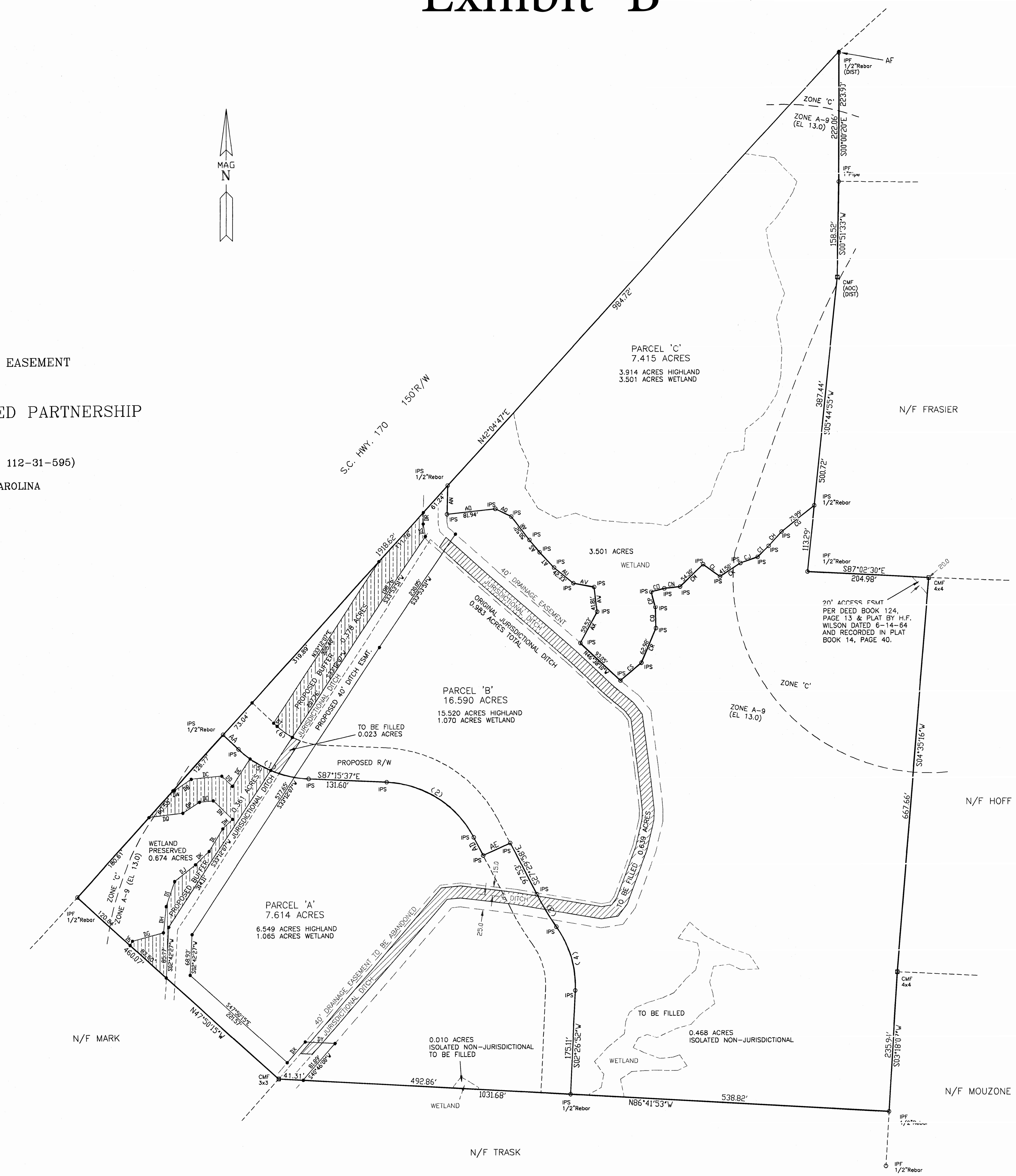
SUBDIVISION PLAT
ALSO SHOWING
NEW WETLAND BUFFERS & DITCH EASEMENT
PREPARED FOR

ASHTON POINTE PROPERTY LIMITED PARTNERSHIP

MU1 PORTION OF TRASK PROPERTY (P.O. 112-31-595)

BEAUFORT COUNTY SOUTH CAROLINA

31.619 ACRES TOTAL



WETLAND PERMIT # - SAC39-2005-0686-1

NO.	DELTA	RADIUS	ARC	TANGENT	C.BEARING	CHORD
1	41°10'08"	183.00'	131.49'	68.73'	S66°40'33"E	128.68'
2	59°45'39"	175.00'	182.53'	100.55'	S57°22'48"E	174.37'
3	7°40'23"	475.00'	63.61'	31.85'	S31°20'09"E	63.57'
4	37°37'13"	175.00'	114.90'	59.61'	S16°21'44"E	112.85'

NO.	DELTA	RADIUS	ARC	TANGENT	C.BEARING	CHORD
5	12°34'21"	183.00'	40.16'	20.16'	S60°18'48"E	40.08'
6	15°39'21"	117.50'	32.11'	16.15'	N53°55'10"W	32.01'

NO.	BEARING	DISTANCE
AA	S46°05'29"E	36.12'
AD	S27°29'58"E	34.78'
AE	N65°21'57"E	50.06'
AF	S00°00'20"E	1.83'
AN	S01°18'09"W	48.68'
AO	N83°55'59"E	81.94'
AQ	S63°51'30"E	29.76'
AR	S37°12'23"E	50.52'
AS	S39°02'47"E	27.18'
AT	S43°10'50"E	35.71'
AU	S50°35'50"E	42.33'
AV	S78°59'29"E	35.75'
AW	S06°40'14"E	41.81'
AX	S28°16'57"W	59.53'
CG	N51°15'28"E	70.99'
CH	N41°45'40"E	32.62'
CI	N45°17'12"E	26.38'
CJ	N70°49'49"E	30.66'
CK	N56°15'29"E	41.50'
CL	S53°28'47"E	35.44'
CM	N45°45'41"E	54.30'
CN	N84°00'11"E	26.67'
CO	N75°22'29"E	22.91'
CP	N15°14'12"W	26.42'
CQ	N01°16'21"W	35.65'
CR	N22°49'43"E	62.98'
CS	N49°40'06"E	46.42'

NO.	BEARING	DISTANCE
DA	N83°23'56"E	2.77'
DB	N56°44'02"E	33.99'
DC	N84°30'00"E	51.76'
DD	S45°51'14"E	24.56'
DE	N33°12'07"E	54.94'
DF	N29°09'11"E	8.15'
DG	N75°01'07"E	54.21'
DH	N05°52'58"E	43.92'
DI	N18°38'12"E	44.26'
DJ	N51°56'00"E	45.03'
DK	N45°30'03"E	32.06'
DL	N31°03'03"E	44.51'
DM	N45°57'18"E	22.77'
DN	N45°51'13"W	45.23'
DO	S84°30'00"W	23.37'
DP	S56°44'03"W	33.58'
DQ	S83°23'51"W	57.75'
DR	S01°18'09"W	19.54'
DS	S09°55'31"E	21.71'
DT	N46°05'30"W	8.18'
DX	N40°46'00"E	46.18'
DY	S86°41'53"E	50.40'

THIS PROPERTY IS LOCATED IN ZONES A-9 (EL 13.0) & C AS DETERMINED BY FEMA, FIRM COMMUNITY-PANEL NUMBER 450025 0065 D, DATED 9-29-86.

R112-031-000-0595-0000 (PORTION OF)

0 50' 100' 200' 300'

SCALE 1" = 100'

FEBRUARY 14, 2006

REVISED 5-18-07 - CORRECTED FLOOD ZONE
REVISED 1-30-08 - ADJUSTED FILLED DITCH AREA

P12611A/MMA

THIS PLAT SUPERSEDES PLAT RECORDED IN PLAT BOOK 120, PAGE 19.

I HEREBY STATE THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF, THE SURVEY SHOWN HEREON WAS MADE IN ACCORDANCE WITH THE REQUIREMENTS OF THE MINIMUM STANDARDS MANUAL FOR THE PRACTICE OF LAND SURVEYING IN SOUTH CAROLINA, AND MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS B SURVEY AS SPECIFIED THEREIN.
ALSO THERE ARE NO VISIBLE ENCROACHMENTS OR PROJECTIONS OTHER THAN SHOWN.

SOUTH CAROLINA BEAUFORT SURVEYING INC. No. 00189 CERTIFICATE OF AUTHORIZATION

DAVID S. YOUMANS RLS 9765
BEAUFORT SURVEYING, INC.
1613 PARIS AVENUE
PORT ROYAL, S.C. 29935
PHONE (843) 524-3261

ORDINANCE NO. 2021/________

AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE A MODIFICATION OF DRAINAGE EASEMENT ASSOCIATED WITH PARCEL R112-031-000-0628-0000

WHEREAS, Beaufort County was granted a 40' drainage easement by William D. Trask and Harold E. Trask, Jr, recorded in Deed Book 567 on Pages 1768-1769 on December 28, 1990 (the "Original Drainage Easement"); and

WHEREAS, the Original Drainage Easement referenced a Sketch Map titled "Drainage Canal Easement Across the Lands Between S.C. Hwy. 20 and S.C. Hwy. 802", which such Sketch Map was later recorded in the Beaufort County Register of Deeds' Office in Plat Book 40 at Page 52 (said Sketch Map, the "Original Easement Plat"); and

WHEREAS, the existing drainage ditch does not lie in the area depicted on the Original Easement Plat, and a portion of the Original Drainage Easement associated with parcel **R112-031-000-0628-0000** located in the Town of Port Royal, Beaufort County, South Carolina was abandoned ; and

WHEREAS, a modification of the Original Drainage Easement is necessary to amend the terms of the Original Drainage Easement to correctly depict and describe the location of the Revised Drainage Easement as defined in the attached **Modification of Drainage Easement (ORB 567 Page 1768) (PB 40 Page 52)**; and

WHEREAS, it is in the best interest of Beaufort County to authorize the County Administrator to execute the attached **Modification of Drainage Easement (ORB 567 Page 1768) (PB 40 Page 52)** to correctly depict the current location of the drainage easement; and

NOW, THEREFORE, BE IT RESOLVED that Beaufort County Council hereby authorizes the County Administrator to execute documents associated with the revised drainage easement located on parcel R112-031-000-0628-0000 as described in the attached **Modification of Drainage Easement (ORB 567 Page 1768) (PB 40 Page 52).**

ADOPTED this ____ day of __________, 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

By: ______________________________________
Joseph Passiment, Chairman

ATTEST:

____
Sarah W. Brock, Clerk to Council

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:
AN ORDINANCE AUTHORIZING THE EXECUTION AND DELIVERY OF AN ACCESS AND UTILITY EASEMENT FOR A PORTION OF A RIGHT OF WAY OWNED BY BEAUFORT COUNTY KNOWN AS CASSIDY DRIVE OFF BUCKWALTER PARKWAY IN BULFFTON TOWNSHIP SOUTH CAROLINA
MEETING NAME AND DATE:
County Council Meeting 10-25-21
PRESENTER INFORMATION:
Jared Fralix, P.E., Assistant County Administrator, Engineering (5 Minutes)
ITEM BACKGROUND:
Item was approved at PFC on 10-18-21 The County ownership of Cassidy Drive is recorded in Deed Book 3710 at Page147 on 10-24-2018.
PROJECT / ITEM NARRATIVE:
BJWSA has requested an Access and Utility Easement to for a portion of parcel R610 022 000 1125 0000 located on Cassidy Drive off Buckwalter Parkway in Bluffton Township.
FISCAL IMPACT:
N/A
STAFF RECOMMENDATIONS TO COUNCIL:
Staff recommends approval of Access and Utility Easement to BJWSA
OPTIONS FOR COUNCIL MOTION:
Motion to either Approve or Deny Access and Utility Easement to BJSWA. *Next Step – 3 readings and public hearing by County Council*

EXHIBIT A

"Access and Utility Easement"

This instrument was prepared by the law firm of
Tupper, Grimsley, Dean & Canaday, P.A.
611 Bay Street
Beaufort, SC 29902
843/524-1116

TG&D File #0075

****************************AREA ABOVE THIS LINE RESERVED FOR RECORDING**********************

STATE OF SOUTH CAROLINA)
) ACCESS AND UTILITY EASEMENT
COUNTY OF BEAUFORT)

THIS AGREEMENT made this _____ day of ________________, 2021, by and between Beaufort County (hereinafter referred to as "Grantor") whose address is PO Box 1228, Beaufort, SC 29902, and Beaufort-Jasper Water & Sewer Authority of 6 Snake Road, Okatie, South Carolina 29909 (hereinafter referred to as "Grantee").

WHEREAS, the Grantor is the owner of the property described herein, known as Cassidy Drive, a portion of Buckwalter, Town of Bluffton, Beaufort County, South Carolina; and

WHEREAS, Grantor desires to grant to Grantee a permanent utility easement.

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS that Beaufort County, for and in consideration of the sum of TEN AND NO/100 DOLLARS ($10.00), and no other valuable consideration, in hand paid, the receipt and legal sufficiency of which is hereby acknowledged, has bargained and sold, and by these presents, subject to the terms and conditions contained herein, does bargain, sell, convey, transfer and deliver unto Grantee a permanent utility easement and right-of-way, including the perpetual rights to enter upon the real estate hereinafter described, for the purposes intended herein, to-wit: to enter upon, construct, extend, inspect, operate, replace, relocate, repair, and perpetually maintain upon, over, along, across, through, and under the Easement Area, various water/sewer main and service lines, manholes, hydrants, valves, meters, and other usual fixtures and appurtenances as may from time to time be or become convenient to the transaction of its business, or that of municipal, public or private systems, for the provision of water and sewer services to the Grantor's property, together with the right of ingress, egress, and access to and from, and across and upon lands of Grantor as may be necessary or convenient for the purposes connected therewith.

Together with the right, from time to time, to trim, cut, or remove trees, underbrush and other obstructions that are over, under, or through a strip of land, within the Easement Area; provided, however, any damage to the property of Grantor (other than that caused by trimming, cutting, or removing) caused by BJWSA in maintaining or repairing said water/sewer main and service lines, hydrants, valves, and meters, shall be borne by such Grantee. The parties to this Agreement agree that if any patching or repair and/or replacement of pavement and/or curbing is required as a result of the actions of BJWSA, said patchwork will be the sole responsibility of the BJWSA. Notwithstanding the foregoing, BJWSA will be responsible to repair and/or replace any other damage such Grantee causes to other utility lines servicing the Grantor's property or any permanent improvement thereupon and agrees to put the Easement Area, to include landscaping, back to its pre-construction condition (to the extent Grantee is responsible therefor).

The permanent easement and right-of-way hereby granted to the Grantee consists of a parcel of land as hereinafter described on property as shown on the drawing referenced herein and more particularly described as follows (herein referred to as "Easement Area"):

ALL that certain piece, parcel or tract of land, situate, lying and being in the Town of Bluffton, Beaufort County, South Carolina, consisting of 0.01 acres, 473 SF, more or less, lying within the right-of-way of Cassidy Drive as will be more fully shown and identified as "Beaufort County Utility Easement" on that certain plat entitled "Easement Plat, Access & Utility Easement within Cassidy Drive, Portion of Buckwalter" prepared by Thomas & Hutton, certified by _________________, SCPLS, dated _______________, a copy of which is recorded in the Office of the Register of Deeds for Beaufort County, South Carolina, in Plat Book _______ at Page _______.

This being a portion of the property conveyed to the Grantor herein by deeds recorded in the Office of the Register of Deeds for Beaufort County, South Carolina, in Records Book 3710 at Page 141 and Deed Book 3710 at Page 147.

TAX REF: R610 022 000 1125 0000 (PORTION OF)

AND ALSO, the Grantor grants to the Grantee the right and authority to approve the location of any additional utility easement that might be located within the above-described easement.

To have and to hold said permanent easement unto the Grantee, its Successors and Assigns, forever.

Grantor hereby covenants with the Grantee that it is lawfully seized and possessed of the real estate above-described, that it has good lawful right to convey it, or any part thereof, and that it will forever warrant and forever defend the title thereto against the lawful claims of its successors and assigns.

WITNESS the hands and seals of the undersigned the date and year first above-written.

IN THE PRESENCE OF:

GRANTOR:

COUNTY OF BEAUFORT

By:_________________________________
(authorized signature)

Eric L. Greenway
(printed name)

Its: County Administrator
(printed title)

____
witness signature

____
(printed name of witness)

____
Notary Public signature

____
(printed name of Notary Public)

STATE OF SOUTH CAROLINA)
) PROBATE
COUNTY OF CHARLESTON)

PERSONALLY appeared before me the undersigned witness who made oath that s/he saw the within named County of Beaufort by _____________________________ its _____________ ________________, sign, seal and as its act and deed, deliver the within written instrument, and that s/he with the other witness above-named witnessed the execution thereof.

SWORN TO BEFORE ME, this _______ day of _________________, 2021.

____
(Notary Public signature)

____
(printed name of Notary Public)
Notary Public for South Carolina
My Commission Expires:

____
witness signature

____
(printed name of witness)

IN THE PRESENCE OF:	GRANTEE:
	BEAUFORT-JASPER WATER & SEWER AUTHORITY
______________________________ witness signature	By:______________________________ (authorized signature)
______________________________ (printed name of witness)	______________________________ (printed name)
______________________________ Notary Public signature	Its:______________________________ (printed title)
______________________________ (printed name of Notary Public)	

STATE OF SOUTH CAROLINA)
) PROBATE
COUNTY OF BEAUFORT)

PERSONALLY appeared before me the undersigned witness who made oath that s/he saw the within named Beaufort-Jasper Water & Sewer Authority by _____________________ its _____________________ sign, seal and as its act and deed, deliver the within written instrument, and that s/he with the other witness above-named witnessed the execution thereof.

SWORN TO BEFORE ME, this _______ day of _________________, 2021.

______________________________ (Notary Public signature)	______________________________ witness signature
______________________________ (printed name of Notary Public) Notary Public for South Carolina My Commission Expires:	______________________________ (printed name of witness)

Ordinance No. 2021/____

AN ORDINANCE AUTHORIZING THE EXECUTION AND DELIVERY OF AN ACCESS AND UTILITY EASEMENT FOR A PORTION OF A RIGHT OF WAY OWNED BY BEAUFORT COUNTY KNOWN AS CASSIDY DRIVE OFF BUCKWALTER PARKWAY IN BULFFTON TOWNSHIP SOUTH CAROLINA.

WHEREAS, Beaufort County owns real property ("County Parcel") known as TMS No. R610 022 000 1125 0000 Right of Way located in the Town of Bluffton, also known as Cassidy Drive off of Buckwalter Parkway; and

WHEREAS, Beaufort Jasper Water Sewer Authority has requested that Beaufort County grant an Access and Utility Easement of said property for the purpose of accessing, constructing and servicing various water/sewer functions more particularly described in document entitled "Access and Utility Easement" prepared by the Law firm of Tupper, Grimsley, Dean & Canandy, P.A (attached as Exhibit "A") and shown on a plat entitled "Easement Plat, Access & Utility Easement within Cassidy Drive, Portion of Buckwalter" prepared by Thomas & Hutton, certified by Robert K. Morgan, III, SCPLS, preliminary dated 09/31/2021 attached as Exhibit "B"; and

WHEREAS, Beaufort County Council has determined that it is in its best interest to authorize the execution and delivery of the requested Access and Utility Easement attached as Exhibit "A" and more particularly shown as "Easement Plat, Access & Utility Easement within Cassidy Drive, Portion of Buckwalter" attached as Exhibit "B"; and

WHEREAS, S.C. Code Ann. § 4-9-130 requires that the transfer of any interest in real property owned by the County must be authorized by Beaufort County Council and a public hearing must be held.

NOW, THEREFORE, BE IT ORDAINED BY BEAUFORT COUNTY COUNCIL that the County Administrator is hereby authorized to execute any and all necessary documents for the conveyance of an Access and Utility Easement for a portion of a right of way owned by Beaufort County and as described on the attached Exhibit "A" (Access and Utility Easement) and Exhibit "B" (Easement Plat, Access & Utility Easement within Cassidy Drive, Portion of Buckwalter).

DONE this ____ day of ______________ 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

By: ______________________________________
Joseph Passiment, Chairman

ATTEST:

____
Sarah W. Brock, Clerk to Council

Third and Final Reading:
Public Hearing:
Second Reading:
First Reading:

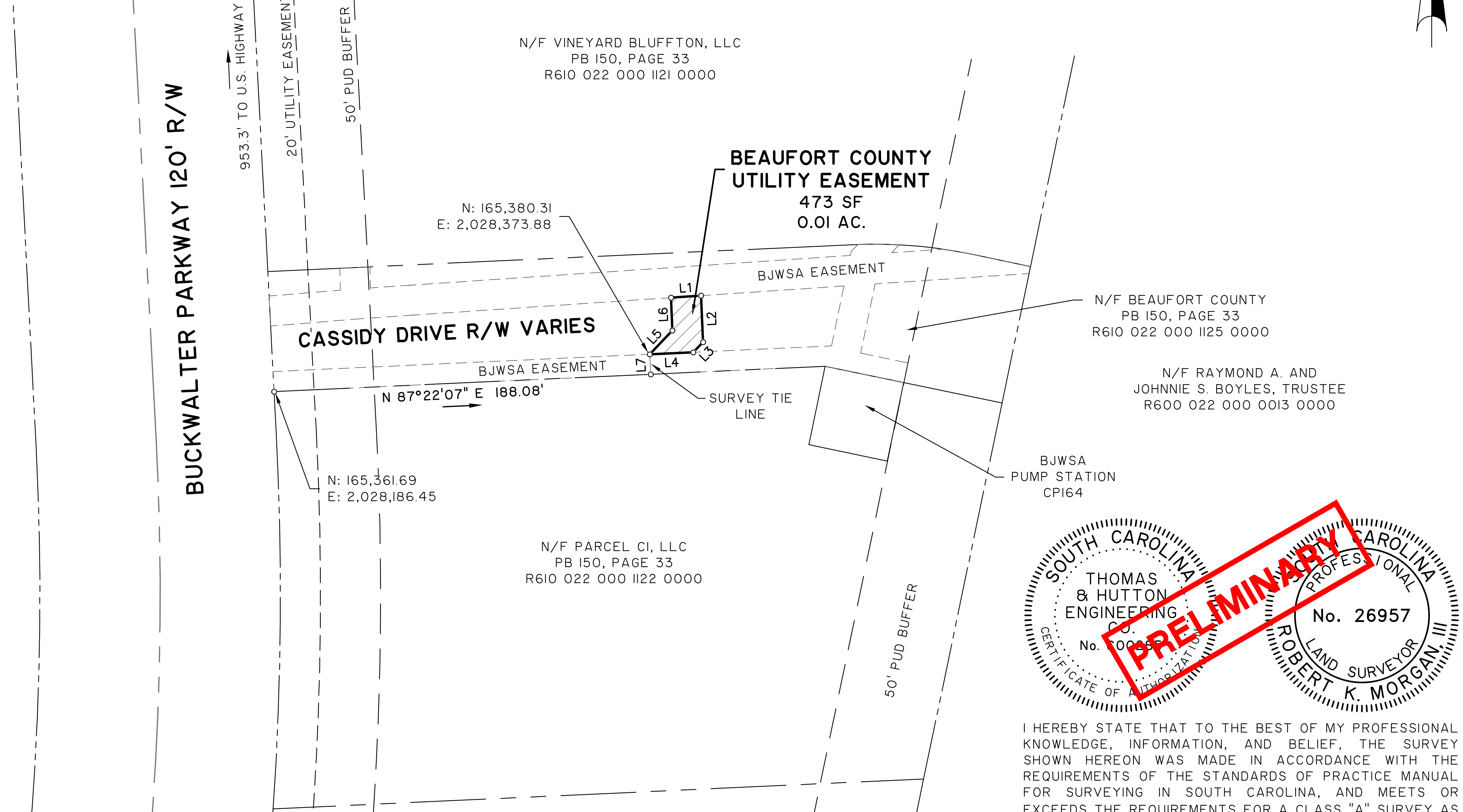
Exhibit B

Item 13.

LINE TABLE		
LINE	BEARING	LENGTH
L1	N 86°08'00" E	15.00'
L2	S 02°37'52" E	23.19'
L3	S 43°50'08" W	7.03'
L4	S 87°22'07" W	21.78'
L5	N 43°50'08" E	16.38'
L6	N 02°37'52" W	16.43'
L7	S 02°37'53" E	10.00'

NOTES

1. TAX MAP NO. (PARENT TRACT): R610 022 000 1125 0000.
2. ACCORDING TO F.I.R.M. MAP 45013C0270G, EFFECTIVE DATE 3-23-21, THIS PROPERTY FALLS ON ZONE X.
3. COORDINATES AND DIRECTIONS SHOWN ON THIS SURVEY ARE BASED ON SOUTH CAROLINA STATE PLANE COORDINATE SYSTEM (NAD83). DISTANCES SHOWN ARE GROUND DISTANCES, NOT GRID DISTANCES.
4. THIS SURVEY IS VALID ONLY IF THE PRINT OF SAME HAS THE ORIGINAL SIGNATURE AND EMBOSSED SEAL OF THE LAND SURVEYOR.
5. A TITLE SEARCH WAS NOT PERFORMED BY THOMAS & HUTTON ENGINEERING CO. AT THE TIME OF THIS SURVEY.
6. THE PROPERTY PLATTED HEREON IS SUBJECT TO ALL EASEMENTS AND RESTRICTIONS OF RECORD.
7. THE POSITION OF UNDERGROUND UTILITIES SHOWN ON THIS DRAWING IS BASED UPON THE LOCATION OF SURFACE APPURTENANCES AND/OR SURFACE MARKINGS AND SHOULD BE CONSIDERED APPROXIMATE.
8. FOR WETLAND BUFFERS AND SETBACKS REFER TO BUCKWALTER P.U.D. AND ANNEXATION DOCUMENTS.
9. PLAT REFERENCES: PB 150 PAGE 33 & PB 153 PAGE 170.

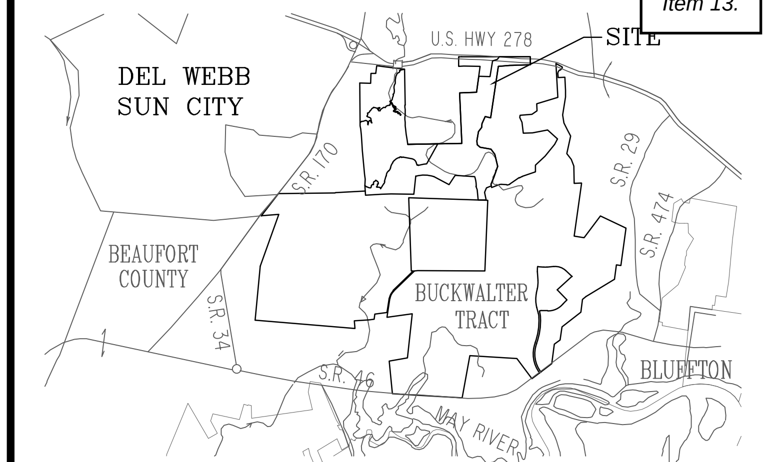


I HEREBY STATE THAT TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, INFORMATION, AND BELIEF, THE SURVEY SHOWN HEREON WAS MADE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STANDARDS OF PRACTICE MANUAL FOR SURVEYING IN SOUTH CAROLINA, AND MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS "A" SURVEY AS SPECIFIED THEREIN.

ROBERT K. MORGAN, III
SOUTH CAROLINA PROFESSIONAL LAND SURVEYOR
LICENSE NO. 26957

LEGEND

- ○ MEANDER POINT (NO MONUMENT)
- ■ CONCRETE MONUMENT (FOUND)
- ◉ IRON PIPE (FOUND)



VICINITY MAP not to scale

EASEMENT PLAT

UTILITY EASEMENT WITHIN CASSIDY DRIVE PORTION OF BUCKWALTER

TOWN OF BLUFFTON
BEAUFORT COUNTY, SOUTH CAROLINA

prepared for
BEAUFORT COUNTY

THOMAS & HUTTON

50 Park of Commerce Way
Savannah, GA 31405 • 912.234.5300

www.thomasandhutton.com

60 0 60 120

1 INCH = 60 FEET

plat	drawn	reviewed	field	crew
08-31-21	LPO	RKM	N/A	N/A

job 25732.1000 SHEET 1 OF 1

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

AN ORDINANCE DECLARING CERTAIN COUNTY OWNED REAL PROPERTY AS SURPLUS PROPERTY AND AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE ANY AND ALL NECESSARY DOCUMENTS TO SELL REAL PROPERTY IDENTIFIED AS TMS NO. R700 036 000 13J 0000, R700 036 000 0112 0000, R700 036 000 0109 0000, R700 036 000 002C 0000 AND R600 036 000 001B 0000

MEETING NAME AND DATE:

Finance Committee, 10/12/2021

PRESENTER INFORMATION:

Brittany Ward, Deputy County Attorney

10 Minutes

ITEM BACKGROUND:

County staff presented to County Council on August 19, 2021 at a Special Called meeting.

PROJECT / ITEM NARRATIVE:

County staff and legal department reviewed County owned real property and have determined that the use of real property identified as TMS NO. R700 036 000 13J 0000, R700 036 000 0112 0000, R700 036 000 0109 0000, R700 036 000 002C 0000 AND R600 036 000 001B 0000 has discontinued. The properties are vacant and unoccupied. Appraisals on the aforementioned properties have or will be completed prior to advertising the sale of the property.

FISCAL IMPACT:

The sale of real property will be for an amount equal to or greater than fair market value.

STAFF RECOMMENDATIONS TO COUNCIL:

Approve to sell surplus properties.

OPTIONS FOR COUNCIL MOTION:

Disapprove.

Move forward to Council for First Reading on October 25, 2021.

ORDINANCE 2021/____

AN ORDINANCE DECLARING CERTAIN COUNTY OWNED REAL PROPERTY AS SURPLUS PROPERTY AND AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE ANY AND ALL NECESSARY DOCUMENTS TO SELL REAL PROPERTY IDENTIFIED AS TMS NO. R700 036 000 13J 0000, R700 036 000 0112 0000, R700 036 000 0109 0000, R700 036 000 002C 0000 AND R600 036 000 001B 0000

WHEREAS, Beaufort County ("County") is the sole owner of the real properties with TMS Nos. R700 036 000 13J 0000, R700 036 000 0112 0000, R700 036 000 0109 0000, R700 036 000 002C 0000 and R600 036 000 001B 0000; hereinafter individually referenced as "Property" and collectively as "Properties"; and

WHEREAS, the County has determined that any use of the Properties has been discontinued, thereby leaving the Properties vacant and unoccupied; and

WHEREAS, each Property shall be sold at or above the fair market value, whereby such fair market value shall be determined by a licensed appraiser; and

WHEREAS, the County shall publicly advertise the sale of the Properties, and any bids for purchase received shall be reviewed and accepted by the County Administrator, or his designee, based on a purchase price and subsequent use of the property; and

WHEREAS, Beaufort County Council has determined that it is in the best interest of the citizens of Beaufort County to declare the Properties as surplus property and to sell the Properties upon such terms and conditions as may be most favorable to the County.

NOW, THEREFORE, BE IT ORDAINED by Beaufort County Council, that the above-described Properties be declared surplus property and authorize the County Administrator to execute any and all necessary documents to sell the surplus Properties upon such terms and conditions as determined to be reasonably prudent and in the best interest of the citizens of Beaufort County.

ADOPTED this ____ day of ______________ 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

By: ____
Joseph F. Passiment, Chairman

ATTEST:

____
Sarah W. Brock, Clerk to Council

PAIGE POINT AREA PROPERTIES

1. **R700 036 000 002C 0000**
   616 Paige Point Road

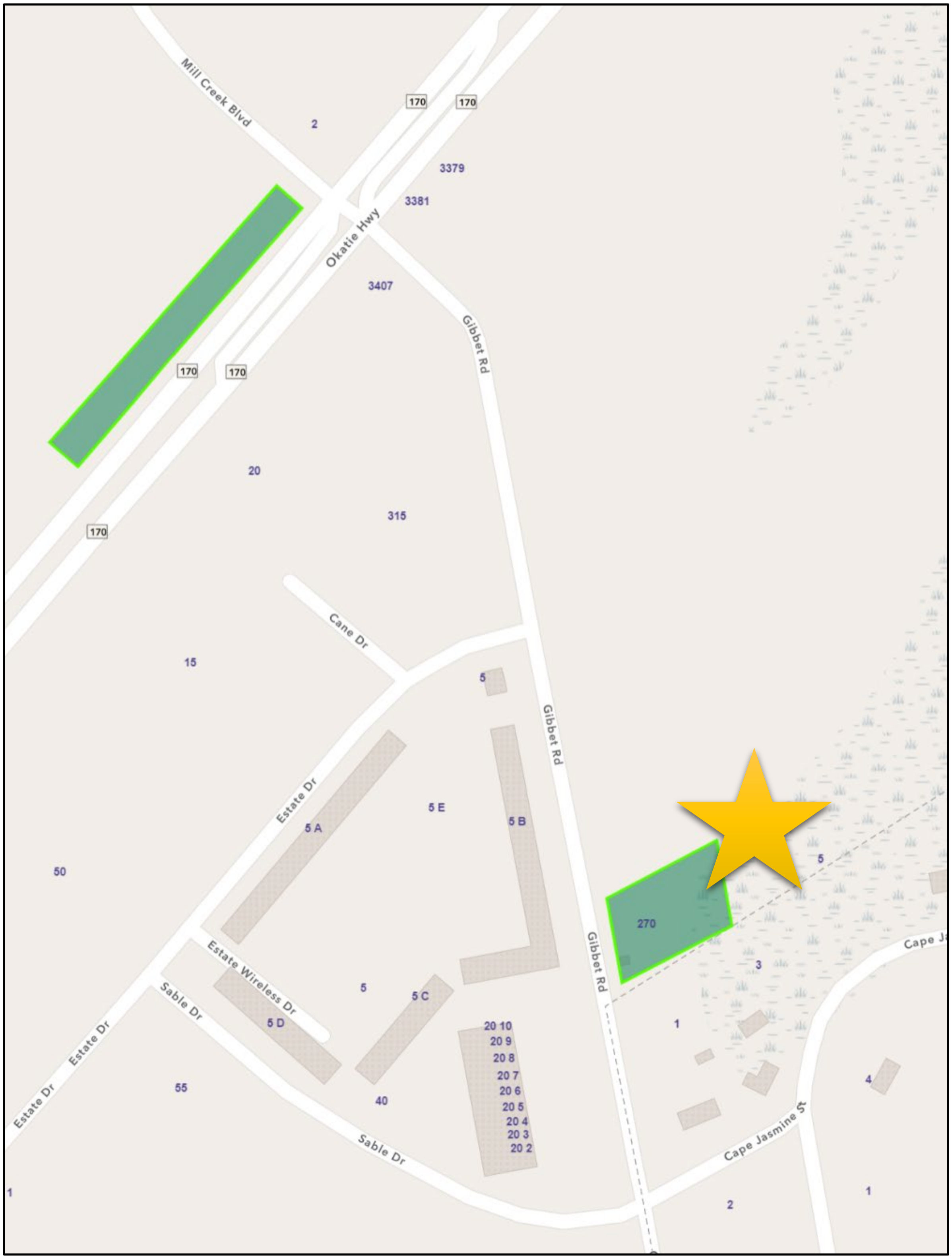
2. **R700 036 000 0112 0000**
   743 Paige Point Road

3. **R700 036 000 0109 000**

4. **R700 036 000 013J 0000**
   465 Paige Point Bluff

R600 036 000 001B 0000

270 GIBBET ROAD



BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

Recommended Changes to Beaufort County Procurement Code, Division 4 concerning approval thresholds and to request additions to the current exemption section-approved by Finance Committee on October 18, 2021.

MEETING NAME AND DATE:

County Council Meeting October 25, 2021

PRESENTER INFORMATION:

Dave Thomas, CPPO, Purchasing Director and Kurt Taylor General Council

(10 minutes)

ITEM BACKGROUND:

The current Beaufort County Procurement Code, Division 4 was last updated in February 2014. The recommended threshold changes require an update to the current staff titles and their authority. The recommended increase to thresholds for staff approval takes into consideration the dramatic change in prices due to inflation, COVID 19, and the availability of Goods and Services requested by staff. The recommended additions to the exemption section is mainly due to the lack of qualified vendors and in most cases there is only one source available to provide the requested Goods or Services. Requesting quotes for these new exemptions is not the best procurement practice and is not practical.

PROJECT / ITEM NARRATIVE:

The attached recommended procurement code changes will increase the approval thresholds for Department Heads, Purchasing Director, Budget Director, County Administrator, Committees and Council. Staff is also recommending adding additional Goods and Services exemptions to the Code. Some of the major justifications for requesting the code changes are due to the current market for Goods and Services (inflation, increased cost) and the outbreak of COVID 19. Note, COVID 19 has contributed to reducing the number of available vendors and their ability to provide/deliver some services and supplies to the County. Furthermore, changing our thresholds and adding exemptions as requested by staff will improve our processes and provide a code for staff to follow, which is more in-line with "Best Practices' used by similar organizations.

FISCAL IMPACT:

NA

STAFF RECOMMENDATIONS TO COUNCIL:

Approve or Deny the recommended changes to the Procurement Code

OPTIONS FOR COUNCIL MOTION:

The Finance Committee approved the recommendation as stated in the attachments and request approval by County Council and possible First Reading.

ORDINANCE 2021/_____

TEXT AMENDMENT TO BEAUFORT COUNTY CODE OF ORDINANCES: ARTICLE VII, DIVISION 4, SECTION 2-508; SECTION 2-509; SECTION 2-513; SECTION 2-517; AND SECTION 2-541 TO UPDATE ADMINISTRATIVE CHANGES, TO PROVIDE NECESSARY CONTRACT DOLLAR THRESHOLD CHANGES AND TO UPDATE EXEMPTION PROVISIONS AND PROCEDURES.

WHEREAS, added text is highlighted in yellow and underlined.

Adopted this __ day of NOVEMBER 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

By: _______________________________________
Joseph Passiment, Chairman

ATTEST:

____
Sarah W. Brock, JD, Clerk to Council

Chronology:

Third Reading:	November 22, 2021 / Vote ____
Second Reading:	November 8, 2021 / Vote ____
Public Hearing:	November 8, 2021
First Reading:	October 25, 2021 / Vote ____

Sec. 2-508. - Establishment, appointment and qualifications of purchasing director.

(a)

Establishment of position. There is created the position of purchasing director, who shall be the county's principal public procurement official. The purchasing director shall report to the Assistant County Administrator, Finance (ACA, Finance).

Sec. 2-509. - Authority and duties of purchasing director.

(a)

Principal public procurement official. The purchasing director shall serve as the principal public procurement official of the county and shall be responsible for the procurement of supplies, services, and construction in accordance with this division, as well as the management and disposal of supplies.

(b)

Duties. In accordance with this division, the purchasing director shall:

(1)

Purchase. Purchase all supplies, materials, equipment, and contractual services required by county agencies and perform the purchasing-related functions required of the purchasing director in this division.

(2)

Negotiate contracts. Negotiate contracts for personal services, submit them for approval, and award as provided in this division.

(3)

Use standard specifications. Use standard specifications wherever they are applicable to purchase orders and contracts, and ensure compliance with such specifications through adequate inspection of deliveries.

(4)

Transfer between agencies. Transfer between agencies supplies, materials, and equipment that are no longer needed by a holding agency but that can be used by the receiving agency.

(5)

Exchange, trade in and sell. Exchange, trade in or sell those supplies, materials and equipment which are surplus, obsolete or unused and which are found by the county administrator not to be required for public use.

(6)

Develop standard forms and conditions. Develop, with the approval of the county attorney as to legal sufficiency, standard forms and conditions of invitations to bid and purchase orders and contracts; develop and prescribe the use by agencies of other forms required in carrying out this division, and amend or eliminate any such forms.

(7)

Acquire and dispose of real property. Upon request of the county council and subject to its approval of each transaction, perform all delegable functions in connection with acquisition and disposal of real property.

(8)

Perform other duties. Perform other duties as assigned by the county administrator and ACA, Finance.

(c)

Operational procedures. Consistent with this division, the purchasing director shall adopt operational procedures relating to the execution of his duties.

(d)

Dollar limitations. Provided that funds have been preapproved by the county council as part of the budget process, an award is made to the lowest responsive and responsible bidder, the contracting authority for the county, except as otherwise provided in section 2-512 pertaining to authority to contract for certain services, section 2-513 pertaining to exemption and section 2-514 pertaining to exemption for real property, shall be as follows:

(1)

Purchasing Director, Budget Director $50,000.00 or less.

(2)

County administrator or his designee, over $50,000.00, but less than $150,000.00. The County Administrator may approve contract renewals and be exempt from the dollar limitations on expenditure authority identified in this Section 2-509-Authority and duties of purchasing director, paragraph (d-e) Dollar limitations in paragraphs (1-4) provided that the funds have been approved by the county council as part of the annual budget appropriation process, and that any expenditure of funds regardless of the amount will not result in a budget deficit.

(3)

Council committee, over $150,000.00, but less than $250,000.00.

(4)

The county council, $250,000.00 and over.

(e)

Elected and appointed officials. Provided that funds have been approved by the county council as part of the annual budget appropriation process, and that any expenditure of funds regardless of the amount will not result in a budget deficit within any elected official's office, the sheriff, auditor, treasurer, clerk of court, coroner, solicitor, public defender, probate judge, and magistrates shall be exempt from the dollar limitations on expenditure authority identified above provided that they shall comply with all of [the] provisions of competitive purchasing as may be required by South Carolina law and the Beaufort County Purchasing Ordinance. The county council may request such reports and information, as it deems necessary and prudent on the purchasing activities of these offices to ensure compliance with these provisions.

(Code 1982, § 12-10; Ord. No. 99-14, 5-24-1999; Ord. No. 2014/4, 2-10-2014)

Sec. 2-513. - Exemption from procedures.

The County Council may, by resolution, exempt specific supplies or services from the purchasing procedures required in this Code. The following supplies and services shall be exempt from the purchasing procedures required in this division; however, the purchasing director for just cause may limit or withdraw any exemptions provided for in this section:

(1)

Works of art for museum and public display.

(2)

Published books, library books, maps, periodicals, technical pamphlets.

(3)

Copyrighted educational films, filmstrips, slides and transparencies.

(4)

Postage stamps, postal fees, and U.S. Post Office box rentals.

(5)

Professional dues, membership fees, seminar registration fees, and Professional training.

(6)

Medicine and drugs.

(7)

Utilities including gas, electric, water and sewer.

(8)

Advertisements in professional publications or newspapers. Add-Advertising time and space in radio, television, and social media platforms including local Chamber of Commerce.

(9) Legal Services, which must be approved by the County Administrator or County Council.

(10) Add- Fixed Wing and Rotary Wing Aircraft Maintenance.

Sec. 2-517. - Small purchases.

Any contract not exceeding $35,000.00 shall be made in accordance with the small purchase procedures established in regulations and updated periodically by the purchasing director; provided, however, that purchase requirements shall not be artificially divided so as to constitute a small purchase under this section.

(Code 1982, § 12-18)

Sec. 2-521. - Requisition required.

Department heads shall use requisitions for goods or services for the operation of the department. Requisitions shall be processed according to the steps outlined in the purchasing administrative regulations.

(Code 1982, § 12-22)

Sec. 2-522. - Purchase order required.

Any purchase made with county funds shall be recorded on a purchase order bearing the quantity and description of each item to be purchased. If exceptions are made by the purchasing director, a control system shall be in effect.

(Code 1982, § 12-23)

Sec. 2-541. - Fiscal responsibility.

Every contract modification, change order, or contract price adjustment in excess of ten percent of the original price under a contract with the county pursuant to this division shall be subject of prior approval by the Purchasing Director and Budget Director. The requesting department must provide a copy of the approved electronic CO form to the Purchasing Department. Purchasing will attach a copy of the approved CO to the contract file before proceeding with the CO process. The Department may proceed with the CO once they receive a copy of the updated purchase order. The CO must not exceed the overall budget, which was approved by County Council.

(Code 1982, § 12-42)

Procurement Code Recommended Changes By Staff

Sec. 2-508. - Establishment, appointment and qualifications of purchasing director.

(a)

Establishment of position. There is created the position of purchasing director, who shall be the county's principal public procurement official. The purchasing director shall report to the Assistant County Administrator, Finance (ACA, Finance).

Sec. 2-509. - Authority and duties of purchasing director.

(a)

Principal public procurement official. The purchasing director shall serve as the principal public procurement official of the county and shall be responsible for the procurement of supplies, services, and construction in accordance with this division, as well as the management and disposal of supplies.

(b)

Duties. In accordance with this division, the purchasing director shall:

(1)

Purchase. Purchase all supplies, materials, equipment, and contractual services required by county agencies and perform the purchasing-related functions required of the purchasing director in this division.

(2)

Negotiate contracts. Negotiate contracts for personal services, submit them for approval, and award as provided in this division.

(3)

Use standard specifications. Use standard specifications wherever they are applicable to purchase orders and contracts, and ensure compliance with such specifications through adequate inspection of deliveries.

(4)

Transfer between agencies. Transfer between agencies supplies, materials, and equipment that are no longer needed by a holding agency but that can be used by the receiving agency.

(5)

Exchange, trade in and sell. Exchange, trade in or sell those supplies, materials and equipment which are surplus, obsolete or unused and which are found by the county administrator not to be required for public use.

(6)

Develop standard forms and conditions. Develop, with the approval of the county attorney as to legal sufficiency, standard forms and conditions of invitations to bid and purchase orders and contracts; develop and prescribe the use by agencies of other forms required in carrying out this division, and amend or eliminate any such forms.

(7)

Acquire and dispose of real property. Upon request of the county council and subject to its approval of each transaction, perform all delegable functions in connection with acquisition and disposal of real property.

(8)

Perform other duties. Perform other duties as assigned by the county administrator and ACA, Finance.

(c)

Operational procedures. Consistent with this division, the purchasing director shall adopt operational procedures relating to the execution of his duties.

(d)

Dollar limitations. Provided that funds have been preapproved by the county council as part of the budget process, an award is made to the lowest responsive and responsible bidder, the contracting authority for the county, except as otherwise provided in section 2-512 pertaining to authority to contract for certain services, section 2-513 pertaining to exemption and section 2-514 pertaining to exemption for real property, shall be as follows:

(1)

Purchasing Director, Budget Director $50,000.00 or less.

(2)

County administrator or his designee, over $50,000.00, but less than $150,000.00. The County Administrator may approve contract renewals and be exempt from the dollar limitations on expenditure authority identified in this Section 2-509-Authority and duties of purchasing director, paragraph (d-e) Dollar limitations in paragraphs (1-4) provided that the funds have been approved by the county council as part of the annual budget appropriation process, and that any expenditure of funds regardless of the amount will not result in a budget deficit.

(3)

Council committee, over $150,000.00, but less than $250,000.00.

(4)

The county council, $250,000.00 and over.

(e)

Elected and appointed officials. Provided that funds have been approved by the county council as part of the annual budget appropriation process, and that any expenditure of funds regardless of the amount will not result in a budget deficit within any elected official's office, the sheriff, auditor, treasurer, clerk of court, coroner, solicitor, public defender, probate judge, and magistrates shall be exempt from the dollar limitations on expenditure authority identified above provided that they shall comply with all of [the] provisions of competitive purchasing as may be required by South Carolina law and the Beaufort County Purchasing Ordinance. The county council may request such reports and information, as it deems necessary and prudent on the purchasing activities of these offices to ensure compliance with these provisions.

(Code 1982, § 12-10; Ord. No. 99-14, 5-24-1999; Ord. No. 2014/4, 2-10-2014)

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(2)

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(3)

Copyrighted educational films, filmstrips, slides and transparencies.

(4)

Postage stamps, postal fees, and U.S. Post Office box rentals.

(5)

Professional dues, membership fees, seminar registration fees, and Professional training.

(6)

Medicine and drugs.

(7)

Utilities including gas, electric, water and sewer.

(8)

Advertisements in professional publications or newspapers. Add-Advertising time and space in radio, television, and social media platforms including local Chamber of Commerce.

(9) Legal Services, which must be approved by the County Administrator or County Council.

(10) Add- Fixed Wing and Rotary Wing Aircraft Maintenance.

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Any contract not exceeding $35,000.00 shall be made in accordance with the small purchase procedures established in regulations and updated periodically by the purchasing director; provided, however, that purchase requirements shall not be artificially divided so as to constitute a small purchase under this section.

(Code 1982, § 12-18)

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Department heads shall use requisitions for goods or services for the operation of the department. Requisitions shall be processed according to the steps outlined in the purchasing administrative regulations.

(Code 1982, § 12-22)

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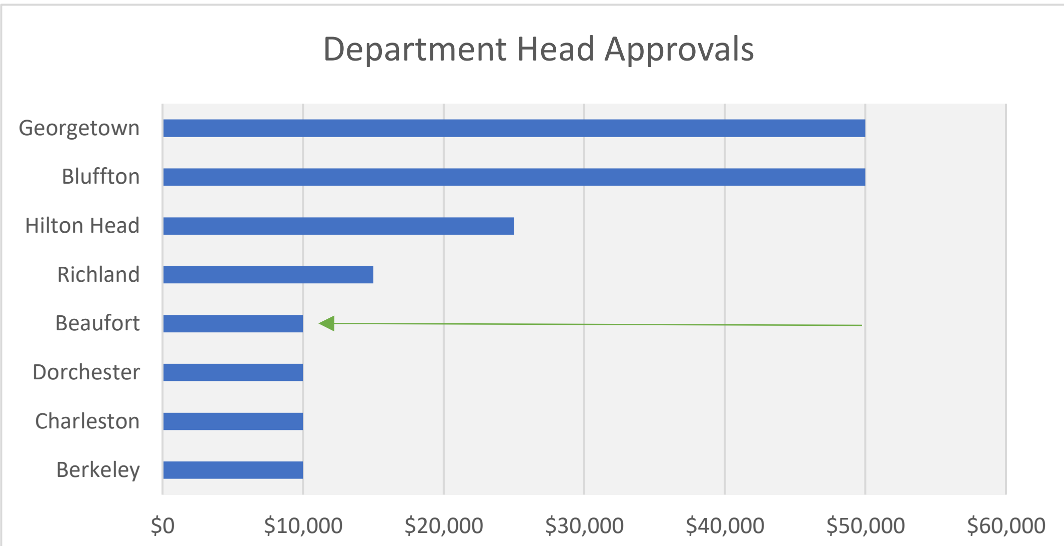
(Code 1982, § 12-42)

Department Head Threshold

From	To
$ 10,000	$ 15,000

Cities and Counties

Berkeley	Charleston	Dorchester	Beaufort	Richland	Hilton Head	Bluffton
$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 15,000	$ 25,000	$ 50,000



Note: All other entities (Greenville, Horry, Lexington & Spartanburg) are $10,000 or less

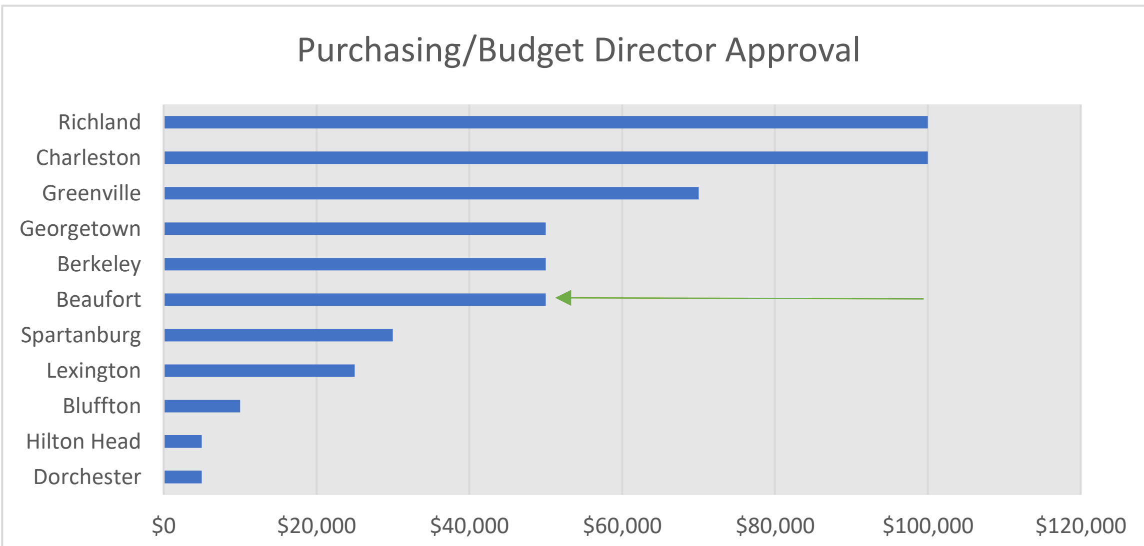
Georgetown	Greenville	Horry	Lexington	Spartanburg
$ 50,000	$10,000 or less			

Purchasing and/or Budget Director Threshold

From	To
$ 10,000	$ 50,000

Cities and Counties

Dorchester	Hilton Head	Bluffton	Lexington	Spartanburg	Beaufort	Berkeley
$ 5,000	$ 5,000	$ 10,000	$ 25,000	$ 30,000	$ 50,000	$ 50,000



Note: If the item was approved in the current budget, the Purchasing Director may approve the item. Otherwise, approval must be sought through the Budget Director with an amendment from another line item.

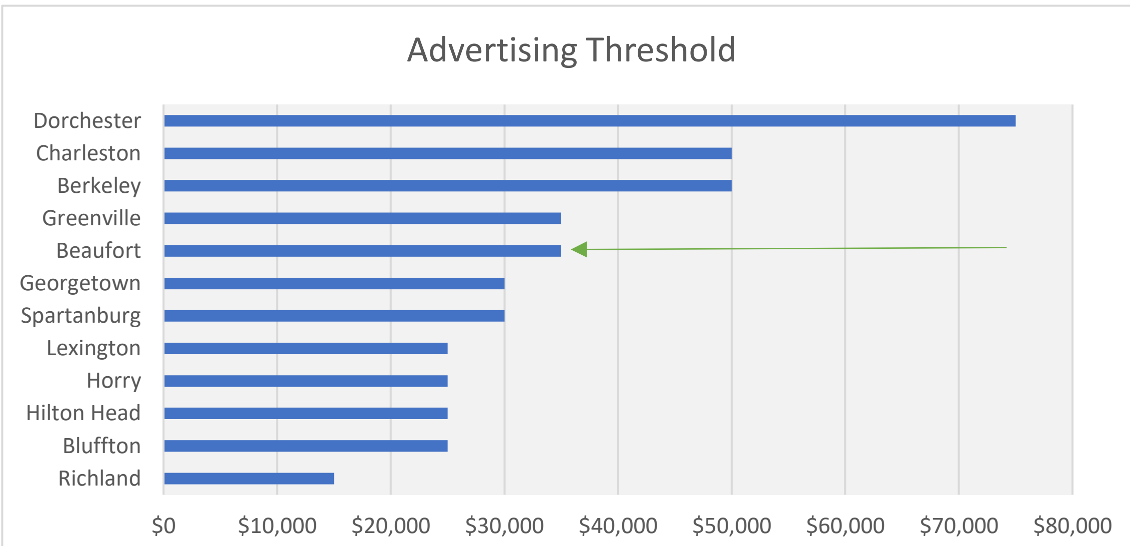
Georgetown	Greenville	Charleston	Richland	Horry
$ 50,000	$ 70,000	$ 100,000	$ 100,000	Unlimited

Advertising Threshold

From		To	
$	25,000	$	35,000

Cities and Counties

	Richland		Bluffton		Hilton Head		Horry		Lexington		Spartanburg		Georgetown
$	15,000	$	25,000	$	25,000	$	25,000	$	25,000	$	30,000	$	30,000



Note: If the purchase is over $35,000 and not available on a state, cooperative, or GSA contract, the Goods or Services must be publically advertised in accordance with our procurement code. This does not apply to our prequalified lists pre-qualified under 50K A & E and Contractor lists.

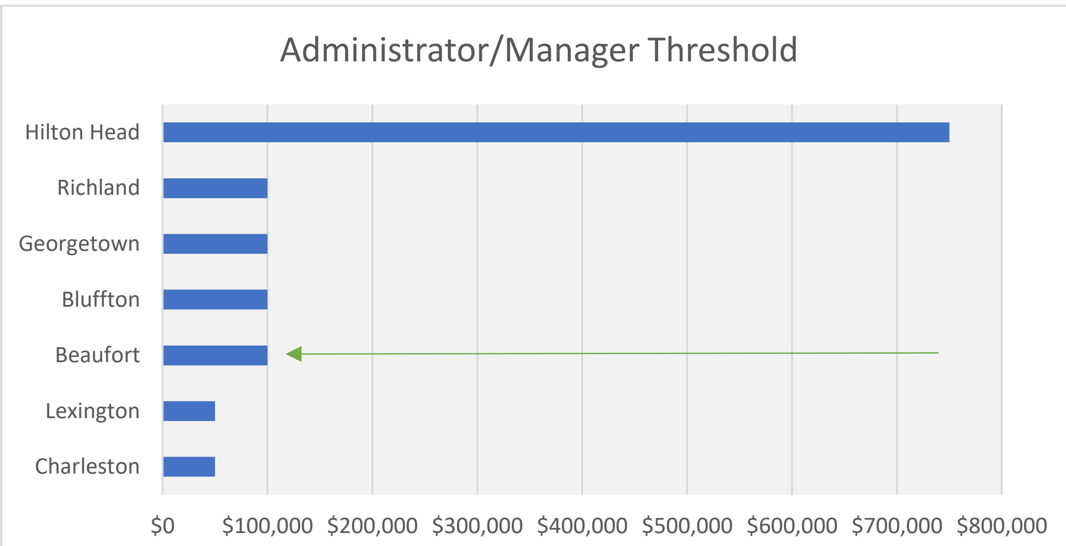
Beaufort	Greenville	Berkeley	Charleston	Dorchester
$ 35,000	$ 35,000	$ 50,000	$ 50,000	$ 75,000

Administrator/Manager Threshold

From	To
$ 50,000	$ 100,000

Cities and Counties

Charleston	Lexington	Beaufort	Bluffton	Georgetown	Richland	Hilton Head
$ 50,000	$ 50,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 750,000

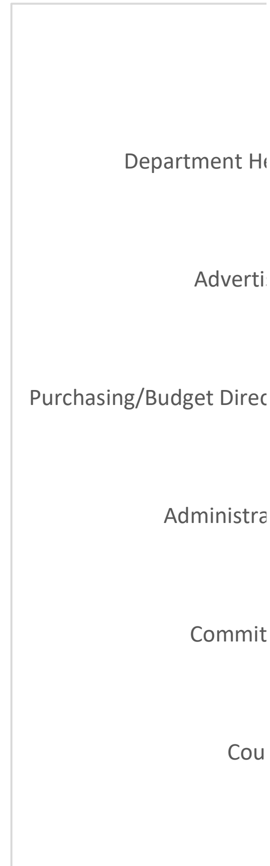


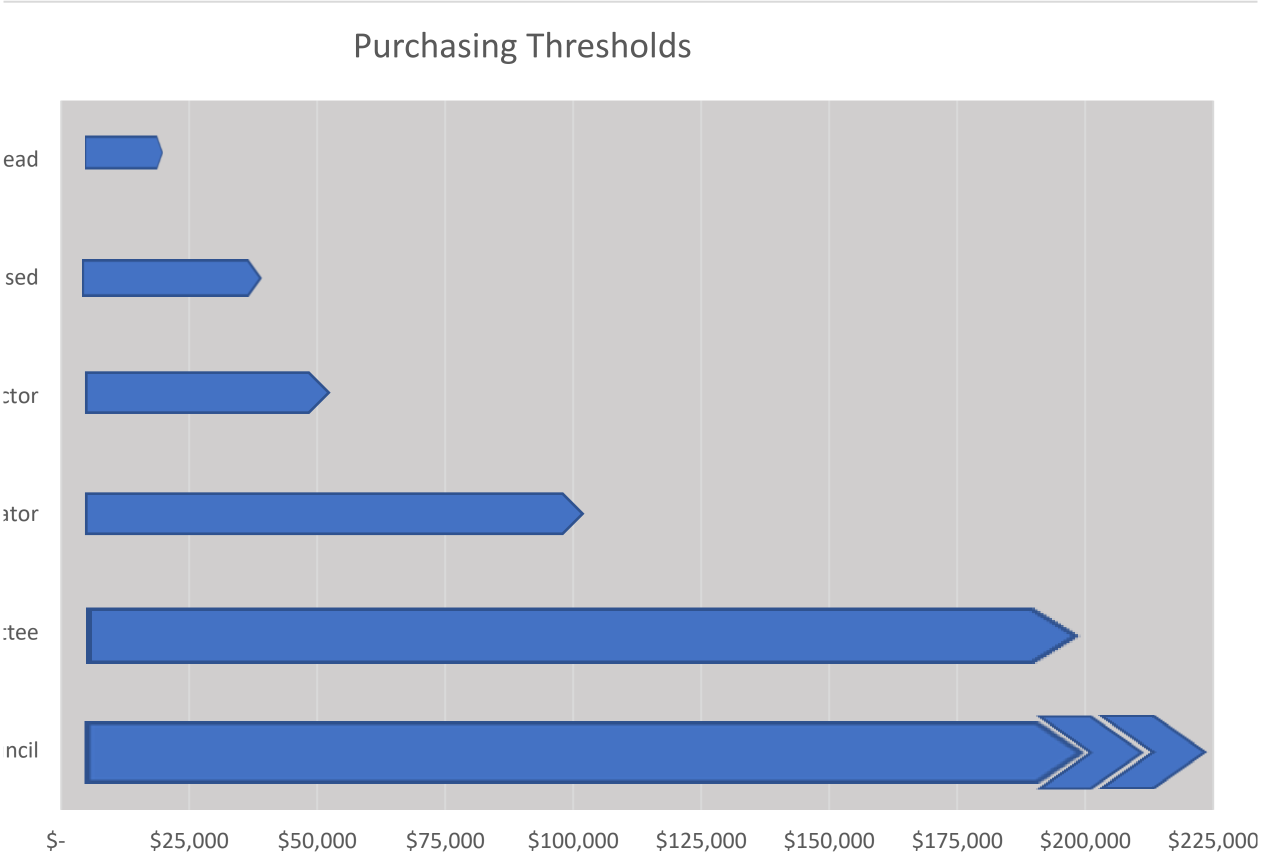
Note: If the item was approved in the current budget, the Purchasing Director may approve the item. Otherwise, approval must be sought through the Budget Director with an amendment from another line item.

Dorchester	Berkeley	Greenville	Horry	Spartanburg
$ 5,000,000	Unlimited	Unlimited	Unlimited	Unlimited

Summary of Purchasing Thresholds

Purchasing Thresholds	Old	New
Department Heads	$ 10,000	$ 15,000
Advertise for IFB/RFP/FRQ	$ 25,000	$ 35,000
Purchasing/Budget Director	$ 25,000	$ 50,000
Administrator	$ 50,000	$ 100,000
Committee	$ 100,000	$ 200,000
Council	Above $100,000	Above $200,000




Purchasing Thresholds
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$-
$25,000
$50,000
$75,000
$100,000
$125,000
$150,000
$175,000
$200,000
$225,000

)

Council	Committee	dministratc	ing/Budget	Advertised	)artment H(
	$ -				

PO
$ 3,000

Exclusions/Exemptions-Price must be fair and reasonable.

Goods, Services or Other Expenditures that, by nature of what they are, may render the requirement to c

<u>Current Exemption Examples:</u>
Utilities
Membership Dues
Postal stamps and fees
Education/Training

<u>Additional Exclusions:</u>
PO Box rentals
Aircraft Maintenance
Legal Fees
Advertising time and space in radio, television, and social media platforms

Other Changes

The County Administrator may approve contract renewals and be exempt from the dollar limitations on expenditure authority identified in this Section 2-509-Authority and duties of purchasing director, paragraph (d-e) Dollar limitations in paragraphs (1-4) provided that the funds have been approved by the county council as part of the annual budget appropriation process, and that any expenditure of funds regardless of the amount will not result in a budget deficit.

obtain 3 quotes impractical. Normally only one source is available.

Beaufort County Department Heads and Staff Comments Supporting the Procurement Code Changes

ACA-Public Safety:

In reference to the changes for Division 4, Procurement Code:

AS the ACA for the Public Safety Division, I support the presented changes to the threshold amounts in the procurement code. The vast majority of our everyday business is between $1 and $100,000; the change will help departments with their everyday operational needs. I am a firm believer that all Ordinances and Policies should be reviewed and changed as necessary to keep up with our changing times.

Director Mosquito Control:

1) The recommended Procurement Code changes will encourage an efficient and effective work flow for various County procurement actions
2) Standardize cost-saving procurement actions within a timely manner
3) Simplify the procurement processes among County Council, various County committees, and/or County staff

Human Resources Director:

I do not have any specific comment other than the changes seemed to be practical and in the spirit of improving the efficiency and agility of the purchasing process. Good work. Thanks for the opportunity to review.

Airports Director:

We like what you are doing and definitely support it. There have been times in the past when important projects that may not qualify, as emergencies but are still time-sensitive have been difficult to accomplish because of lower thresholds and the time it takes to get through the "pipeline." Therefore, the Purchasing Departments plan to align better with other counties similarly sized and situated is a very positive one.

ACA-Engineering:

I fully support this endeavor! An update to this ordinance will significantly allow staff to perform the functions of the County in a more expeditious manner. The change will require fewer resources manage and will allow staff to deliver projects and services more swiftly. I think the documentation detailing the number of expenditures in the proposed range of values displays that this is a small portion of County operations and this level of expenditures does not adversely affect the County's financials. Way to go!!!

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:
AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE THE NECESSARY DOCUMENTS TO CONVEY A PORTION OF, ACCEPT A DEED FOR, AND CONVEY A PERPETUAL EASEMENT ON A PORTION OF PROPERTY OWNED BY BEAUFORT COUNTY WITH TMS NO. R600 021 000 0673 0000; EXECUTE AN AMENDMENT TO A DEED OF PERPETUAL EASEMENT ON A PORTION OF THE PROPERTY WITH TMS NO. R600 021 000 0007 0000; AND ACCEPT A DONATION TO THE RURAL AND CRITICAL LANDS PROGRAM
MEETING NAME AND DATE:
County Council November 8, 2021 (1st reading) December 13, 2021 (2nd reading and Public Hearing) January 10, 2022 (3rd reading)
PRESENTER INFORMATION:
Stefanie M. Nagid, Passive Parks Manager and Brittany Ward, Deputy County Attorney (10 minutes)
ITEM BACKGROUND:
On October 25, 2021, County Council approved a motion (7:4) to move the ordinance forward
PROJECT / ITEM NARRATIVE:
Execute the necessary documents to convey Parcel A by way of a quit claim deed to James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby. Execute the necessary documents and accept the conveyance of any and all interest in Parcel B from James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby. Execute the necessary documents to convey a perpetual easement on Parcel B for the continued existing use of the real property to James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby. Accept from Robert L. Graves a donation of Twenty-Five Thousand ($25,000) Dollars to the Rural and Critical Lands Program.
FISCAL IMPACT:
Possible survey costs Acceptance of $25,000 donation
STAFF RECOMMENDATIONS TO COUNCIL:
Approve the ordinance
OPTIONS FOR COUNCIL MOTION:
Motion to approve the ordinance as written. Motion to amend the ordinance. Motion to deny the ordinance.

AN ORDINANCE AUTHORIZING THE COUNTY ADMINISTRATOR TO EXECUTE THE NECESSARY DOCUMENTS TO CONVEY A PORTION OF, ACCEPT A DEED FOR, AND CONVEY A PERPETUAL EASEMENT ON A PORTION OF PROPERTY OWNED BY BEAUFORT COUNTY WITH TMS NO. R600 021 000 0673 0000; EXECUTE AN AMENDMENT TO A DEED OF PERPETUAL EASEMENT ON A PORTION OF THE PROPERTY WITH TMS NO. R600 021 000 0007 0000; AND ACCEPT A DONATION TO THE RURAL AND CRITICAL LANDS PROGRAM

WHEREAS, Beaufort County (“County”) purchased real property from Robert L. Graves, and is the current fee simple owner of the real property known as Okatie River Park with TMS No. R600 021 000 0673 0000 and being recorded in the Office of the Register of Deeds for Beaufort County, South Carolina on December 20, 2013, in Book 3293 Pages 2884-2893; hereinafter referred to as the “Public Park”; and

WHEREAS, the County purchased the Public Park through the Rural and Critical Lands Program and intends to develop a public passive park on the real property; and

WHEREAS, the County desires to provide the citizens and visitors of Beaufort County with public access to the Public Park in the most direct and accessible manner possible; and

WHEREAS, adjacent to the Public Park is the real property with TMS No. R600 021 000 0007 0000 which was previously owned by Verna G. Crosby, and is currently owned by James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby; hereinafter the “Adjacent Property”; and

WHEREAS, Verna Crosby previously provided Robert L. Graves a Deed of Perpetual Easement of ingress and egress over a portion of the Adjacent Property for livestock, farm equipment and human foot traffic; whereby the easement was executed on January 30, 1996, and recorded in the Beaufort County Register of Deeds in Book 432 Page 5389; hereinafter the “Access Easement”; and

WHEREAS, the land survey dated January 18, 1996 and being recorded in the Office of the Register of Deeds for Beaufort County, South Carolina in Book 55 Page 82 identifies Parcel A as a “Disputed Area”, Parcel B which abuts the Adjacent Property, and Parcel C with an Access Easement located on the Adjacent Property; the aforementioned survey is shown in Exhibit A attached hereto and incorporated herein by reference; and

WHEREAS, the County desires to convey Parcel A by way of a quit claim deed to James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby; and

WHEREAS, the owners of the Adjacent Property desire to convey any and all potential interest in Parcel B to the County; and

WHEREAS, the County desires to convey a perpetual easement on Parcel B for the continued existing use of the real property to James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby; and

WHEREAS, the County and owners of the Adjacent Property desire to amend the Access Easement on Parcel C, including but not limited to, permitting the County to further develop the already existing dirt pathway and establish a permeable road; to permit public vehicular access to the Public Park; to require the County to maintain vegetation along the road abutting the Adjacent Property; and to permit a gated access to the Adjacent Property from the Access Easement; and

WHEREAS, in support of providing the citizens and visitors of Beaufort County vehicular access to the Public Park, Robert L. Graves desires to provide a Twenty-Five Thousand ($25,000) Dollar donation to the Rural and Critical Lands Program.

NOW, THEREFORE BE IT ORDAINED BY BEAUFORT COUNTY COUNCIL, duly assembled, does hereby authorize the County Administrator as follows:

1. Execute the necessary documents to convey Parcel A, as shown in Exhibit A, by way of a quit claim deed to James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby; and

2. Execute the necessary documents and accept the conveyance of any and all interest in Parcel B, as shown in Exhibit A, from the owners of the Adjacent Property; and

3. Execute the necessary documents to convey a perpetual easement on Parcel B, as shown in Exhibit A, for the continued existing use of the real property to James E. Crosby, Michael S. Crosby, and Geoffrey S. Crosby; and

4. Accept from Robert L. Graves a donation of Twenty-Five Thousand ($25,000) Dollars to the Rural and Critical Lands Program.

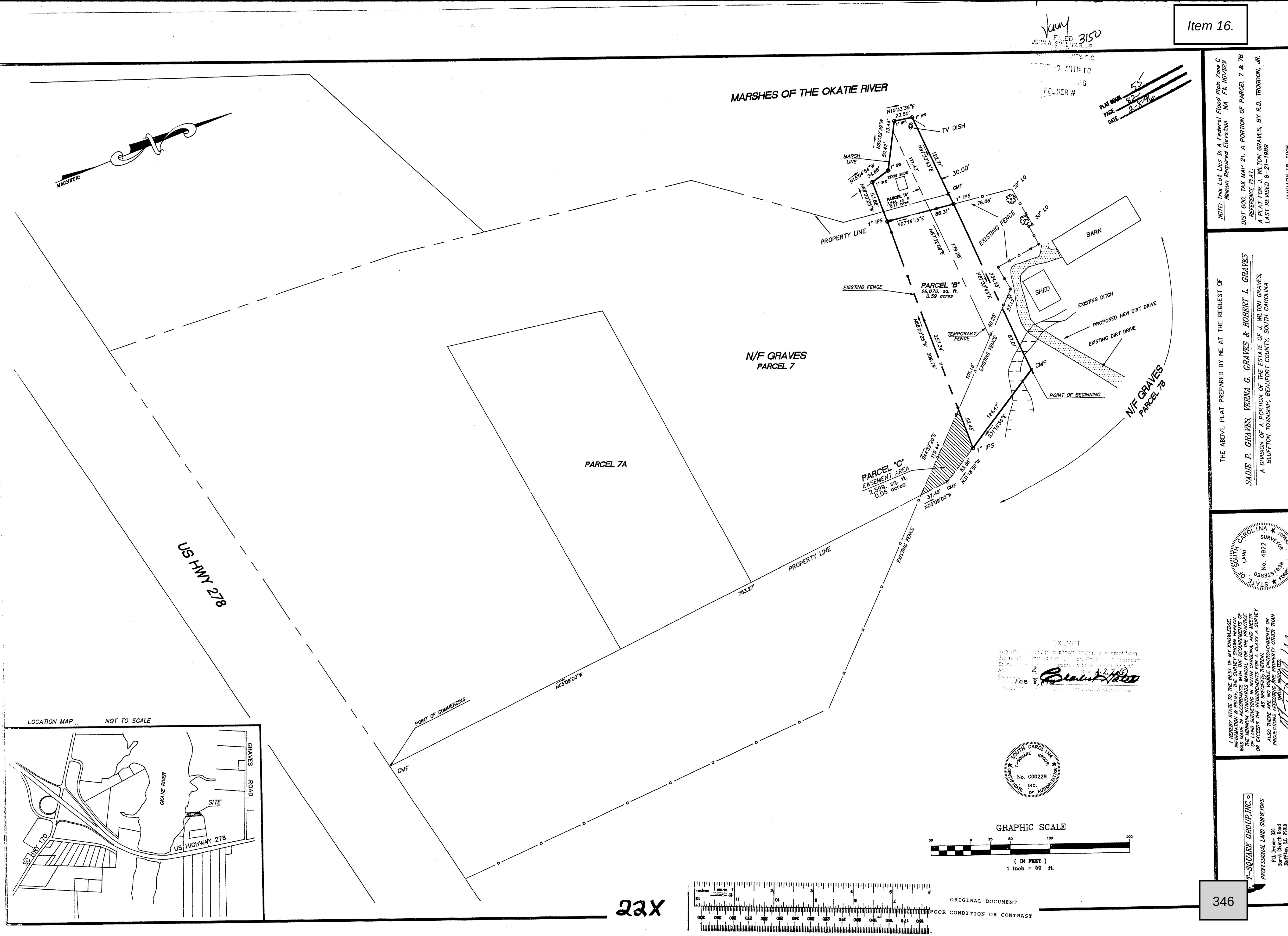
Adopted this _____ day of ________________, 2022.

COUNTY COUNCIL OF BEAUFORT COUNTY

By: ______________________________________
Joseph Passiment, Chairman

ATTEST:

____
Sarah Brock, Clerk to Council


MARSHES OF THE OKATIE RIVER
MAGNETIC
PROPERTY LINE
TV DISH
BARN
SHED
EXISTING FENCE
EXISTING DITCH
PROPOSED NEW DIRT DRIVE
EXISTING DIRT DRIVE
POINT OF BEGINNING
PARCEL "A"
PARCEL "B"
26,070. sq. ft.
0.59 acres
TEMPORARY FENCE
N/F GRAVES
PARCEL 7
N/F GRAVES
PARCEL 7B
PARCEL 7A
PARCEL "C"
EASEMENT AREA
2,599. sq. ft.
0.05 acres
US HWY 278
POINT OF COMMENCING
CMF
753.27'
N05°09'00"W
LOCATION MAP
NOT TO SCALE
GRAVES ROAD
OKATIE RIVER
SITE
US HIGHWAY 278
SC HWY 170
GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.
NOTE: This Lot Lies In A Federal Flood Plain Zone C
Minimum Required Elevation NA Ft. NGVD29
DIST 600, TAX MAP 21, A PORTION OF PARCEL 7 & 7B
REFERENCE PLAT:
A PLAT FOR J. WILTON GRAVES, BY R.D. TROGDON, JR.
LAST REVISED 8-21-1989
THE ABOVE PLAT PREPARED BY ME AT THE REQUEST OF
SADIE P. GRAVES, VERNA G. GRAVES & ROBERT L. GRAVES
A DIVISION OF A PORTION OF THE ESTATE OF J. WILTON GRAVES,
BLUFFTON TOWNSHIP, BEAUFORT COUNTY, SOUTH CAROLINA
STATE OF SOUTH CAROLINA
REGISTERED LAND SURVEYOR
No. 4922
I HEREBY STATE TO THE BEST OF MY KNOWLEDGE, INFORMATION & BELIEF, THE SURVEY SHOWN HEREON WAS MADE IN ACCORDANCE WITH THE REQUIREMENTS OF THE MINIMUM STANDARDS MANUAL FOR THE PRACTICE OF LAND SURVEYING IN SOUTH CAROLINA, AND MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS A SURVEY AS SPECIFIED THEREIN.
ALSO THERE ARE NO VISIBLE ENCROACHMENTS OR PROJECTIONS AFFECTING THE PROPERTY OTHER THAN THOSE INDICATED.
SOUTH CAROLINA
T-SQUARE GROUP
No. C00229
INC.
CERTIFICATE OF AUTHORIZATION
T-SQUARE GROUP, INC.
PROFESSIONAL LAND SURVEYORS
P.O. Drawer 330
Burnt Church Road
Bluffton, S.C. 29910
FILED
3150
PLAT BOOK 55
PAGE 82
FOLDER #
22X
ORIGINAL DOCUMENT
POOR CONDITION OR CONTRAST

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

AN ORDINANCE ADOPTING UPDATES TO THE SOUTHERN LOWCOUNTRY DESIGN MANUAL ($0.00)

MEETING NAME AND DATE:

Natural Resources Committee – November 1, 2021

PRESENTER INFORMATION:

Jared Fralix, ACE – Engineering

Neil Desai, P.E - Public Works Director *(Alternate)*

(5 min)

ITEM BACKGROUND:

January 11th, 2021 – County Council Approved adoption of Southern Lowcountry Design Manual
October 13th, 2021 – Stormwater Utility Board approved proposed updates to the Southern Lowcountry Design Manual.

PROJECT / ITEM NARRATIVE:

As Beaufort County has implemented the Southern Lowcountry Design Manual, staff has recognized the need for updates to be made to stay current as knowledge in our field improves. Updates to this manual also include process improvements for the development community in Beaufort County. The manual updates are consistent with the regional standards for those who have adopted the Southern Lowcountry Design Manual.

FISCAL IMPACT:

There are no fiscal impacts associated with the adoption of the Southern Lowcountry Design Manual updates.

STAFF RECOMMENDATIONS TO COUNCIL:

Staff recommends approval of the proposed Southern Lowcountry Design Manual updates.

OPTIONS FOR COUNCIL MOTION:

Motion to approve/deny the adoption of the proposed Southern Lowcountry Design Manual updates.

(Next Step – Upon approval, send to County Council for First Reading)

ORDINANCE 2021 /

A ORDINANCE TO AMEND THE STORMWATER MANAGEMENT UTILITY ORDINANCE AS ADOPTED SEPTEMBER 26, 2016 TO PROVIDE FOR THE ADOPTION OF STORMWATER MANAGEMENT STANDARDS SET FORTH IN THE SOUTHERN LOWCOUNTRY DESIGN MANUAL TO MEET THE MUNICIPAL SEPARATE STORMSEWER SYSTEM (MS4) PERMIT REQUIREMENTS

WHEREAS, Act 283 of 1975, The Home Rule Act, vested Beaufort County Council with the independent authority to control all acts and powers of local governmental authority that are not expressly prohibited by South Carolina law; and

WHEREAS, Chapter 99, Article II, "Stormwater Management Utility" was adopted on August 27, 2001 and was modified by ordinance on August 22, 2005, September 28, 2015 and September 26, 2016; and

WHEREAS, Stormwater Management Utility was established for the purpose of managing, acquiring, constructing, protecting, operating, maintaining, enhancing, controlling, and regulating the use of stormwater drainage systems in the county; and

WHEREAS, pursuant to the requirements mandated by the Municipal Separate Stormsewer System (MS4) permit issued by the South Carolina Department of Health and Environmental Control (DHEC) on December 1, 2015, Beaufort County is required to adopt standards related to Stormwater management and create a regulatory framework to enforce the same; and

WHEREAS, County Council adopted the Southern Lowcountry Design Manual on January 11th, 2021 as the source of the technical stormwater standards used in the development of Stormwater Plans; and

WHEREAS, County Council desires to authorize the County Administrator to adopt the updates to the Southern Lowcountry Design Manual;

NOW THEREFORE, BE IT RESOLVED, THAT BEAUFORT COUNTY COUNCIL, in a meeting duly assembled, does hereby authorize the County Administrator to adopt and implement Southern Lowcountry Design Manual attached hereto and made part of this Ordinance:

ADOPTED, this ___ day of __________, 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ________________________________
Joseph Passiment, Chairman

ATTEST:

____

Southern Lowcountry Stormwater Design Manual

Stormwater Best Management Practices

Prepared by

March 2020

Lead Authors:

Bill Hodgins, P.E., Center for Watershed Protection

Greg Hoffmann, P.E., Center for Watershed Protection

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Acronym Definitions

Acronym/Abbreviation	Definition
ARC	Antecedent Runoff Condition
BMP	Best Management Practice
BSD	Better Site Design
CDA	Contributing Drainage Area
CN	Curve Number
C-SWPPP	Construction Stormwater Pollution Prevention Plan
EGL	Energy Grade Line
EPA	United States Environmental Protection Agency
ESC	Erosion and Sediment Control
FHWA	Federal Highway Administration
GI	Green Infrastructure
HDS	Hydraulic Design Services
HGL	Hydraulic Grade Line
HUC	Hydrologic Unit Code
IWS	Internal Water Storage
LID	Low-Impact Development
LOD	Limits of Disturbance
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NC DEQ	North Carolina Department of Environmental Quality
NEH	National Engineering Handbook
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PROW	Public Right-of-Way
PUD	Planned Unit Development
SC DHEC	South Carolina Department of Health and Environmental Control
SC DOT	South Carolina Department of Transportation
SDA	Site Drainage Area
SWMP	Stormwater Management Plan
SWRv	Stormwater Retention Volume

Chapter 1. Introduction, Background, Purpose, and Administration

1.1 Introduction

Upon passage of the Southern Lowcountry Stormwater Ordinance as amended and adopted by Beaufort County Public Works Department, participating municipalities/jurisdictions will follow the design and permitting requirements of the *Southern Lowcountry Stormwater Design Manual*. The Ordinance directs residents, land developers, redevelopment, and government permit applicants to submit details and plans that comply with this Manual. It is the intent of the Ordinance that all proposed development, redevelopment, and major substantial improvement shall provide stormwater quality control for the stormwater retention volume (SWRv) for Watershed Protection Areas and/or Special Watershed Protection Areas. In the following chapters, Better Site Design (BSD) practices, green infrastructure/low impact development practices (GI/LID), and stormwater best management practices (BMPs) are described in detail to support the stormwater retention requirements. Through in-line and off-line application of these practices, the cumulative impact is reduction of the runoff and the retention on site of design storms.

This Manual and the design criteria presented within represent good engineering practice and should be used in the preparation of stormwater management plans. The criteria are intended to establish requirements, minimum standards, and methods for a sound planning, design, and review process. It is intended to guide the stormwater design review of proposed work done by developers, private parties, and governmental agencies.

1.2 Background

The U.S. Environmental Protection Agency (EPA) recommends that the Phase II Small Municipal Separate Storm Sewer System (MS4) permit require the permittee to adopt a planning process that identifies the municipality's program goals (e.g., minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing the program, EPA states that the permit should also require the permittee to assess existing ordinances, policies, programs and studies that address stormwater runoff quality. These policy assessments should include the following:

- Policies and ordinances that:
  - provide requirements and standards to direct growth to identified areas,
  - protect sensitive areas such as wetlands and riparian areas,
  - maintain and/or increase open space (including a dedicated funding source for open space acquisition),
  - provide buffers along sensitive water bodies,
  - minimize impervious surfaces, and
  - minimize disturbance of soils and vegetation;
- Policies or ordinances that encourage infill development in higher density urban areas and areas with existing infrastructure;
- Education programs for developers and the public about project designs that minimize water quality impacts; and
- Measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas (81 Federal Register 237).

1.3 Purpose

This Manual's purpose is to provide a framework for designing a stormwater management system to:

- Improve water quality through runoff reduction to the maximum extent practicable (MEP);
- Prevent downstream stream bank and channel erosion;
- Reduce downstream overbank flooding; and
- Safely pass or reduce the runoff from extreme storm events.

This Manual presents a unified approach for sizing stormwater best management practices (BMPs) in the Southern Lowcountry to meet pollutant removal goals, reduce peak discharges, and pass extreme floods. Additionally, it follows a watershed approach for their size and specification. Based on the site's watershed, stormwater design criteria specific to each must be met for development permit approval.

1.4 Applicability and Exemptions

1.4.1 Applicability

Design criteria in this Manual are applicable to any new development or redevelopment activity that meets one or more of the following criteria, or is a major substantial improvement, unless exempt pursuant to Section 1.4.2 below:

1. New development that involves the creation of 5,000 square feet of land disturbance.
2. Redevelopment that involves the creation, addition, or replacement of 5,000 square feet or more of land disturbance.
3. New development or redevelopment, regardless of size, that is part of a larger common plan of development, even though multiple, separate and distinct land disturbing activities may take place at different times and on different schedules.
4. A major substantial improvement of an existing property, which is defined as a renovation or addition to a structure that meets both of the following cost and size thresholds: a) construction costs for the building renovation/addition are greater than or equal to 50% of the pre-project assessed value of the structure as developed using current Building Valuation Data of the International Code Council, and b) project size where the combined footprint of structure(s) exceeding the cost threshold and any land disturbance is greater than or equal to 5,000 square feet.

The design criteria are applicable for infill development of platted lots, whether they are new development or redevelopment sites if the work involves creation, addition or replacement of 5,000 square feet or more of land disturbance

1.4.2 Exemptions

The following activities are exempt from the permitting requirements of this Manual:

1. Any maintenance, alteration, renewal, or improvement as approved by Beaufort County Public Works Department which does not alter existing drainage pattern, does not result in change or adverse impact on adjacent property and/or downstream properties, or create adverse environmental or water quality impacts, and does not increase the temperature, rate, quality, volume, or location of stormwater runoff discharge.
2. Projects that are exclusively for agricultural or silvicultural activities within areas zoned for these agricultural and silvicultural uses. Proof of Silvaculture permit required;
3. Agricultural activity not involving relocation of drainage canals;

4. Redevelopment that constitutes the replacement of the original square footage of impervious cover and original acreage of other land development activity when the original development is wholly or partially lost due to natural disaster or other acts of God occurring after January 31st, 2021,
5. Work by agencies or property owners required to mitigate emergency flooding conditions. If possible, emergency work should be approved by the duly appointed officials in charge of emergency preparedness or emergency relief. Property owners performing emergency work will be responsible for any damage or injury to persons or property caused by their unauthorized actions. Property owners will stabilize the site of the emergency work within 60 days, or as soon as reasonable, following the end of the emergency period;
6. Golf courses are required to comply with all site runoff volume and water quality and drainage planning and design requirements. However, both golf courses and private lagoons shall be exempt from the peak attenuation requirements.
7. Existing dirt roads which are improved or paves as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 are deemed not to constitute "development" under the County Code of Ordinance Chapter 99 (Stormwater Utility Ordinance), MS4 Program, or this manual and are, therefore, exempt from the provisions and requirements herein.
8. Small subdivisions may be exempt from the permitting requirements of this manual, and shall be handled on a case by case basis and to be approved by the Public Works Director.

1.5 Administration

1.5.1 Approval Requirements

Before the Beaufort County Public Works Department may issue a stormwater permit for any project requiring stormwater management, the Beaufort County Public Works Department must approve a Stormwater Management Plan (SWMP) meeting the requirements of the Southern Lowcountry Stormwater Ordinance and receive all fees required by the Beaufort County Public Works Department for site and building development plans.

A complete SWMP submittal includes a completed engineer's certification statement, a submittal checklist, plans and design that are signed and sealed by a registered professional engineer licensed in South Carolina. Erosion and sediment control for sites below the South Carolina Department of Health and Environmental Control (SC DHEC) National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities (SCR100000) thresholds must obtain permit coverage under this stormwater permit. All construction stormwater permit applications above the SC DHEC thresholds are reviewed by the DHEC Office of Coastal Resources Management, or the reviews are delegated to the Beaufort County Public Works Department to determine compliance with the requirements of SCDHEC's NPDES General Permit for Stormwater Discharges from Construction Activities (SCR100000) and of the Construction Stormwater Pollution Prevention Plan (C-SWPPP). These permit applications must be approved, issued, and provided to Beaufort County Public Works Department prior to the issuance of the stormwater management plan approval.

1.5.2 Fees

An applicant is responsible for paying fees that provide for the cost of review, administration, and management of the stormwater permitting process and inspection of all projects subject to the requirements of Beaufort County Public Works. These fees are posted by the Beaufort County Public Works Department.

Chapter 2. Design, Review, & Permitting Process

2.1 Satisfying the Stormwater Management, Site Planning, & Design Criteria

2.1.1 Overview

This chapter presents a comprehensive set of site planning and design and post-construction criteria that must be applied to new development and redevelopment activities occurring within the Southern Lowcountry region. Satisfying these criteria promotes the systematic development of acceptable stormwater management plans, and a successful integration of natural resource protection and stormwater management through the site planning and design process (Figure 2.2).

Through the use of Better Site Design, as described in detail below, the integration of natural resource protection and stormwater management can be achieved by:

- Identifying and protecting valuable natural resources;
- Limiting land disturbance, new impervious cover, and disturbed pervious cover; and
- Reducing and managing post-construction stormwater runoff rates, volumes, and pollutant loads.

This approach involves the use of two distinct but complementary groups of natural resource protection and stormwater management techniques:

- Green Infrastructure Practices: Natural resource protection and stormwater management practices and techniques (i.e., better site planning and design techniques, low impact development practices) that can be used to help prevent increases in post-construction stormwater runoff rates, volumes and pollutant loads.
- Stormwater Management Practices: Stormwater management practices (e.g., wet ponds, swales) that can be used to manage post-construction stormwater runoff rates, volumes and pollutant loads.

Natural resource protection and stormwater management techniques help control and minimize the negative impacts of the land development process while retaining and, perhaps, even enhancing a developer's vision for a development site. When applied during the site planning and design process, they can be used to create more natural and aesthetically pleasing development projects and create more cost-effective post-construction stormwater management systems (ARC, 2001). The use of these techniques, particularly the green infrastructure practices, can even reduce overall development costs while maintaining or increasing the resale value of a development project (MacMullan and Reich, 2007; US EPA, 2007; Winer-Skonovd et al., 2006).

2.1.2 Better Site Design in the Planning Process

Better Site Design (BSD) refers to encouraged planning land development using certain principles to minimize stormwater impacts. Integral to low impact development design, proper application of BSD principles can allow for smaller required stormwater BMP storage and retention volumes, and can help provide significant reductions in post-construction peak flows and pollutant loads. These principles include reduction/restoration of impervious cover, conservation of natural cover areas, stream restoration, and integration of both structural and non-structural stormwater management within site design. The principles of Better Site Design are referenced in the sections below. To note, any design standards in conflict with the Beaufort County Community Development Code (CDC) will be superseded by the CDC.

Fundamental to the application of Better Site Design is the correlation between impervious surface area in a watershed and negative impacts on receiving water resources. On a national level, the Impervious Cover Model (ICM) estimates stream quality based on percentage of impervious cover (Schueler and Fraley-McNeal, 2009). This model demonstrates that streams follow a continuous gradient of degradation in response to increasing impervious cover in a watershed. Local studies have supported this paradigm, and report that changes in the rate and volume of stormwater runoff were primary causes of ecological impairment in headwater tidal creeks, such as those found in Beaufort and Jasper Counties. These studies have shown that physical and chemical characteristics such as altered hydrography, increased salinity variance, increased chemical contaminants, and increased fecal coliform loadings of tidal creeks were negatively impacted with as little as 10 to 20% impervious cover. When impervious cover exceeded 30% of the watershed, measurable impacts to living resources were observed, indicating the ecological processes in the creek ecosystems were impaired (Holland et al., 2004).

Such findings are of consequence to Beaufort and Jasper Counties. Increasing pressure for development in response to population growth, and land development practices of the Lowcountry result in significant tree removal and loss of vegetative cover from land grading and storm pond construction and increases in impervious surfaces. According to the NOAA C-CAP Land Cover Analysis (https://coast.noaa.gov/ccapatlas/), from 1996 to 2010, the percent net increase in impervious surface area was 60% for Beaufort County and 59% for Jasper County. Table 2. 1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010. below summarizes the findings of this NOAA report. Although the percentage of total wetlands lost is relatively low for both counties, the actual wetland types have been converted from palustrine forested wetlands to palustrine scrub/shrub and palustrine emergent wetlands, which may alter ecosystem processes and hydrology in these areas.

Table 2. 1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010.

	Beaufort County[1]			Jasper County[1]		
Land Cover %	1996	2010	% Change	1996	2010	% Change
Development	3.87	6.16	+59.12	1.62	2.52	+55.15
Forested Area	25.28	21.5	-14.98	62.50	48.37	-22.60
Wetlands	33.85	33.20	-1.93	45.24	44.74	-1.11

[1] Percent of County under each land cover type.

Given the rapid growth the Southern Lowcountry experienced in the past 20 years, the goals of Better Site Design should resonate with those charged with managing stormwater and its release into the area watersheds. Succinctly, the goals of Better Site Design include the following:

- Preventing stormwater impacts rather than mitigating them;
- Managing stormwater (quantity and quality) as close to the point of origin as possible and minimizing collection and conveyance;
- Utilizing simple, nonstructural methods for stormwater management that are lower cost and lower maintenance than structural controls;
- Creating a multifunctional landscape; and
- Using hydrology as a framework for site design.

The Center for Watershed Protection's Better Site Design Handbook outlines 22 model development principles for site design that act to reduce impervious cover, conserve open space, prevent stormwater pollution, and reduce the overall cost of development (CWP, 2017). The principles can provide notable reductions in post-construction stormwater runoff rates, volumes and pollutant loads (ARC, 2001). Better Site Design across the country is implemented through review of existing planning and development codes, and streets, parking and stormwater engineering criteria. Within the context of a stormwater management document and this Manual, the Better Site Design techniques of greatest application include protection of existing natural areas, incorporation of open space into new development, effective sediment and erosion control practices, and stormwater management that mimics natural systems. The following sections apply Better Site Design to the Southern Lowcountry Watershed Protection Areas and Special Watershed Protection Areas to help mitigate the effects of development to the watersheds. Therefore, the conservation principles below are part of an overall watershed approach to stormwater management and will complement the Watershed Protection Area approach in this Manual. Their application is subject to Beaufort County Public Works Department requirements and/or standards.

2.1.3 Site Planning & Design Process

Figure 2.2 depicts the site planning and design process that is captured in *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014) and is applicable to the Beaufort County Public Works Department. The site planning and design checklist of the Southern Lowcountry Design Manual does not make each of the phases of the process a submittal requirement. The checklist, however, gives the Beaufort County Public Works Department the opportunity to ask whether each of these steps have been considered. Required steps for the Beaufort County Public Works Stormwater Permit submittal are the conceptual plan and final plan, with construction and final inspections occurring after final plan has been approved. The actual document submittal begins with the preliminary plan when considered in context of the planning process below:

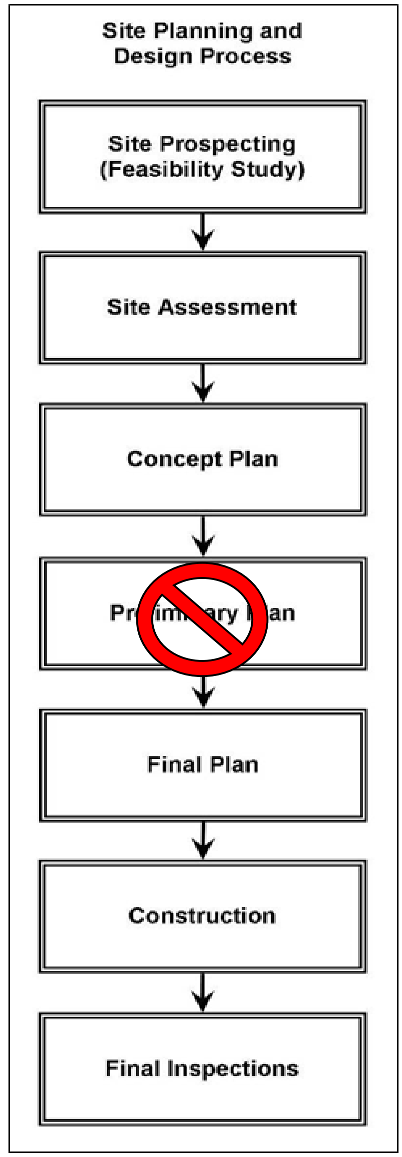


Figure 2.1. Site planning & design process

- Site Prospecting: During the site prospecting phase, some basic information is used to evaluate the feasibility of completing a development or redevelopment project. A *feasibility study* is typically used to evaluate the many factors that influence a developer's decision about whether or not to move forward with a potential development project. Factors that are typically evaluated during a *feasibility study* include information about site characteristics and constraints, applicable local, state and federal stormwater management and site planning and design requirements, adjacent land uses and access to local infrastructure (e.g., water, sanitary sewer).
- Site Assessment: Once a potential development or redevelopment project has been deemed feasible, a more thorough assessment of the development site is completed. The site assessment, which is typically completed using acceptable site reconnaissance and surveying techniques, provides additional information about a development site's characteristics, its natural resource inventory and constraints. Once the assessment is complete, a developer can identify and analyze the natural, man-made, economic and social aspects of a potential development project, define the actual buildable area available on the development site and begin making some preliminary decisions about the layout of the proposed development project.

- Concept Plan: The results of the site assessment are typically used to create a concept pla~~n~~) for the proposed development project. A concept plan is used to illustrate the basic layout of the proposed development project, including lots and roadways, and is usually reviewed with the local development review authority before additional resources are used to create a more detailed plan of development. During this phase, several alternative concept plans can be created and compared with one another to craft a plan of development that best “fits” the character of the development site (Figure 2.3, Figure 2.4, and Figure 2.5). It is at this point in the planning and design process that a Maximum Extent Practicable demonstration described in Section 3.9 is required for development projects that will seek a waiver from requirements of this Manual.
- Final Plan: The final plan adds further detail to the preliminary plan and reflects any changes to the plan of development that were requested or required by the local development review authority. The final plan typically includes all of the information that was included in the preliminary plan, as well as information about landscaping, pollution prevention, erosion and sediment control and long-term operation and maintenance of the site’s post-construction stormwater management system. There may be several iterations of the final plan between the time that it is submitted and the time that it is approved by the local development review authority.
- Construction: Once the final plan has been reviewed and approved, performance bonds are set and placed, contractors are retained, and construction begins. During the construction phase, a development project may be inspected on a regular basis by the local development review authority to ensure that all roadways, parking areas, buildings, utilities and other infrastructure, including the post-construction stormwater management system, are being built in accordance with the approved final plan and that all primary and secondary conservation areas have been protected from any land disturbing activities.
- Final Inspections: Once construction is complete, final inspections take place to ensure that all roadways, parking areas, buildings, utilities and other infrastructure, including the post-construction stormwater management system, were built according to the approved final plan. As-built plans are also typically prepared and executed during this phase. If a development project passes all final inspections, an occupancy permit may be issued for the project.

2.1.4 Natural Resources Inventory

The first step to conserve natural resources is properly documenting existing assets. An up-to-date natural resources inventory map can provide geospatial information for water resources, soils, sensitive natural resource areas, critical habitats, and other unique resources (Ellis et al., 2014).

An application for new development requires a natural resources inventory prior to the start of any land disturbing activities. A natural resources inventory prepared by a qualified person shall be used to identify and map the most critical natural resources identified on the property that would be best to preserve, such as those listed in Table 2.2, as they exist predevelopment. Qualified persons include individuals with a working knowledge of hydrology, wetlands, plant taxonomy, and field survey methods. Qualified individuals include but are not limited to licensed foresters, professional wetland scientists, and geographic information professionals. A thorough assessment of the natural resources, both terrestrial and aquatic, found on a development site shall be submitted in the development application.

Table 2.2. Resources to be identified and mapped during the Natural Resources Inventory.

Resource Group	Resource Type
General Resources	• Topography • Natural Drainage Divides • Natural Drainage Patterns • Natural Drainage Features (e.g., Swales, Basins, Depressional Areas) • Soils • Erodible Soils • Steep Slopes (e.g., Areas with Slopes Greater Than 15%) • Trees and Other Existing Vegetation
Freshwater Resources	• Freshwater Wetlands
Estuarine Resources	• Tidal Rivers and Streams • Tidal Creeks • Coastal Marshlands • Tidal Flats • Scrub-Shrub Wetlands
Marine Resources	• Near Coastal Waters •
Groundwater Resources	• Groundwater Recharge Areas • Wellhead Protection Areas
Terrestrial Resources	• • Bottomland Hardwood Forests • Beech-Magnolia Forests

- Pine Flatwoods
- Longleaf Pine-Wiregrass Savannas
- Longleaf Pine-Scrub Oak Woodlands
- Shellfish Harvesting Areas
- Floodplains

Other Resources

- Aquatic Buffers
- Other High Priority Habitat Areas as described by South Carolina Department of Natural Resources

2.1.5 Conservation Development

Conservation development, also known as open space development or cluster development, is a site planning and design technique used to concentrate structures and impervious surfaces in a small portion of a development site, leaving room for larger conservation areas and managed open spaces elsewhere on the site (Figure 2.2). Alternative lot designs are typically used to “cluster” structures and other impervious surfaces within these conservation developments.

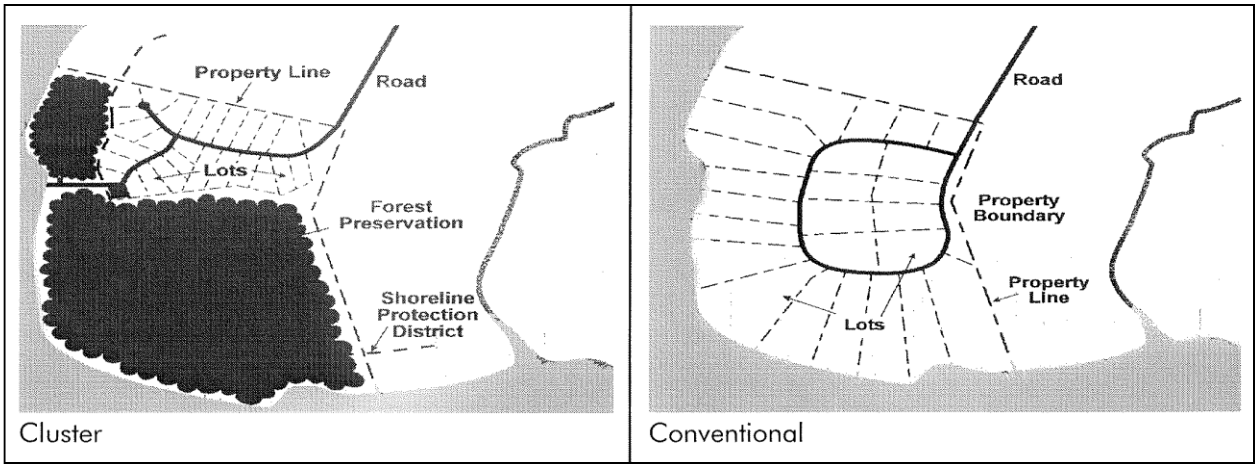


Figure 2.2. Conservation (i.e., cluster) development versus conventional development.

Conservation development projects provide a host of environmental benefits that are typically more difficult to achieve with conventional site design techniques. They provide for better natural resource protection on development sites and inherently limit increases in site imperviousness, sometimes by as much as 40 to 60 percent. Reduced site imperviousness results in reduced post-construction stormwater runoff rates, volumes and pollutant loads, which helps better protect both on-site and downstream aquatic resources from the negative impacts of the land development process. Reduced stormwater runoff rates, volumes and pollutant loads also help reduce the size of and need for storm drain systems and stormwater management practices on development sites.

As a number of recent studies have shown conservation development projects can also be significantly less expensive to build than more conventional development projects. Most of the cost savings can be attributed to the reduced amount of infrastructure (e.g., roads, sidewalks, post-construction stormwater management practices) needed on these development projects. And while these projects are frequently less expensive to build, developers often find that the lots located within conservation developments command higher prices and sell more quickly than those located within more conventional developments (ARC, 2001).

Table 2. 3 provides suggestions for Better Site Design techniques that will help protect valuable resources such as buffers, trees, wetlands, and open space.

Table 2. 3. Better Site Design principles for conservation.

Principle	Description
Vegetated Buffer System	Create a variable width, naturally vegetated buffer system along all streams that also encompasses critical environmental features such as the 100-year floodplain, steep slopes, and freshwater wetlands. *Recommended buffer widths are included in Table 3.2-4 in Ellis et al., 2014*
Buffer Maintenance	The riparian buffer should be preserved or restored with native vegetation that can be maintained through delineation, plan review, construction, and occupancy stages of development.
Clearing and Grading	Clearing and grading of forests and native vegetation should be limited to the minimum amount needed to build lots, allow access, and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner.
Tree Conservation	Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native plants. Wherever practical, manage community open space, street rights-of-way, parking lot islands, and other landscaped areas to promote natural vegetation.
Land Conservation	Open space development should be encouraged to promote conservation of stream buffers, forests, meadows, and other areas of environmental value. In addition, off-site mitigation consistent with locally-adopted watershed plans should be encouraged.
Stormwater Outfalls	New stormwater outfalls should not discharge unmanaged into jurisdictional wetlands, sole-source aquifers, or sensitive areas.

2.1.6 Residential Streets & Parking Lots

Up to 65% of the total impervious cover in a watershed can be the attributed to streets, parking lots, and driveways (CWP, 1998). Table 2.4 describes Better Site Design principles related to techniques to reduce the impervious surfaces associated with these hardscapes.

Table 2.4. Better Site Design principles for streets and parking to meet Beaufort County Community Development Code requirements.

Principle	Description
Street Width	Design residential streets for the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance, and service vehicles.
Street Length	Reduce the total length of residential streets by examining alternative street layouts to determine the best option for increasing the number of homes per unit length.

Right-of-Way Width	Wherever possible, residential street right-of-way widths should reflect the minimum required to accommodate the travel-way, the sidewalk, and vegetated open channels. Utilities and storm drains should be located within the pavement section of the right-of-way wherever feasible.
Cul-de-sacs	Minimize the number of residential cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.
Vegetated Open Channels	Where density, topography, soils, and slope permit, vegetated open channels should be used in the street right-of-way to convey and treat stormwater runoff.
Parking Ratios	The required parking ratio governing a particular land use or activity should be enforced as both a maximum and a minimum in order to curb excess parking space construction. Existing parking ratios should be reviewed for conformance, taking into account local and national experience to see if lower ratio is warranted and feasible.
Parking Lots	Reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in spillover parking areas.
Structured Parking	Utilize structured (e.g., parking garage) and shared parking to reduce impervious surface area.
Parking Lot Runoff	Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips, and/or other practices that can be integrated into required landscaping areas and traffic islands.

2.1.7 Lot Development Principles to Meet Requirements

Development of lots follows similar guidelines for reducing impervious cover and protecting natural areas, such as open space.

Table 2. 5 summarizes Better Site Design principles for lot development. Preserving open space is critical to maintaining water quality at the regional level. Compared to traditional development, open space development can reduce the annual runoff volume from a site by 40%–60%, nitrogen loads by 42%–81%, and phosphorus loads by 42%–69% (CWP, 1998). Large, continuous areas of open space reduce and slow runoff, absorb sediments, serve as flood control, and help maintain aquatic communities. Open space can be provided by minimizing lot sizes, setbacks, and frontage distances

Table 2. 5. Better Site Design principles for lot development.

Principle	Description
Open Space Development	Utilize open space development that incorporates smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection.
Setbacks and Frontages	Consider minimum setbacks allowed by Beaufort County Community Development Code. Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce overall lot imperviousness.
Sidewalks	Where practical, consider locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas.
Driveways	Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.
Rooftop Runoff	Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and should avoid routing rooftop runoff to the roadway and the stormwater conveyance system.
Open Space Management	Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space.

For more detailed descriptions of these techniques, please reference *Better Site Design: A Handbook for Changing Development Rules in Your Community* (CWP, 1998) and Chapter 3 of *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014).

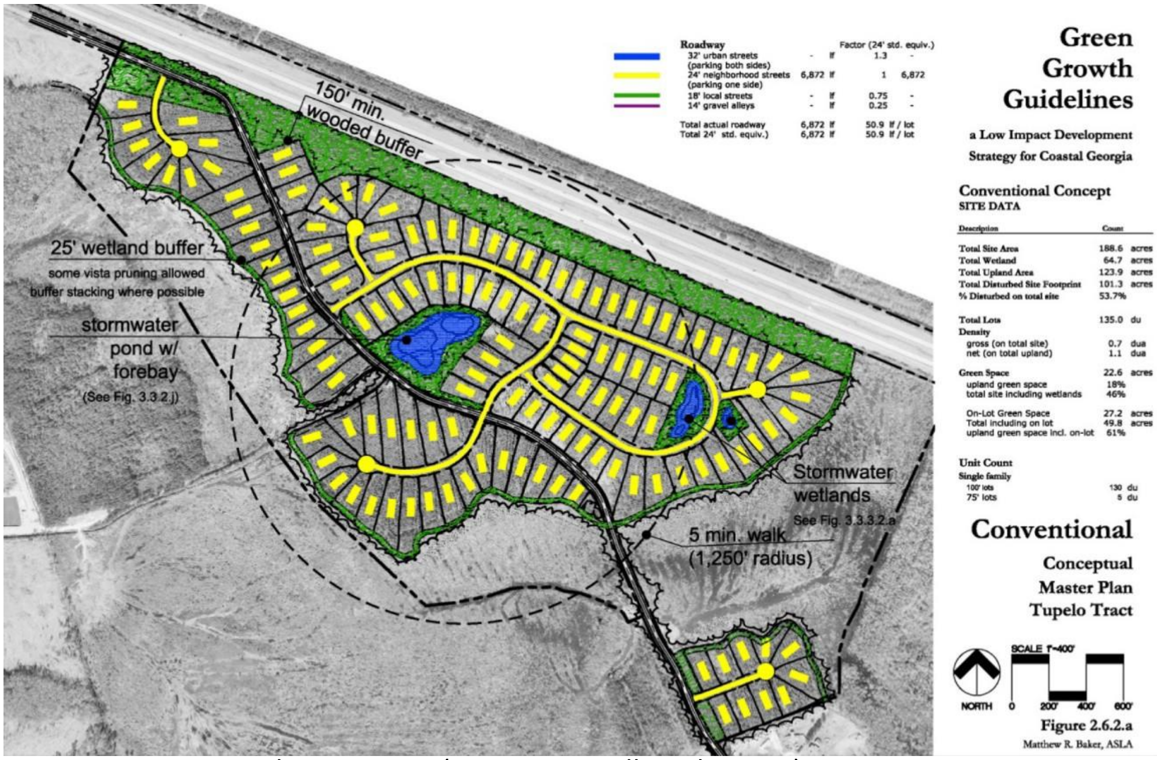


Figure 2.3. Conventional Site Design (source: Merrill et al., 2006).

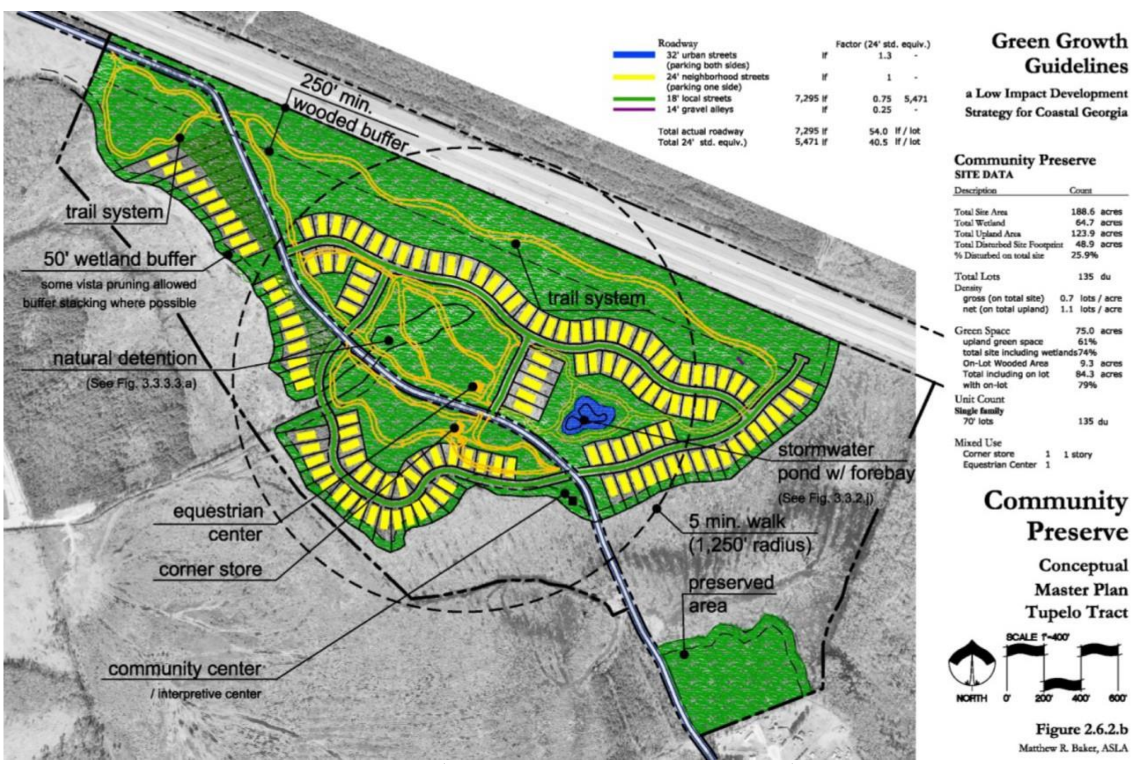


Figure 2.4. Conservation Site Design (source: Merrill et al., 2006).

Figure 2.5. New Urbanist Site Design (source: Merrill et al., 2006).

2.1.8 Integrating Natural Resource Protection & Stormwater Management with the Site Planning & Design Process

In order to successfully *integrate* natural resource protection and stormwater management with the site planning and design process, site planning and design teams are to consider following questions at the beginning of the process:

- What valuable natural resources, both terrestrial and aquatic, can be found on the development site?
- How can better site planning techniques be used to protect these valuable natural resources from the direct impacts of the land development process?
- How can better site design techniques be used to minimize land disturbance and the creation of new impervious and disturbed pervious cover?
- What low impact development practices can be used to help preserve pre-development site hydrology and *reduce* post-construction stormwater runoff rates, volumes and pollutant loads?
- What stormwater management practices can be used to *manage* post-construction stormwater runoff rates, volumes and pollutant loads?
- Are there any site characteristics or constraints that prevent the use of any particular low impact development or stormwater management practices on the development site?

Although answering these questions is no easy task, they can be readily obtained within the context of the six-step *stormwater management planning and design process* outlined in Figure 2.1, and the steps are described in more detail below.

- **Step 1: Pre-Application Meeting**

It is recommended that a pre-application meeting between the applicant's site planning and design team and the Beaufort County Staff Review Team with development review authority occur at the very beginning of the stormwater management planning and design process. This meeting, which should occur during the site prospecting phase of the overall site planning and design process (Figure 2.6), helps establish a relationship between the site planning and design team and the Beaufort County Staff Review Team with development review authority. The pre-application meeting also provides an opportunity to discuss the local site planning and stormwater management design criteria that will apply to the proposed development project, which increases the likelihood that the remainder of the site planning and design process will proceed both quickly and smoothly.

- **Step 2: Review of Local, State, and Federal Stormwater Management, Site Planning, & Design Requirements**

Once a pre-application meeting has been completed, it is recommended that the site planning and design team review the local, state and federal requirements that will apply to the proposed development project. This review should occur during the site prospecting phase of the overall site planning and design process (Figure 2.6), while the feasibility study is still being completed.

During their review of stormwater management and site planning and design requirements, the applicant's site planning and design teams should also investigate opportunities and incentives for land conservation, and opportunities and incentives for conservation development as illustrated earlier in Figure 2.1.

- **Step 3: Natural Resources Inventory**

Once the potential development or redevelopment project has been deemed feasible, acceptable site reconnaissance and surveying techniques must be used to complete a thorough assessment of the natural resources, both terrestrial and aquatic, found on the development site. The identification and subsequent preservation and/or restoration of these natural resources helps reduce the negative impacts of the land development process "by design." The natural resources inventory should be completed during the site assessment phase of the overall site planning and design process (Figure 2.6). A map that is created to illustrate the results of the natural resources inventory, known as a site fingerprint, should be used to prepare a stormwater management concept plan for the proposed development project.

Once the natural resources inventory has been completed and a site fingerprint has been created, the site planning and design team should have a better understanding of a development site's characteristics and constraints. This information can be used to identify primary and secondary conservation areas (Figure 2.6. Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).) and define the actual buildable area available on the development site. Along with information about adjacent land uses and available infrastructure (e.g., roads, utilities), the site fingerprint can also be used to make some preliminary decisions about the layout of the proposed development project and to guide the creation of the stormwater management concept plan.

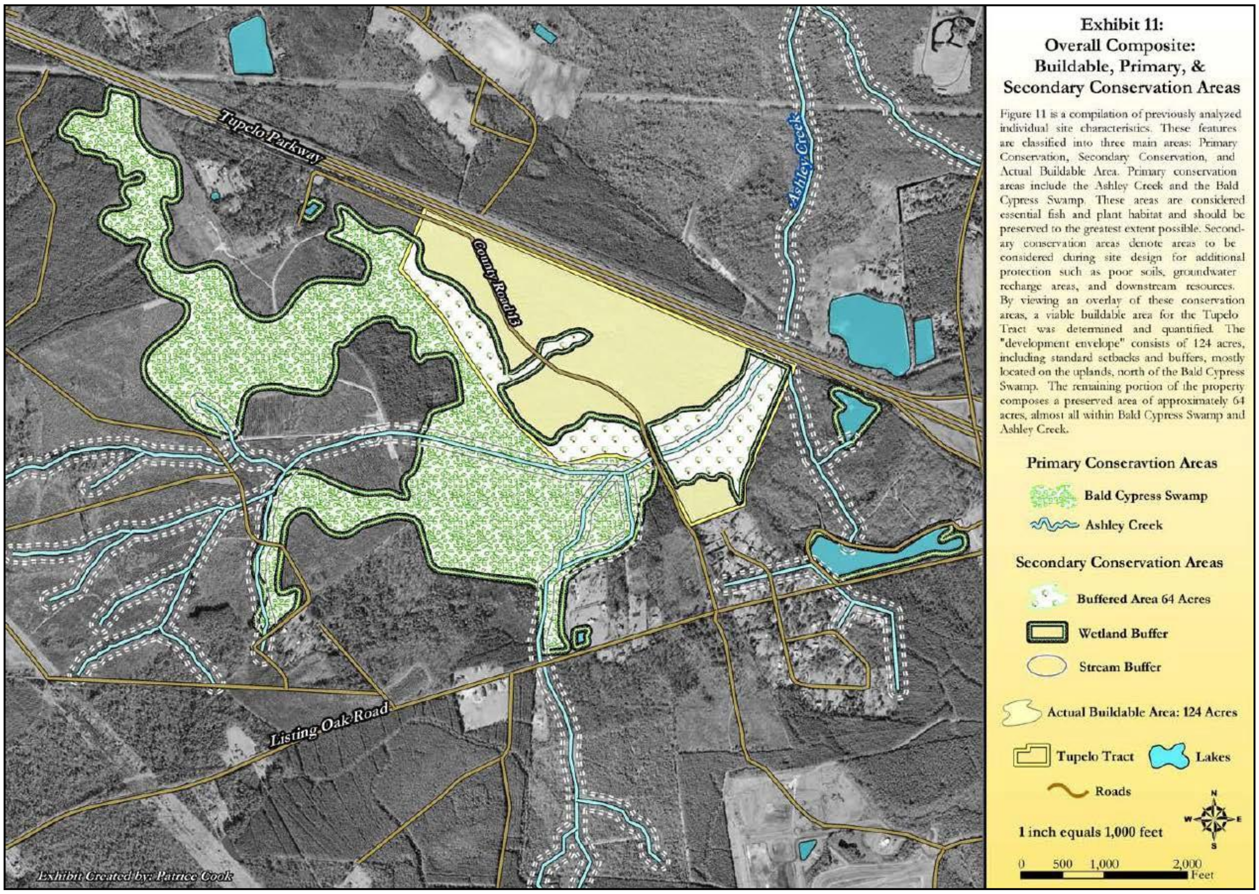


Figure 2.6. Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).

- **<u>Step 4: Prepare Stormwater Management Concept Plan</u>**

After the natural resources inventory has been completed, it is recommended that the site fingerprint be used to develop a stormwater management concept plan for the proposed development project. The stormwater management concept plan should illustrate the layout of the proposed development project and should show, in general, how post-construction stormwater runoff will be managed on the development site.

The creation of a stormwater management concept plan allows the applicant's site planning and design team to make some preliminary decisions about the layout of the proposed development project. If it is submitted to the local development review authority prior to the preparation and submittal of the stormwater management design plan, it can also be used to solicit early feedback on the project and on the green infrastructure and stormwater management practices that will be used to manage post-construction stormwater runoff on the development site.

During the creation of the stormwater management concept plan, most of the site layout, including the layout of lots, buildings, roadways, parking areas, sidewalks and green infrastructure and stormwater management practices, will be completed. Therefore, it is very important that natural resource protection and stormwater management be considered throughout this part of the stormwater management planning and design process.

- **Step 6: Prepare Stormwater Management Design Plan**

Subsequent to review and approval of the stormwater management concept plan, the site planning and design team should prepare a stormwater management design plan. The stormwater management design plan should detail how post-construction stormwater runoff will be managed on the development site and should include maps, narrative descriptions and design calculations (e.g., hydrologic and hydraulic calculations) that show how the stormwater management and site planning and design criteria that apply to the development project have been met. The stormwater management design plan should be submitted to the local development review authority for review and approval.

2.2 Submittal & Review Process of Stormwater Management Plans

The Stormwater Management Plan (SWMP) consists of the entire submittal package and includes the following components:

- Project description and narrative;
- Description of selected stormwater management systems;
- Erosion and sediment control plans;
- Sufficient information to evaluate the environmental characteristics of the affected areas, the potential impacts of the proposed development on water resources, the effectiveness and acceptability of stormwater best management practices (BMPs), and land covers for managing stormwater runoff;
- Supporting computations and drawings; and
- Construction, inspection, and maintenance schedules.

All SWMPs must include the Stormwater submittal checklist (Appendix D) and calculations summary. The plans must include the calculated stormwater retention volume (SWRv) for each BMP and for the overall project, the pre and post development peak flow comparison, extreme flood requirements, and any off-site retention or detention volume obligation.

The SWMP and accompanying documentation may be submitted according to the Beaufort County Public Works Department process, but the applicant must also submit one paper copy of the SWMP carrying the stamp of a registered professional engineer licensed in the State of South Carolina with all supporting documentation to Beaufort County Public Works Department.

Upon acceptance of a complete application (which includes payment of filing fees), the Beaufort County Public Works Department will review the SWMP and make a determination to approve, approve with conditions, or disapprove the SWMP. Relatively large and/or complicated projects tend to require a longer review time than smaller and less complicated projects. A written response of approval or disapproval will be provided to the applicant. If it is determined that more information is needed or that a significant number of changes must be made before the SWMP can be approved, the applicant must resubmit the applications with the revisions required and certified by the registered professional engineer according to the plan resubmittal process of the Beaufort County Public Works Department.

When a SWMP approval is granted, a final submission package is required, including the following:

- One PDF copy of the SWMP, certified by a registered professional engineer licensed in the State of South Carolina,
- A declaration of covenants that has been approved for legal sufficiency by the Beaufort County Public Works Department, and
- All supporting documents specified within this Manual or as requested during the review process according to the Beaufort County Public Works Department requirements.

2.2.1 Components of a Stormwater Management Plan

As itemized in the SWMP checklist in Appendix D Design Checklists, a SWMP includes the following:

Site Plan

The following information must be formatted to print as a standard drawing size of 24 by 36 inches. The site drawing will provide details of existing and proposed conditions:

- A cover page that contains a blank space measuring 7 inches wide by 9.5 inches high. The blank space must be located 1 inch below the top edge and 1 inch from the left edge of the page;
- A plan showing property boundaries and the complete address of the property;
- Lot number or property identification number designation (if applicable);
- North arrow, scale, and date;
- Property lines (include longitude and latitude);
- Location of easements (if applicable);
- Existing and proposed structures, utilities, roads, and other paved areas;
- Existing and proposed topographic contours;
- Soil information for design purposes;
- Area(s) of soil disturbance;
- Drainage area(s) within the limits of disturbance (LOD) and contributing to the LOD;
- Contributing drainage area (CDA) to each BMP;
- Location(s) of BMPs, marked with the BMP ID Numbers to agree with the BMP design summary list;
- Delineation of existing and proposed land covers including natural cover, compacted cover, and impervious surfaces. Consult Appendix G Compliance Calculator Instructions for details;
- Natural resources inventory with site fingerprint map;

- All plans and profiles must be drawn at a scale of 1 in. = 10 ft, 1 in. = 20 ft, 1 in. = 30 ft, 1 in. = 40 ft, 1 in. = 50 ft, or 1 in. = 100 ft. Although, 1 in. = 10 ft, 1 in = 20 ft, and 1 in. = 30 ft, are the most commonly used scales. Vertical scale for profiles must be 1 in. = 2 ft, 1 in. = 4 ft, 1 in. = 5 ft, or 1 in. = 10 ft;
- Drafting media that yield first- or second-generation, reproducible drawings with a minimum letter size of No. 4 (1/8 inch);
- Location and size of existing utility lines including gas lines, sanitary lines, telephone lines or poles, electric utilities and water mains;
- A legend identifying all symbols used on the plan;
- Applicable flood boundaries and FEMA map identification number for sites lying wholly or partially within the 100-year floodplain;
- Site development plan and stormwater management narrative;
- Assess potential application of green infrastructure practices in the form of better site planning and design techniques. Low impact development practice should be used to the maximum extent practicable during the creation of a stormwater management concept plan. A demonstration of better site planning is required. The following site information and practices shall be considered:
  - Soil type (from Soil Study);
  - Depth of ground water on site;
  - Whether the type of development proposed is a hotspot as defined by the Ordinance and Design Manual and address how this influences the concept proposal;
  - Protection of primary and secondary conservation areas;
  - Reduced clearing and grading limits;
  - Reduced roadway lengths and widths;
  - Reduced parking lot and building footprints to minimize impervious surface;
  - Soil restoration;
  - Site reforestation/revegetation;
  - Impervious area disconnection;
  - Green roof (for redevelopment, infill and major substantial improvement projects); and
  - Permeable pavements.
- Stormwater Pollution Prevention Plan (SWPPP) or Erosion and Sediment Control narrative (for projects disturbing over an acre);
- Information regarding the mitigation of any off-site impacts anticipated as a result of the proposed development;
- Construction specifications;
- Design and As-Built Certification, including the following:
  - i Certification by a registered professional engineer licensed in the State of South Carolina seal that the site design, land covers, and design of the BMPs conforms to the standard of care applicable to the treatment and disposal of stormwater pollutants and that the Facility has been designed in accordance with the specifications required under the stormwater ordinance of the Beaufort County Public Works Department.
  - ii Submission one set of the As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina within 21 days after completion of construction of the site, all BMPs, land covers, and stormwater conveyances.
  - iii For a project consisting entirely of work in the public right-of-way (PROW), the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMP and related stormwater infrastructure.

- Maintenance sheet for stormwater BMPs, including the following:
  - i A maintenance plan that identifies routine and long-term maintenance needs and a maintenance schedule;
  - ii A maintenance agreement and schedule for all post construction best management practices in a form and manner that meets the Beaufort County Public Works Department requirements.
  - iii For applicants using Rainwater Harvesting, submission of third-party testing of end-use water quality may be required at equipment commissioning as determined by the requirements in Appendix J Rainwater Harvesting Treatment and Management Requirements. Additional regular water quality reports certifying compliance for the life of the BMP may also be required in Appendix J Rainwater Harvesting Treatment and Management Requirements.

Stormwater Retention Volume Computations

The following summary calculations must be included on the plan set. Supporting documentation and the South Carolina DHEC C-SWPPP are not in the plan set but provided separately.

- Calculation(s) of the required SWRv for the entire site within the LOD and each site drainage area (SDA) within the LOD;
- Calculation(s) for each proposed BMP demonstrating retention value towards SWRv in accordance with Chapters 2 and 4;
- For Rainwater Harvesting BMP, calculations demonstrating the annual water balance between collection, storage, and demand, as determined using the Rainwater Harvesting Retention Calculator;
- For proprietary and non-proprietary BMPs follow the guidance in Chapter 4.13 to identify/receive approval or denial to use these practice(s); and
- Off-site stormwater volume requirement.
- Compliance Calculator sheets identifying that proposed BMP(s) meet standards for water quality

Pre-/Post-Development Hydrologic Computations

Include in the plan set a summary of the pre-/post-runoff analysis with the following information at a minimum:

- A summary of soil conditions and field data;
- Pre- and post-project curve number summary table;
- Pre and post construction peak flow summary table for the 2-, 10-, 25- , 50-, 100-year 24-hour storm events for each SDA within the project's LOD; and
- Flow control structure elevations.

Hydraulic Computations

Hydraulic computations for the final design of water quality and quantity control structures may be accomplished by hand or through the use of software using equations/formulae as noted in Chapters 3 and 4. The summary of collection or management systems will include the following:

- Existing and proposed SDA must be delineated on separate plans with the flow paths used for calculation of the times of concentration;
- Hydraulic capacity and flow velocity for drainage conveyances, including ditches, swales, pipes, inlets, and gutters. Plan profiles for all open conveyances and pipelines, with energy and hydraulic gradients for the 2-, 10-,25-, 50-, 100-year, 24-hour storms;

- The proposed development layout including the following:
  - Location and design of BMP(s) on site, marked with the BMP ID Numbers;
  - Stormwater lines and inlets;
  - A list of design assumptions (e.g., design basis, 2 through 50-year return periods);
  - The boundary of the CDA to the BMP;
  - Schedule of structures (a listing of the structures, details, or elevations including inverts); and
  - Manhole to manhole profile, listing of pipe size, pipe type, slope, (i.e., a storm drain pipe schedule) computed velocity, and computed flow rate, energy grade line (EGL) and hydraulic grade line (HGL).

Supporting Documentation

Provide a written report with the following supporting documentation:

- Pre- and post-project curve number selection
- Time of concentration calculation;
- Travel time calculation;
- Hydrologic computations supporting peak discharges assumed for each SDA within the project's LOD for the 2-, 10-, 25-, 50-, and 100-year, 24-hour storm events;
- SC DHEC's Construction Stormwater Pollution Prevention Plan (C-SWPPP).

A professional engineer registered in the State of South Carolina must also submit the following:

1. Elevation and topographic data illustrating changes in topography and drainage;
2. Impacts upon local flood flows (2-, 10-, 25-, 50-, and 100-year storm events;
3. Identify areas where stormwater flows are discharged off-site or off-property;
4. For proposed off-site/property discharge points, perform analysis of receiving off-site conveyance systems to confirm safe conveyance from the proposed developed property, no negative impact to adjacent properties, and adequacy of the receiving, existing conveyance system for 25-yr storm flows. Such analysis shall be taken to point where the 25-yr storm conveyance is determined to be adequate in the public stormwater conveyance/infrastructure system; and
5. Documentation supporting safe passage of the 100-yr post development flow according to the 10% Rule (see Section 3.8);

2.2.2 Resubmission of Stormwater Management Plans

If changes occur in the design or construction of an accepted SWMP, the applicant may be required to resubmit the SWMP for approval. Examples of changes during design and construction that will require SWMP resubmission for review include, but may not be limited to the following:

1. Revision to the property boundary, property size, or LOD boundaries that may require redesigning BMPs;
2. Any change to SWRv through land cover designation change;
3. Change in compaction or infiltration rates due to construction activities;
4. Encountering contaminated soil or other underground source of contamination;
5. Changes to floodplain designation or requirements;
6. Changes in any component of the BMP that may adversely affect the intended capacity of the approved BMP, such as the following:

   a. Modification to approved BMP selection, dimensions, or location
   b. Modification to approved material specification
   c. Changes to the size, invert, elevation, and slopes of pipes and conveyances
   d. Installation of new drains and conveyance structures
   e. Need for a new storm sewer outlet connection to the sanitary/storm sewer main
   f. Changes to the amount of off-site requirements
   g. Changes to the CDA to a BMP
7. Revision to the approved grading and drainage divides and that may require redesigning BMPs;
8. Relocation of an on-site storm sewer or conveyance; or
9. Abandonment, removal, or demolition of a BMP.

If the applicant resubmits an SWMP after making changes, the resubmission must contain a list of the changes made and may be in the form of a response to comments. The resubmittal plans and calculations must include the stamp of the registered professional engineer in South Carolina.

However, if any of the following minor changes are made to the SWMP, resubmission is not required. These minor changes may be made anytime during inspection or at the as-built submittal by Beaufort County Public Works Department.

1. Changes to SWM components that do not adversely affect BMP capacity while in consultation with Beaufort County Public Works Department. The inspector should review the appropriate manufacturer's documentation to his/her satisfaction before approving such a change and should ensure that such changes are recorded as red line changes or deviations in the as-built plans. These changes include the following:
   a. Changes to parts type of similar function (e.g. dewatering valve)
   b. Change in hole pattern or size of underdrain pipe perforations
   c. Change in project address, ownership, permit status, or zoning

Design Certifications
The engineer shall certify that this Plan satisfies all requirements of the Southern Lowcountry Ordinance and Stormwater Design Manual. The following statement with engineer's seal is required in the Plan submittal.

> The engineering features of all stormwater best management practices (BMPs), stormwater infrastructure, and land covers (collectively the "Facility") have been designed/examined by me and found to be in conformity with the standard of care applicable to the treatment and disposal of stormwater pollutants. The Facility has been designed in accordance with the specification required under of Beaufort County Stormwater Ordinance.

2.3 Construction Inspection Requirements

2.3.1 Inspection Schedule & Reports

Prior to the approval of a SWMP, the applicant will submit a proposed construction inspection schedule. Beaufort County Public Works Department will review the schedule to determine if changes are required. The construction schedule should reflect the construction sequences defined in each BMP section Stormwater Best Management Practices (BMPs) of this Manual. The construction and inspection schedule must be included in the SWMP. Beaufort County Public Works Department may conduct inspections and file reports of inspections during construction of BMPs and site stormwater conveyance systems to ensure compliance with the approved plans.

Note: No stormwater management work may proceed past the stage of construction that Beaufort County Public Works Department has identified as requiring an inspection unless

- Beaufort County Public Works Department has issued an “approved” or “passed” report;
- Beaufort County Public Works Department has approved a plan modification that eliminates the inspection requirement; or
- Beaufort County Public Works Department has eliminated or modified the inspection requirement in writing.

Beaufort County Public Works Department may require that the professional engineer responsible for sealing the approved SWMP, the professional engineer responsible for certifying the as-built SWMP, or, for a project entirely in the PROW, the officer of the contracting company responsible for certifying the Record Drawing be present during inspections.

If Beaufort County Public Works Department conducts an inspection and finds work that is not in compliance with the SWMP, Beaufort County Public Works Department may issue a Notice of Violation, and the applicant must take prompt corrective action. The written notice provides details on the nature of corrections required and the time frame within which corrections must be made.

2.3.2 Inspection Requirements Before & During Construction

Beaufort County Public Works Department construction stormwater inspection form is provided in Appendix E Construction Inspection Form.

Preconstruction Meetings. These meetings are required prior to the commencement of any land-disturbing activities and prior to the construction of any BMPs. The applicant is required to contact Beaufort County Public Works Department to schedule preconstruction meetings three (3) days prior to beginning any construction activity subject to the requirements Beaufort County Public Works Department.

Inspections During Construction. The applicant is required to contact Beaufort County Public Works Department to schedule inspection three (3) days prior to any stage of BMP construction, or other construction activity, requiring an inspection. For large, complicated projects, the applicant and Beaufort County Public Works Department may agree during the preconstruction meeting to an alternative approach such as a weekly notification schedule. Any such agreement must be made in writing and signed by all parties. Beaufort County Public Works Department will revert to the 3-day notification procedure if the agreement is not followed.

During construction, Beaufort County Public Works Department may require the presence of the professional engineer responsible for sealing the approved SWMP; the professional engineer responsible for certifying the as-built SWMP; or for a project entirely in the PROW, the officer of the contracting company responsible for certifying the Record Drawing.

Final Inspection. The applicant is required to contact Beaufort County Public Works Department to schedule a final inspection one week prior to the completion of a BMP construction to schedule a final inspection of the BMP. Upon completion of the BMP, Beaufort County Public Works Department will conduct a final inspection to determine if the completed work was constructed in accordance with approved plans.

Inspection Requirements by BMP Type. Chapter 4 Stormwater Best Management Practices (BMPs) of this Manual provides details about the construction sequences for each BMP. After holding a preconstruction meeting, regular inspections may be made at the following specified stages of construction:

- **Infiltration Systems and Bioretention Areas** may be inspected at the following stages to ensure proper placement and allow for infiltration into the subgrade:
  - During on-site or off-site percolation or infiltration tests;
  - Upon completion of stripping, stockpiling, or construction of temporary sediment control and drainage facilities;
  - Upon completion of excavation to the subgrade;
  - Throughout the placement of perforated PVC/HDPE pipes (for underdrains and observation wells) including bypass pipes (where applicable), geotextile materials, gravel, or crushed stone course and backfill; and
  - Upon completion of final grading and establishment of permanent stabilization;
- **Flow Attenuation Devices**, such as open vegetated swales upon completion of construction;
- **Retention and Detention Structures**, at the following stages:
  - Upon completion of excavation to the sub-foundation and, where required, installation of structural supports or reinforcement for structures, including but not limited to the following:
  - During testing of the structure for water tightness;
  - During placement of structural fill and concrete and installation of piping and catch basins;
  - During backfill of foundations and trenches;
  - During embankment construction; and
  - Upon completion of final grading and establishment of permanent stabilization.
- **Stormwater Filtering Systems**, at the following stages:
  - Upon completion of excavation to the sub-foundation and installation of structural supports or reinforcement for the structure;
  - During testing of the structure for water tightness;
  - During placement of concrete and installation of piping and catch basins;
  - During backfill around the structure;
  - During prefabrication of the structure at the manufacturing plant;
  - During pouring of floors, walls, and top slab;
  - During installation of manholes/trap doors, steps, orifices/weirs, bypass pipes, and sump pit (when applicable);
  - During placement of the filter bed; and
  - Upon completion of final grading and establishment of permanent stabilization.

- **Green Roof Systems**, at the following stages:
  - During placement of the waterproofing layer, to ensure that it is properly installed and watertight;
  - During placement of the drainage layer and drainage system;
  - During placement of the growing media, to confirm that it meets the specifications and is applied to the correct depth (certification for vendor or source must be provided);
  - Upon installation of plants, to ensure they conform to the planting plan (certification from vendor or source must be provided); and
  - At the end of the first or second growing season, to ensure desired surface cover specified in the Care and Replacement Warranty has been achieved.

2.3.3 Final Construction Inspection Reports

Beaufort County Public Works Department will conduct a final inspection to determine if the completed work is constructed in accordance with approved plans and the intent of this Manual and the Stormwater Ordinance. Within 21 days of the final inspection, the applicant must submit an as-built package, including one PDF copy of the as-built SWMP certified by a registered professional engineer licensed in the State of South Carolina. For a project consisting entirely of work in the PROW, the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMPs, related stormwater infrastructure, and land covers.

A registered professional engineer licensed in South Carolina is required to certify as-built SWMPs and state that all activities including clearing, grading, site stabilization, the preservation or creation of pervious land cover, the construction of drainage conveyance systems, the construction of BMPs, and all other stormwater-related components of the project were accomplished in strict accordance with the approved SWMP and specifications. As stated in Section 2.2.2 Resubmission of Stormwater Management Plans, all plan changes are subject to Beaufort County Public Works Department approval. The as-built certification must be on the original SWMP.

Upon completion, these plans will be submitted to Beaufort County Public Works Department for processing. The estimated time for processing will be two weeks (10 working days), after which the plans will be returned to the engineer. Beaufort County Public Works Department will provide the applicant with written notification of the final inspection results.

2.3.4 Inspection for Preventative Maintenance

The Stormwater Ordinance requires maintenance inspections for BMPs and land covers to ensure their ongoing performance is in compliance with their original design. The inspection will occur at least once every three (3) years. Maintenance inspection forms are provided in Appendix F Maintenance Inspection Checklists. Beaufort County Public Works Department may conduct these maintenance inspections, though it may, in certain circumstances, allow a property to self-inspect and provide documentation.

Beaufort County Public Works Department will maintain maintenance inspection reports for all BMPs that they inspect and are provided by the landowner. The reports will evaluate BMP functionality based on the detailed BMP requirements of Stormwater Best Management Practices (BMPs) and inspection forms found in Appendix F Maintenance Inspection Checklists.

If, after an inspection by Beaufort County Public Works Department, the condition of a BMP presents an immediate danger to the public safety or health because of an unsafe condition or improper maintenance, Beaufort County Public Works Department may take such action as may be necessary to protect the public and make the BMP safe. Any costs incurred by Beaufort County Public Works Department may be assessed against the owner(s).

2.4 Inspections & Maintenance

2.4.1 Inspections & Maintenance Responsibilities

A site with an approved SWMP must also have a responsible party inspect and maintain the BMPs and land covers according to the inspections and maintenance schedule in the SWMP and this Manual. Land covers must be maintained in type and extent as approved. Approved BMPs must be kept in good condition, including all the engineered and natural elements of each practice, as well as conveyance features (e.g., grade surfaces, walls, drains, structures, vegetation, soil erosion and sediment control measures, and other protective devices). All repairs or restorations must be in accordance with the approved SWMP.

A Maintenance Agreement including an exhibit stating the owner's specific maintenance responsibilities must be recorded with the property deed at the Record of Deeds. An inspection and maintenance schedule for any BMP will be developed for the life of the project and shall state the inspection and maintenance to be completed, the time for completion, and who will perform the inspections and maintenance. The schedule will be printed on the SWMP and will appear as an exhibit in the Maintenance Agreement.

2.4.2 Inspection & Maintenance Agreements

Inspection and maintenance obligations are binding on current and future owners of a property subject to recorded covenants. Beaufort County Public Works Department will not issue final approval of a complete set of the SWMP for private parcels until the applicant has executed a stormwater maintenance agreement providing notice of this obligation to current and subsequent owners of the land served by the BMP(s) and land covers. Inspection and maintenance agreements by regulated projects include providing access to the site and the BMP(s) at reasonable times for regular inspection by Beaufort County Public Works Department and for regular or special assessments of property owners, as needed, to ensure that the BMP(s) is maintained in proper working condition and the land covers are retained as approved in the SWMP. An example of the declaration of covenants/maintenance agreement for a site with BMPs and designated land covers is provided at the end of this chapter.

The applicant must record the agreement as a declaration of covenants with Beaufort County Public Works Department Recorder of Deeds. The agreement must also provide that, if after written notice by Beaufort County Public Works Department to correct a violation requiring maintenance work, satisfactory corrections are not made by the owner(s) of the land served by the BMP within a reasonable period of time, not to exceed 45 to 60 days unless an extension is approved in writing by Beaufort County Public Works Department. Beaufort County Public Works Department may perform all necessary work to place the BMP in proper working condition. The owner(s) of property served by the BMP will be assessed the cost of the work and any potential penalties/fines.

As-Built Submittals

One set of As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina must be submitted as required by the procedure for handling close out documents for private development projects by Beaufort County Planning and Zoning department.

The following items must be completed and provided:

General Information:

- Words As-Built in or near the project title
- As-Built Signature/Approval block on each sheet
- As-builts shall have a coordinate system based on the South Carolina Coordinate System North American Datum of 1983 (NAD83).
- Elevations shown shall be based on the North American Vertical Datum of 1988 (NAVD88).
- Vicinity map
- Sheets numbered correctly
- Project ID number, Project Name, Permit number and name, address and contact information of project engineer
- All measurements and coordinates shall be shown on all drainage structures, detention and BMP structure outlets, outlet control structures and manholes.
- Any change to BMP capacities, dimensions, specifications or location shall be shown as mark-through of the original design on the drawings
- Elevations to the nearest 0.1 ft.

Basins:

- At least two benchmarks on the plans
- Profile of the top of berm
- Cross-section of emergency spillway at the control section
- Profile along the centerline of the emergency spillway
- Cross-section of berm at the principle spillway
- Elevation of the principle spillway crest or top of structure elevations
- Elevation of the principle spillway inlet and outlet invert
- Riser diameter/dimensions and riser base size
- Diameter, invert elevation and sizes of any stage orifices, weirs or storm drain pipes
- Barrel diameter, length, and slope
- Types of material used
- Outfall protection length, width, depth, size of rip rap and filter cloth
- Size, location, and type of anti-vortex and trash rack device (height and diameter, elevations and spacing)
- Pipe cradle information
- On plan view show length, width and depth of pond and contours of the basin area so that design volume is specified
- As-built spot elevations with the disturbed area required for basin construction in sufficient detail to provide accurate as-built contours
- Core trench limits and elevation s of bottom of cut off trench
- Show length width and depth of outfall rip rap
- Certification by a Geotechnical Engineer for compact and unified soil classes
- Vegetation cover certification
- Show location of planted landscaping
- Utility locations and elevations encountered, test pitted and/or relocation during contract work

Storm Drain Piping:

- At least two benchmarks on the plans
- Diameter and class of pipe
- Invert of pipe at outfall, structures and/or field connections

- Slope of pipe
- Pipe lengths (show stationing)
- Types of materials
- Location of all pipes and structures horizontally on the plan
- Length, width and depth of all rip rap and other outfall protection as specified
- Elevation of rip rap at outfall and at changes in grade
- Utility locations and elevations encountered, test pitted and/or relocation during contract work

Post construction BMP Specific details:

- Provide as-built details as described for each best management practice in Chapter 4.

Chapter 3. Minimum Control Requirements

3.1 Introduction

This chapter establishes the minimum stormwater control standards necessary to implement the Southern Lowcountry Stormwater Ordinance within Beaufort County Public Works Department. The term "runoff reduction" is used throughout this chapter to describe the retention of the stormwater on site. The SWRv is used to describe the volume of stormwater to be retained on site.

Two levels of stormwater retention are prescribed, the 85th and the 95th percentile storm, and are assigned based on a site's subwatershed as identified by the U.S. Geological Survey Hydrologic Unit Code 12 (HUC-12) presented in Section 3.5.1 below. In addition, peak discharge control of the post-development 2-, 10-,25-, 50-, 100-year, 24-hour storms to their predevelopment flow shall be provided by a combination of structural controls, GI/LID practices and other non-structural BMPs. As well, requirements to manage the 100-yr, 24-hour storm event are provided in the extreme flood event section below. Further, this Manual and Appendices provide the framework and necessary tools to document the methods proposed by development plans to comply with these requirements. It should be noted that stormwater ponds are considered the least favorable structural best management practice to meet the SWRv and water quality requirements of this Manual.

3.2 Regulated Site Definition

According to the Stormwater Ordinance, the design criteria of this Manual shall be applicable to any new development, redevelopment or major substantial improvement activity, including, but not limited to, site plan applications, public improvement projects, and subdivision applications that meet the applicability standards found in Chapter 1.4.

The Southern Lowcountry stormwater design requirements are applied according to the flow chart in Figure 3.1 and should be determined as follows:

1) In sequence, first determine which HUC-12 watershed that the project is in according to Table 3.1. Stormwater design criteria for the development follows the watershed area in which it is located. Next, determine the square feet of impervious area to be created, added or replaced as a part of the development or redevelopment. Will the project disturb greater than 5000 sq feet If the answer is "yes", the project plan must meet the requirements for stormwater management in this Manual for their respective watershed area.

2) If a project is a major substantial improvement, refer to section 1.4.1 it must meet the water quality criteria for its respective watershed protection area to the maximum extent practicable (MEP) or obtain off-site stormwater credit. The terms MEP and off-site stormwater credit are further explained in Section 3.9 and 3.10 below. A waiver to meet Peak control requirements for major substantial improvement projects may be applied for. Approval is at the discretion of the Public Works Director or their designee.

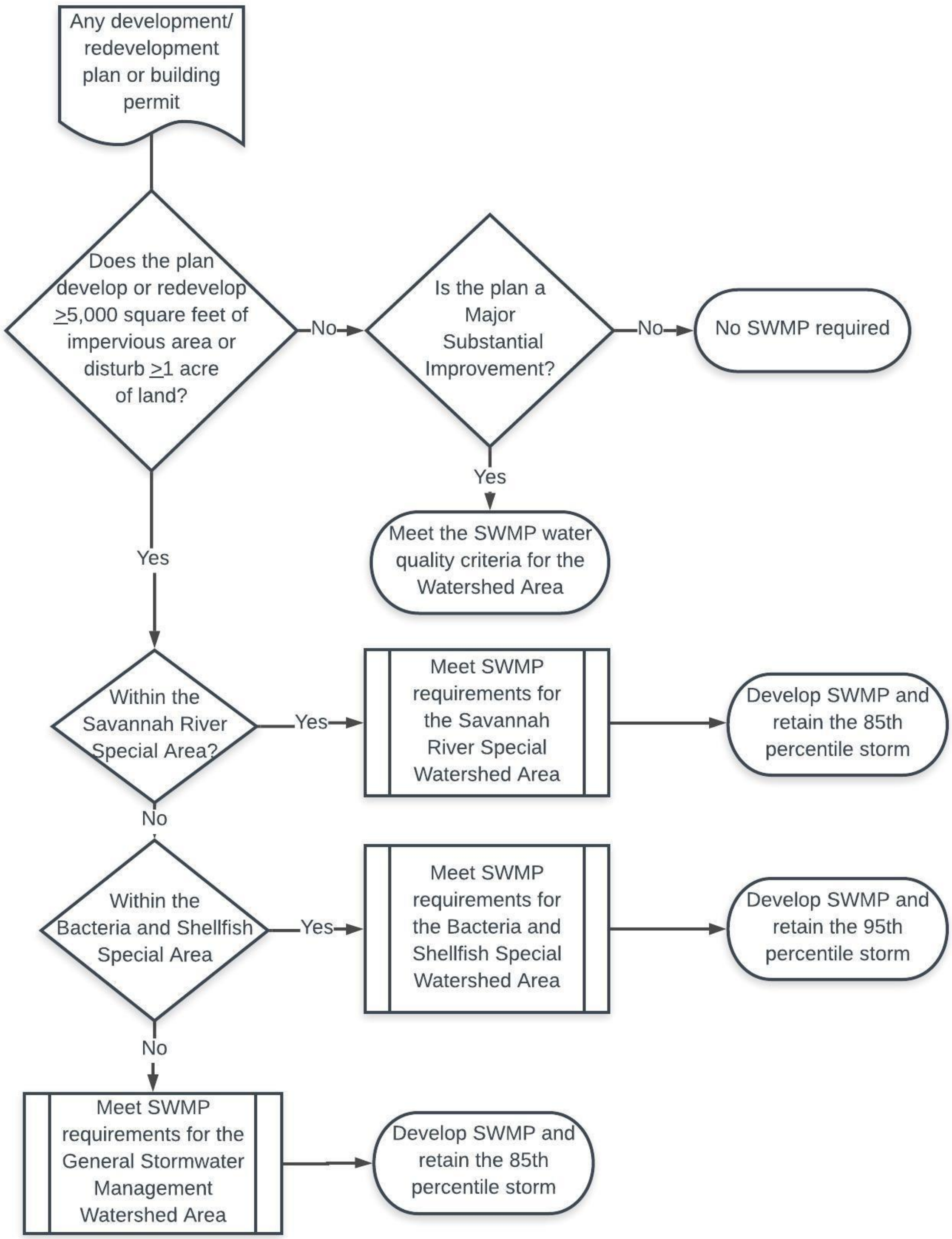


Figure 3.1. Southern Lowcountry Stormwater Design Manual applicability diagram.

3.3 Infill & Redevelopment

An infill project is one on a previously platted property that may or may not have stormwater management capacity in its original development plan. Regardless of size, infill that is part of a larger common plan of development, even through multiple, separate, and distinct land disturbing activities that may take place at different times and on different schedules must comply with this Manual. Such projects may include Planned Unit Developments (PUDs) that have stormwater systems built that do not meet the requirements of this Manual. If the proposed project meets the applicability criteria of Section 1.4.1, the stormwater plan review in this Manual is necessary. If the development's original stormwater management plan is sufficient to meet the current requirements of this Manual and is documented through approved plans and as-built drawings, or current field measurements and engineering calculations, no further stormwater requirements must be met. When the infill project is part of an original plan that does not meet the current stormwater requirements, the level of stormwater management that is provided in the current development may be credited toward the current volume and hydrologic analysis. Infill locations that, due to the municipal jurisdiction's zoning or land use requirements or site conditions, cannot meet the requirements of this Manual must complete the maximum extent practicable (MEP) evaluation in Section 3.9 for approval by the Public Works Director and/or their designee for project advancement/approval.

Similarly, redevelopment may be credited for the level of stormwater in place. If the redevelopment's original stormwater management plan is sufficient to meet the current requirements of this Manual and is documented through approved plans and as-built drawings, or current field measurements and engineering calculations, no further stormwater requirements must be met. When the redevelopment is part of an original plan that does not meet the current stormwater requirements, the level of stormwater management that is provided in the current development may be credited toward the current volume and hydrologic analysis. Redevelopment projects that, due to the municipal jurisdiction's zoning or land use requirements or site conditions, cannot meet the requirements of this Manual must complete the maximum extent practicable (MEP) evaluation in Section 3.9 for project approval.

3.4 Stormwater Runoff Quality & Peak Discharge Control

Since its inception, the Clean Water Act was designed to address the water quality impacts of stormwater runoff. As it has been applied through successive stormwater permit cycles, the Act's requirements have been interpreted to mean application of stormwater best management practices to the maximum extent practicable. The U.S. Environmental Protection Agency (EPA) has stated that such conditions include specific tasks or best management practices (BMPs), BMP design requirements, and performance requirements (EPA, 81 Fed. Reg. 3).

Consistent with the EPA's Phase II MS4 permit, this Manual requires that stormwater runoff shall be adequately treated before it is discharged from a development site. A stormwater management system is assumed to meet the stormwater runoff quality criteria by satisfying the stormwater runoff volume criteria for its respective Watershed Area presented in this Manual. If any of the required stormwater runoff volume cannot be reduced on the site, due to impractical site characteristics or constraints, the following questions shall be addressed in the permitting process:

1. Can the required stormwater volume be obtained from an adjacent site owned or available for stormwater retention purposes;
2. Is there available stormwater retention volume within the adjacent right-of-way and available through fee-in-lieu arrangements within this jurisdiction; and
3. Is a waiver granted based on a maximum extent practicable evaluation?

Further, a stormwater management system is presumed to comply with these criteria if:

- It intercepts and treats stormwater runoff in stormwater management practices that have been selected, designed, constructed and maintained in accordance with this Manual;
- It is provided with documentation to show that total suspended solids, nitrogen and bacteria removal were considered during the selection of the stormwater management practices that will be used to intercept and treat stormwater runoff on the development site;
- It is designed to provide the amount of stormwater load reduction specified in the latest edition of this Manual; and
- It manages the peak flow and extreme flood event storms in accordance with this Manual.

3.5 Southern Lowcountry Stormwater Management Performance Requirements

Stormwater management requirements of this Manual are intended to enhance the quality of development, protect and enhance stormwater quality and management, protect aquatic resources from the negative impacts of the land development process, address water quality impairments or a total maximum daily load, as identified by the South Carolina Department of Health and Environmental Control (DHEC), or address localized flooding issues.

3.5.1 Watershed Protection Area Designations

Not all watersheds of the Southern Lowcountry region require the same level of post-construction stormwater management. Currently, three watershed protection areas are designated with specific unique stormwater management requirements based on the current and anticipated water quality control measures for their contributing watersheds. The Southern Lowcountry Stormwater Ordinance provides Beaufort County Public Works Department the flexibility and authority to designate sub watersheds or drainage areas as Special Watershed Protection Areas that may lead to more restrictive requirements or special criteria. Such special designations and criteria will be provided as a future appendix to this manual.

In the Southern Lowcountry, impairments include recreational water use impairment from bacteria (*Enterococcus* for saltwater and *E. coli* for freshwater), aquatic life use impairment from turbidity or dissolved oxygen, and shellfish harvesting use impairment from fecal coliform bacteria. Stormwater best management practices for these types of impairments include erosion and sediment control for turbidity impairments, illicit discharge detection, vegetated conveyances, vegetated buffers, pet waste programs, and post-construction runoff control. Currently, Southern Lowcountry water quality impairments do not include nutrient impairments, but nutrients can also be addressed through erosion and sediment control and the stormwater best management practices outlined in this Manual.

Most of Beaufort County and the lower reaches of the Jasper County watersheds have shellfish receiving waters or are recreational waters and are therefore sensitive to bacteria impairments. Land development and redevelopment projects in these watersheds require greater scrutiny to ensure that low impact development methods are designed, implemented and maintained to be protective of these water uses.

Watersheds tributary to the Savannah River in the Southern Lowcountry include most of the freshwater wetlands of the region. River water quality is excellent and is a supply for drinking water for the City of Savannah and the Beaufort Jasper Water and Sewer Authority. Savannah River impairments downstream of the I-95 bridge are primarily aquatic life use due to low dissolved oxygen. Since the Savannah River is the boundary of Georgia and South Carolina, it is reasonable to align stormwater requirements within Jasper County with those in Chatham and Effingham Counties, GA. Stormwater permits for the Georgia jurisdictions require use of the Georgia Coastal Stormwater Supplement to the Georgia Stormwater Management Manual, which is primarily a green infrastructure/low impact development (GI/LID) design Manual with requirements specific to the Georgia coastal counties.

The remaining watersheds of the Southern Lowcountry are more upland areas and in agricultural or silvicultural use or are conservation lands. For these areas new development is subject to stormwater management requirements similar to previous county requirements. This Manual unifies stormwater management standards across the designated watersheds rather than differing across county or jurisdictional lines.

The map in Figure 3.2 outlines the boundaries of the three watershed protection areas of the Southern Lowcountry. Requirements specific to each area are further developed in this chapter. Table 3.1 lists the US Geological Survey 12-Digit Hydrologic Unit Code (HUC-12) for the watersheds in each area. To identify a site's HUC-12, refer to the South Carolina DHEC Watershed Atlas, available online at https://gis.dhec.sc.gov/watersheds/. After identifying the site's HUC 12, use Table 3.2 to identify the watershed protection area.

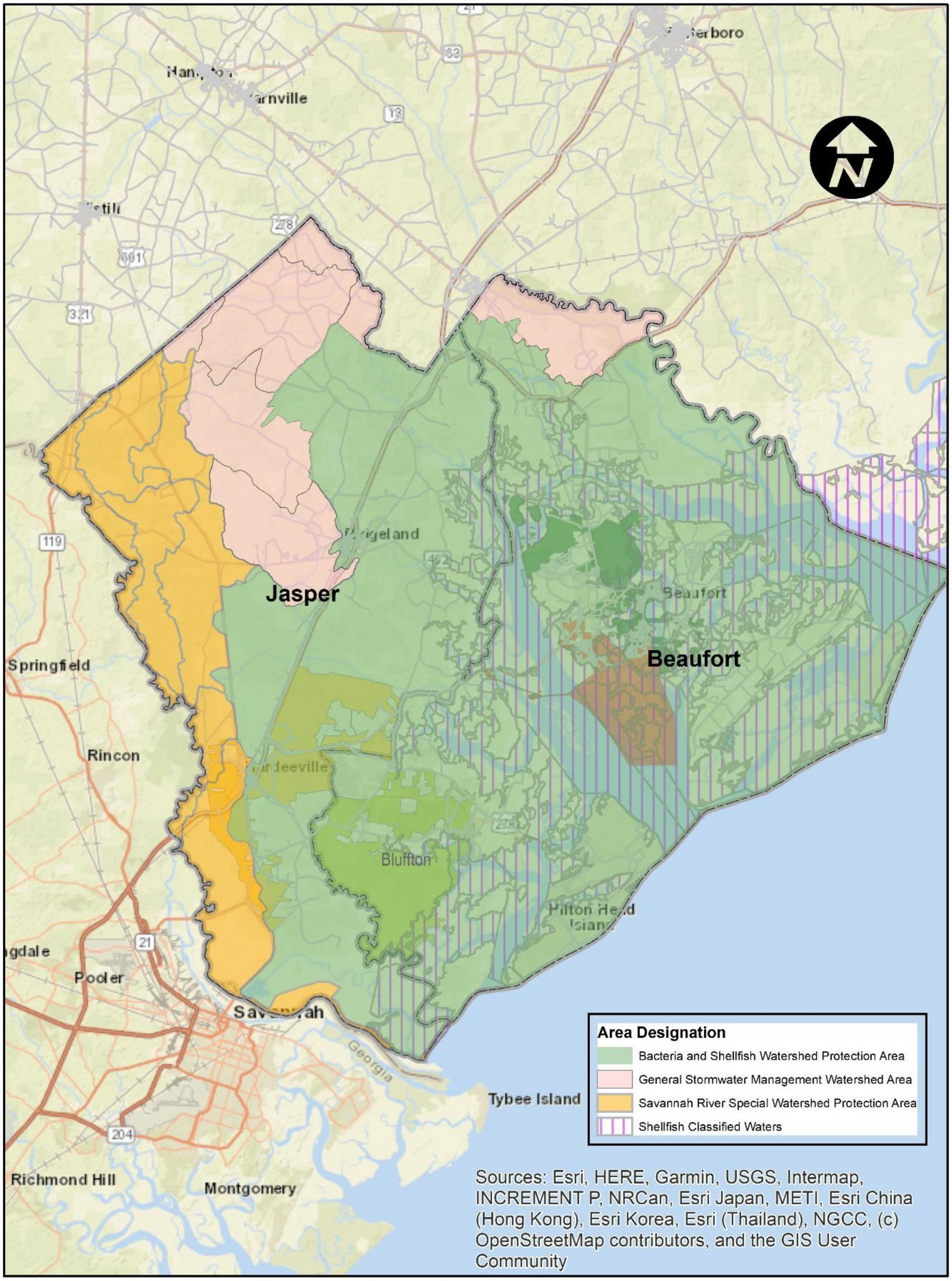


Figure 3.2. Watershed Protection Areas of the Southern Lowcountry.

Table 3.1. Watershed Protection Area HUC-12 Codes.

General Stormwater Management Watershed Areas		Savannah River Watershed Protection Area	
HUC-12 No.	**Watershed Name**	**HUC-12 No.**	**Watershed Name**
030502070704	Middle Combahee River	030601090107	Hog Branch-Savannah River
030502080301	Johns Pen Creek	030601090301	Cypress Branch
030502080302	Cypress Creek	030601090302	Black Swamp
030502080404	Mcpherson Creek-Coosawhatchie River	030601090303	Coleman Run
030502080405	Early Branch-Coosawhatchie River	030601090304	Sand Branch
030601100101	Gillison Branch	030601090305	Dasher Creek-Savannah River
030601100102	Upper Great Swamp	030601090307	Outlet Savannah River
Bacteria and Shellfish Watershed Protection Area			
HUC-12 No.	**Watershed Name**	**HUC-12 No.**	**Watershed Name**
030502070706	Lower Combahee River	030502080605	Boyd Creek-Broad River
030502071101	Wimbee Creek	030502080606	Colleton River
030502071102	Coosaw River	030502080607	Chechessee River
030502071103	Morgan River	030502080608	Broad River-Port Royal Sound
030502071104	Coosaw River-St. Helena Sound	030502100101	Harbor River-St. Helena Sound
030502080406	Bees Creek	030502100102	Harbor River-Trenchards Inlet
030502080407	Tulifiny River-Coosawhatchie River	030601090306	Wright River
030502080501	Battery Creek	030601100103	Lower Great Swamp
030502080502	Upper Beaufort River-Atlantic Intracoastal Waterway	030601100201	Upper New River-Atlantic Intracoastal Waterway
030502080503	Lower Beaufort River-Atlantic Intracoastal Waterway	030601100202	Lower New River-Atlantic Intracoastal Waterway
030502080601	Pocotaligo River-Broad River	030601100301	May River
030502080602	Huspa Creek	030601100302	Broad Creek
030502080603	Whale Branch	030601100303	Cooper River-Calibogue Sound
030502080604	Euhaw Creek	030601100304	Calibogue Sound

3.5.2 Overall Performance Requirements

Based on the watershed water quality criteria, its impairment status, or stormwater permit requirements, development and redevelopment stormwater management performance requirements will differ. These requirements are interpreted in terms of sizing and performance criteria. Table 3.2 presents a summary of the sizing criteria used to achieve the stormwater management performance requirements for each watershed protection area.

Table 3.2. Watershed Area Overall Performance Requirements.

General Stormwater Management Watershed Protection Areas	Savannah River Watershed Protection Area
Overall Performance Requirements	Overall Performance Requirements
• Water Quality: Implement Better Site Design, maintain pre-development hydrology of the site to the Maximum Extent Practicable (MEP) for the 85^{th} percentile storm event. • Peak Control: Control post-development peak runoff discharge rate to pre-development rate for: 2-, 10- and 25-year, 24-hour design storm events. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load. • Complete a natural resources inventory for new site development applications.	• Water Quality: Implement Better Site Design, retain the 85^{th} percentile storm event on-site to the MEP or obtain off-site credit. • Peak Control: Control post-development peak runoff discharge rate to pre-development rate for: 2-, 10- and 25-year, 24-hour design storm events. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load. • Complete a natural resources inventory for new site development applications.
Rationale	Rationale
The previous Jasper County stormwater design manual specified these overall performance requirements.	The Savannah River watershed adjoins Georgia counties that are subject to similar overall performance requirements as outlined in the Georgia Coastal Stormwater Supplement.
Bacteria and Shellfish Watershed Protection Area	
Overall Performance Requirements	
• Water Quality: Implement Better Site Design and retain the 95^{th} percentile storm on-site with approved infiltration/filtering BMPs. Fulfill MEP requirements or, as a last resort, fulfill off-site credit and/or fee-in-lieu requirements. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.	• Peak control: Control the post-development peak runoff discharge rate for the 2, 10, 25, 50, 100-year, 24-hour design storm events to the pre-development discharge rates. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • Complete a natural resources inventory for new site development applications.
Rationale	
The Bacteria and Shellfish Watershed Protection Areas are either impaired or have TMDLs, or the receiving waters are classified for shellfish harvesting. These watersheds require greater protection due to their Clean Water Act status or water quality classification. The site's natural resource inventory is a necessary component of permit application.	

3.5.3 Southern Lowcountry Stormwater Precipitation & Runoff

As in the natural environment, a site's stormwater runoff volume depends upon soil conditions and land cover. To evaluate each site's development plan, this Manual relies on the rainfall runoff estimating methods of the Natural Resources Conservation Service National Engineering Handbook (NEH). Sometimes referred to as the curve number method or soil cover complex method, NEH chapter 9 describes the runoff response to rainfall events based on hydrologic soil group (HSG A, B, C or D) and land cover type with an integer between 29 and 100 (NRCS, 2004). Accordingly, information documenting the site's soils, their permeability, predeveloped land use or natural cover, and post-developed land cover, as well as the shallow groundwater table, are required in development plans in order to review and permit the development activity.

Precipitation event size and distribution are set by this Manual for the three watershed protection areas that make up the Southern Lowcountry.

The precipitation event distribution terms used in this Manual are defined as follows:

> **85th Percentile Storm** is the 24-hour rainfall amount that according to the National Oceanic and Atmospheric Administration records for the past 30 years in which 85% of all rainfall events do not exceed at the nearest US Weather Service station to the County seat. For the General Stormwater Management Watershed Areas and the Savannah River Watershed Protection Areas, this number is 1.16 inches of rainfall.
>
> **95th Percentile Storm** is the 24-hour rainfall amount that according to the National Oceanic and Atmospheric Administration records for the past 30 years in which 95% of all rainfall events do not exceed at the nearest US Weather Service station to the County seat. For the Bacteria and Shellfish Watershed Protection Areas this is 1.95 inches of rainfall.

Plans submitted for new development or redevelopment must demonstrate through accepted hydrologic methods that the development at post-construction will attenuate and treat the prescribed storm events. This includes volume reduction, peak flow management and extreme flood protection both on site and downstream.

3.5.4 Savannah River Watershed Protection Area

Upon implementation of this Manual, any applicable new development, redevelopment or major substantial improvement in the designated HUC-12 watersheds that are part of the Savannah River watershed shall meet the following requirements:

- Complete a natural resources inventory for new site development applications.
- Document use of Better Site Design.
- Retain the 85th percentile storm event on-site to the MEP or obtain off-site credit.
- Control the post-development peak runoff discharge rate for the 2, 10 and 25-year, 24-hour design storm events to the pre-development discharge rates.
- Accommodate 100-year, 24-hour storm event through the development without causing damage to the on-site and offsite structures. Provide 10% rule analysis.
- At a minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.

3.5.5 Bacteria & Shellfish Watershed Protection Area

Upon implementation of this Manual, any applicable new development, redevelopment or major substantial improvement in the designated HUC-12 watersheds that are part of the Bacteria and Shellfish Watershed Protection Area shall meet the following requirements:

- Complete a natural resources inventory for new site development applications.
- Document use of Better Site Design.
- Retain the 95th percentile storm on-site with approved infiltration/filtering BMPs.
- Fulfill MEP requirements or, as a last resort, fulfill off-site credit and/or fee-in-lieu requirements.
- At a minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.
- Control the post-development peak runoff discharge rate for the 2, 10, 25, 50, and 100-year, 24-hour design storm events to the pre-development discharge rates.
- Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis.

3.5.6 General Stormwater Management Watershed Area

Upon implementation of this Manual, any applicable new development, redevelopment or major substantial improvement in the designated HUC-12 watersheds for the General Stormwater Management Watershed Area shall meet the following requirements:

- Complete a natural resources inventory for new site development applications.
- Document use of Better Site Design.
- Maintain pre-development hydrology of the site to the Maximum Extent Practicable (MEP) for the 85th percentile storm event.
- Control post-development peak runoff discharge rate for the 2, 10, 25, 50, and 100-year, 24-hour design storm events to pre-development discharge rates.
- Accommodate 100-year, 24-hour storm event through the development without causing damage to the on-site and offsite structures. Provide 10% rule analysis.
- As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.

3.5.7 Runoff Reduction & Pollutant Removal

It is the minimum criteria of this Manual that a site's stormwater best management practices shall retain the precipitation event size for its watershed protection area as summarized in Section 3.5.2. Through successive application of the practices below and that are described in detail in Chapter 4, provide at least an 80% reduction in total suspended solids loads, 30% reduction of total nitrogen load, and 60% reduction in bacteria load (Jasper County, 2011).

Stormwater best management practices, when built according to the standards in Chapter 4 and maintained according to the site's maintenance agreement, can be expected to achieve runoff reduction and pollutant removal efficiencies according to Table 3.3. These values are to be used in the pollutant removal documentation and are used within the stormwater runoff reduction calculator in Appendix H. Other water quality credits may be assigned for BMPs based on the determination by Beaufort County Public Works Department and valid study results presented with the Stormwater Management Plan submittal.

Table 3.3. Pollutant Removal Efficiencies of Structural BMPs.

BMP	Water Quality Credits			
	Runoff Reduction	TSS % Removal	Total N % Removal	Bacteria % Removal
Bioretention - No Underdrain	100%[1]	100%[1]	100%[6]	100%[6]
Bioretention – Internal Water Storage	75%[1]	85%[1]	85%[4]	80%[5]
Bioretention - Standard	60%[2]	85%[1]	75%[4]	80%[5]
Permeable Pavement - Enhanced	100%[1]	100%[1]	100%[6]	100%[6]
Permeable Pavement - Standard	30%[2]	80%[1]	45%[4]	30%[6]
Infiltration	100%[1]	100%[1]	100%[6]	100%[6]
Green Roof	100%[3]	100%[6]	100%[6]	100%[6]
Green Roof - Irrigated	50%[3]	50%[6]	50%[6]	50%[6]
Rainwater Harvesting	100%[3]	100%[6]	100%[6]	100%[6]
Impervious Surface Disconnection	40%[2]	80%[1]	40%[4]	40%[6]
Grass Channel	10%[2]	50%[1]	25%[4]	30%[5]
Grass Channel - Amended Soils	20%[2]	50%[1]	35%[4]	30%[5]
Dry Swale	60%[2]	85%	70%[4]	80%[5]
Wet Swale	0%[1]	80%[1]	25%[4]	60%[5]
Regenerative Stormwater Conveyance	0%[1]	80%[1]	40%[6]	80%[6]
Filtering Systems	0%[3]	80%[1]	30%[4]	80%[6]
Storage Practices	0%[3]	60%[1]	10%[4]	60%[5]
Stormwater Ponds	0%[1]	80%[1]	30%[4]	60%[5]
Stormwater Wetlands	0%[1]	80%[1]	25%[4]	60%[5]
Tree Planting and Preservation	see section 4.12			
Proprietary Practices	see section 4.13			
Conservation Areas	see section 4.14			

Notes:

The following resources were used to develop the runoff reduction and pollutant removal values in the above table.

1. (ARC, 2016).
2. (Hirschman, 2018).
3. (DOEE. 2013)
4. (Hirschman, 2018). Nitrogen removal values from this source were applied to the remaining volume after runoff reduction was applied. The values provided in the table above represent the results of this application.
5. (Chesapeake Stormwater Network, 2018)
6. Best professional judgement was used where a BMP's pollutant removal values were not available in the above sources, or conflicts were present. In all cases, a BMP's pollutant removal value must be at least as high as its runoff reduction values (for example, if a BMP is assigned a runoff reduction value of 100%, it will also have TSS, nitrogen, and bacteria removal rates of 100%). In addition, it was assumed that a Regenerative Stormwater Conveyance (RSC) will have similar nitrogen removal to bioretention systems, so the nitrogen removal value from the Runoff Reduction Method was applied as described in reference 4, above. It was also assumed that both RSCs and filtering systems will have the same bacterial removal rate as bioretention (with no runoff reduction).

3.6 Erosion & Sediment Control (ESC) Requirements

The design and management of construction site runoff control measures for all qualifying developments as defined in the Ordinance shall be in accordance with SCDHEC NPDES General Permit for Stormwater Discharges from Construction Activities, the SCDHEC Erosion and Sediment Reduction and Stormwater Management regulations and its most current version of standards, where applicable. Beaufort County Public Works Department reserves the right to require additional erosion and sediment control or a higher standard of measure and make their requirement a condition of a development permit approval.

3.7 Retention Standard & Volume

This section provides the formulas and rationale for use of the runoff reduction method to compare predeveloped and post-development hydrology for projects submitted for approval to the Southern Lowcountry jurisdictions.

Runoff reduction is defined as “the total annual runoff volume reduced through canopy interception, soil infiltration, evaporation, transpiration, rainfall harvesting, engineered infiltration, or extended infiltration” (Hirschman, 2008). The formula to calculate the volume reduced through successive application of stormwater best management practices originates with the Natural Resources Conservation Service (NRCS) method of estimating direct runoff from storm rainfall and the curve number method of NEH Chapter 9 (NEH, 2004). As shown in Equation 3.1, rainfall event runoff (Q) is a function of depth of event rainfall (P) over the watershed, the initial abstraction (I_a) and the maximum potential retention (S).

Equation 3.1. Curve number runoff equation.

$$QQ = \frac{(PP - II_{aa})^{22}}{(PP - II_{aa}) + SS}$$

$$II_{aa} = 00.22SS$$

$$QQ = \frac{(PP - 00.22SS)^{22}}{(PP + 00.88SS)}$$

$$QQ - RR = \frac{(PP - 00.22SS)^{22}}{(PP = 00.88SS)}$$

$$SS = \frac{110000}{CCCC} - 11$$

Where:

Q =	Runoff depth (in)
P =	Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)
I_a =	Initial abstraction (in)
S =	Potential maximum retention after runoff begins (in)
CN =	Runoff curve number
R =	Retention storage provided by runoff reduction practices (in)

Not all stormwater BMPs provide runoff reduction equally. Through the crediting procedures of the Compliance Calculator found in Appendix H and the retention volumes required in this section, designers will be able to evaluate their proposed designs and submit for approval in a unified process across the Southern Lowcountry jurisdictions.[1]

Supplemental information on the terms below can be found in the *Low Impact Development in Coastal South Carolina: Planning and Design Guide*, and the Georgia Stormwater Management Manual (Ellis, K. et al., 2014; ARC, 2016).

The Stormwater Retention Volume (SWRv) is the volume of stormwater runoff that is required to be retained, post-development. It is calculated as shown in Equation 3.2 for the entire site and for each site drainage area (SDA). The SDA is defined as the area that drains to a single discharge point from the site or sheet flows from a single area of the site. A development site may have multiple SDAs and runoff coefficients.

Equation 3.2. Stormwater retention volume (SWRv) equation

$$SSSSRRSS = \frac{PP \times [(RRSS_{II} \times II) + (RRSS_{CC} \times CC) + (RRSS_{CC} \times CC)]}{1122}$$

Where:

SWRv =	Volume required to be retained (cubic feet)
P =	Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)
Rv_I =	Runoff coefficient for impervious cover and BMP cover based on SCS hydrologic soil group (HSG) or soil type
I =	Impervious cover surface area (square feet)
Rv_C =	Runoff coefficient for compacted cover based on soil type
C =	Compacted cover surface area (square feet)
Rv_N =	Runoff coefficient for forest/open space based on soil type
N =	Natural cover surface area (square feet)
12 =	Conversion factor (inches to feet)

	Rv Coefficients			
	A soils	**B Soils**	**C Soils**	**D Soils**
Forest/Open Space (R_{VN})	0.02	0.03	0.04	0.05
Managed Turf (Rv_C)	0.15	0.20	0.22	0.25
Impervious Cover (R_{vI})	0.95	0.95	0.95	0.95
BMP	0.95	0.95	0.95	0.95

The Compliance Calculator in Appendix H uses best available pollutant removal efficiencies for total suspended solids, total nitrogen and fecal indicator bacteria. Use of the compliance calculator allows the designer to evaluate alternative designs to arrive at compliance with the runoff reduction and pollutant removal requirements and clearly summarize them for the local plan reviewer. The compliance

[1] Compliance Calculator instructions are found in Appendix G

calculator output is a necessary submittal for a plan reviewer to evaluate selected BMPs to demonstrate compliance with the watershed protection area standards of this Manual.

3.7.1 Total Suspended Solids, Nutrients, & Bacteria

The minimum pollutant removal performance requirements for all watersheds of the Southern Lowcountry include the interception and treatment of stormwater runoff volume to at least an 80% reduction in total suspended solids load, 30% reduction of total nitrogen load, and 60% reduction in bacteria load. These requirements are established for the following reasons.

Stormwater in the Lowcountry conveys the plant nutrients nitrogen and phosphorus. Nitrogen tends to dissolve in water, but phosphorus is adsorbed to suspended solids predominantly. Control of total suspended solids through the BMPs in this Manual will also remove a proportional amount of phosphorus. Relying on the judgement of stormwater researchers and other state design manuals, the approach for the Southern Lowcountry is similar. If a BMP is effective at runoff reduction or retention of stormwater, it is similarly effective at removal of the initial volume of suspended solids (NCDEQ, 2014).

Many of the Southern Lowcountry watersheds at the HUC-12 size are directly tributary to bacteria and shellfish impaired waters. As these watersheds develop with rooftops, roads and other impervious surfaces, there is an increasing potential for bacteria in the stormwater from wildlife populations (deer, racoons, waterfowl), pet waste, septic system discharges and sanitary sewer system malfunctions. Similarly, nutrients can be expected to increase due to fertilizer use in erosion control practices, managed turf and landscaping, septic system leachate, and atmospheric deposition on impervious surfaces. Best management practices, along with better site design practices, can be used to reduce bacteria and nutrients in stormwater to the benefit and restoration of Southern Lowcountry water quality.

3.7.2 Hydrologic & Hydraulic Analysis

In order to prevent an increase in the duration, frequency and magnitude of downstream overbank flooding and scouring, this Manual requires that enough stormwater detention be provided on a development site to control the post-development peak runoff discharge to the predevelopment runoff rates for the 2, 10, 25, 50, and 100 -year, 24-hour storm events. The capacity of the existing downstream receiving conveyance system for all off-site discharge points must be determined to be adequate. An analysis of the downstream conveyance capacity to accommodate the site's post development 25- and 100-year, 24-hour peak flow shall be provided in the engineering report. Discharge to the public right-of-way of the SC State highway system shall comply with the SCDOT Requirements for Hydraulic Design Studies. Necessary upgrades within the public right-of-way due to inadequate capacity for the post-development 25-yr flow must be identified during the permit application process. Upgrades to the downstream system to accommodate the 100-yr 24-hour flow must be considered through the MEP process outlined in Section 3.9. Documentation supporting safe passage of the 100-yr post development flow to the downstream point where the detention or storage area comprises 10% of the total drainage area, and an analysis of the surrounding neighborhood area to identify any existing capacity shortfalls or drainage blockages is required for plan approval. This analysis is called the 10% analysis rule in Section 3.8 of this Manual.

The recommended 2, 10, 25, and 100-year, 24-hour storm event values from Appendix F of the South Carolina DHEC Storm Water Management BMP Handbook, July 31, 2005 for Beaufort and Jasper Counties are in Table 3.4[2].

Table 3.4. Rainfall depth (inches) for the Southern Lowcountry.

	Return Period (years)			
County	**2**	**10**	**25**	**100**
Beaufort	4.5	6.9	8.4	11.0
Jasper	4.2	6.4	7.8	10.2

In this Manual, Appendix I General Design Criteria and Guidelines provides the acceptable methodologies and computer models for estimating runoff hydrographs before and after development, as well as design criteria for stormwater collection systems and land cover designations. The following are the acceptable methodologies and computer models for estimating runoff hydrographs before and after development. These methods are used to predict the runoff response from given rainfall information and site surface characteristic conditions. The design storm frequencies used in all of the hydrologic engineering calculations will be based on design storms required in this Manual unless circumstances make consideration of another storm intensity criterion appropriate:

- Rational Method (limited to sites under 10 acres)
- Urban Hydrology for Small Watersheds TR-55
- Storage-Indication Routing
- HEC-1, WinTR-55, TR-20, ICPR v3 or 4 and SWMM computer models

These methods are given as valid in principle and are applicable to most stormwater management design situations in the Southern Lowcountry.

The following conditions should be assumed when developing predevelopment, pre-project, and post-development hydrology, as applicable:

- The design storm duration shall be the 24-hour rainfall event, using the NRCS (SCS) Type III rainfall distribution with a maximum six-minute time increment.
- The predeveloped peaking factor shall be 200 for new development (Blair et al., 2012).
- The post development peaking factor shall be 400.
- For new development sites the predeveloped condition shall be calculated as a composite CN based on the HSG and meadow conditions (NEH, 2004).
- For infill and redevelopment sites, the predeveloped condition shall be calculated as a composite CN based on the HSG and the land cover type and hydrologic condition at the time of the project's initial submittal.

[2] Until SCDHEC updates its Stormwater Management BMP Handbook rainfall table to the NOAA Atlas 14 values, the Southern Lowcountry region shall use the Handbook Appendix F rainfall table for 24 hour storm events.

- Antecedent Runoff Condition (ARC) II is the average adjustment factor for calculations using TR-55. ARC III is to be used for wetter conditions such as areas that receive irrigation water harvested from stormwater ponds and for poorly drained soils.

Project designs must include supporting data and source information. All storm sewer systems shall be analyzed for both inlet and outlet control (including tailwater effects) by using the following:

a. Equations and nomographs as shown in the Federal Highway Administration (FHWA) Hydraulic Design Services (HDS) publication No. 5.

b. Computer programs that calculate the actual hydraulic grade line for the storm sewer system can be used, provided all losses (friction, bend, junction, etc.) are taken into account using the appropriate loss coefficient (K) values.

c. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis.

d. Allowable headwater. The allowable headwater of all culverts, pipe systems, open channels, bridges and roadway culverts shall be established following the SCDOT Requirements for Hydraulic Design Studies.

All culverts, pipe systems, and open channel flow systems shall be sized in accordance with the design criteria found in Appendix I Hydrology and Hydraulics Design Requirements.

3.7.3 Maintenance Easements

Maintenance easements are provided for the protection and legal maintenance of stormwater management facilities not within a right-of-way. Drainage easements shall be required in subdivisions over any portion of a stormwater management facilities not within a right-of-way and necessary for the functioning of the system. Drainage easements for all facilities must be shown on construction drawings and approved by the stormwater manager. The easements shall be designated on the plan prior to issuance of a development permit and recorded in public records with copy of recorded easement submitted prior to Beaufort County Public Works Department permit termination. The minimum allowable width of drainage easements may be as shown in Table 3.5.

Table 3.5. Drainage maintenance access easements.

Stormwater Management Facility	Minimum Easement Width
Closed systems (storm sewers/pipes/culverts)	diameter + 4 ft + 2D(20-ft minimum)*
Open drainage systems	
Bottom width 20 ft or less	15 ft + BW + 2SD (30 ft minimum)**
Bottom width 20 ft to 40 ft	30 ft + BW + 2SD**
Bottom width greater than 40 ft	40 ft + BW + 2SD**
Retention/detention BMPs	20 ft around facility***
Pond Maintenance Access	A 20’ maintenance access easement between lot lines and top of bank shall be provided for stormwater ponds with a permanent pool. The easement shall be provided for boat trailer access, and for all structure maintenance and repair. No permanent structures (mechanical, electrical, phone, fences) or landscaping are allowed within the 20’ pond maintenance access easement.

*Where: D = Depth from grade to pipe invert **Where: BW = Bottom width S = Side slope D = Depth of opening
Note: The minimum required width and configuration of drainage easements may be modified if deemed necessary by the stormwater manager for justifiable reasons.

3.8 Extreme Flood Requirement: 10% Rule

The peak discharge generated by the 100-year, 24-hour storm event under post-development conditions is considered the extreme peak discharge. The intent of the extreme flood protection is to prevent flood damage from infrequent but large storm events, maintain the boundaries of the mapped 100-year floodplain, and protect the physical integrity of the best management practices as well as downstream stormwater and flood control facilities. The 100-yr flow is to be used in the routing of runoff through the drainage system and stormwater management facilities to determine the effects on the facilities, adjacent property, and downstream. Emergency spillways of best management practices should be designed appropriately to pass the resulting flows safely.

Documentation supporting safe passage of the 100-year post-development flow shall be provided by the applicant/engineer. In order to prevent an increase in the duration, frequency and magnitude of downstream extreme flooding over existing conditions, an evaluation must be provided to include downstream analysis to the point where the project comprises 10% of the total contributing drainage area. The 10% rule evaluation must address existing conveyance system capacity and “pinch points” where a pipe/culvert would be overtopped and where the pipe/culvert will need to be upgraded or the peak discharge rate will need to be limited to the capacity of the downstream system.

The 10% rule recognizes the fact that a structural BMP control providing detention has a “zone of influence” downstream where its effectiveness can be felt. Beyond this zone of influence, the structural control becomes relatively small and insignificant compared to the runoff from the total drainage area at that point. Based on studies and master planning results from a large number of sites, that zone of influence is considered to be the point where the drainage area controlled by the detention or storage facility comprises 10% of the total drainage area. For example, if the drainage control drains 10 acres, the zone of influence ends at a point where the total drainage area is 100 acres or greater (ARC, 2016).

Demonstration of safe passage of the 100-year, 24-hour storm shall include a stage storage analysis of the system, an inflow/outflow comparison of the system, and construction of a table showing peak stage elevations in comparison to safe freeboards to structures of the system and adjacent buildings/structures/infrastructure. Safe passage to the receiving water also requires that there be no additional downstream flooding or other environmental impacts (e.g., stream channel enlargement, degradation of habitat).

Typical steps in the application of the 10% rule are:

1. Determine the target peak flow for the site for predevelopment conditions.
2. Using a topographic map, determine the lower limit of the zone of influence (10% point)

3. Using a hydrologic model, determine the predevelopment peak flows and timing of those peaks at each tributary junction beginning at the pond outlet and ending at the next tributary junction beyond the 10% point.
4. Change land use on the site to post-development and rerun the model.
5. Design the structural control facility such that the overbank flood protection (25-year) post-development flow is adequately conveyed to the lower limit of the zone of influence and the Extreme Flood (100-year) post-development flow does not impact any existing structures within the area of zone of influence.
6. If the overbank flood protection (25-year) post-development flow is not adequately conveyed to the lower limit of the zone of influence and/or Extreme Flood (100-year) post-development flow is shown to impact any structure, the structural control facility must be redesigned or one of the following options considered:
    a. Work with Beaufort County Public Works Department to reduce the flow elevation through channel or flow conveyance structure improvements downstream.
    b. Obtain a flow easement from downstream property owners to the 10% point.
    c. Request a detention waiver from Beaufort County Public Works Department. This waiver would be for water quantity control only and best management practices to achieve water quality goals will still be required.

3.9 Maximum Extent Practicable

Maximum extent practicable (MEP) is the language of the Clean Water Act that sets the standards to evaluate efforts pursued to achieve pollution reduction to the Waters of the United States. The MEP refers to management practices; control techniques; and system, design, and engineering methods for the control of pollutants. It allows for considerations of public health risks, societal concerns, and social benefits, along with the gravity of the problem and the technical feasibility of solutions. The MEP for stormwater management is achieved, in part, through a process of selecting and implementing different design options with various structural and non-structural stormwater best management practices (BMPs), where ineffective BMP options may be rejected, and replaced when more effective BMP options are found (DOEE, 2019).

There must be a serious and demonstrated attempt to comply with this Manual, and practical solutions may not be lightly rejected. If project applicants implement and demonstrate only a few of the least expensive BMPs, and the regulated volume has not been retained, it is likely that the MEP standard has not been met. If, on the other hand, a project applicant implements all applicable and effective BMPs except those shown to be technically infeasible, then the project applicant would have achieved retention to the MEP.

Major land-disturbing activities, infill and redevelopment projects, and projects in the existing public right-of-way, must achieve the SWRv, and meet peak flow requirements for channel and extreme flood protection to the MEP. Through application of stormwater best management practices on site or at an off-site property within the same stormwater drainage catchment, land development projects should be able to comply with the Southern Lowcountry Stormwater Ordinance. It is the applicant's responsibility to demonstrate to the greatest extent that the requirements of this Manual can be met for the proposed development. The applicant must fully demonstrate that the requirements of the Manual are not possible or feasible before entering into a MEP analysis, and only after the concurrence and approval of the Public Works director and/or their designee of Beaufort County Public Works Department based on the project submittals, documentation and discussions. The applicant must realize that if the requirements of the Manual cannot be met, the site may not be conducive for development, as proposed, in the interest of public safety and welfare.

When a new land development project, infill or redevelopment cannot meet the volume and peak flow requirements of this Manual, the following design and review process is required to comply with the MEP requirement. This evaluation is intended to be completed during the concept review stage of plan development.

1) Demonstrate how BSD has been implemented to the maximum extent practicable or document site restrictions that prevent BSD application.
2) List the site restrictions that prevent the on-site use of the stormwater BMPs of this Manual.
3) Cite justification for not being able to retain the SWRv and attain the required peak discharge limits.
4) Is there off-site capacity in the same drainage catchment as defined by Beaufort County Public Works Department to meet the volume and/or peak flow requirements for the site's contributing drainage area(s)?
5) Does the publicly maintained stormwater drainage system have sufficient capacity for the development site's extreme flood peak flow?
6) Develop a cost versus aggregated stormwater retention volume achieved curve for the site's contributing drainage area. A minimum of five cost points with three of the BMP alternatives in series as a treatment train are necessary for the curve. Include the evaluation off-site capacity cost. Identify the inflection point of the cost curve to identify the optimal solution where increased cost does not result in increased effectiveness.
7) The optimum aggregated retention value and BMP selection and size analysis must be submitted as a part of the stormwater management plan for the project.
8) Offsite stormwater volume retention credit or fee-in-lieu documents will be required for project completion.

The MEP submittal must provide documentable evidence of the process the applicant has performed that demonstrates the restrictions to the use and implementation of BMPs and approved by the Beaufort County Public Works Director and/or their designee and to meet the requirements of this Manual in whole or in part.

3.10 Off-Site Stormwater Management

All stormwater management design plans shall include on-site stormwater management practices, unless post-construction stormwater runoff in an off-site or regional stormwater management practice is approved according to this Section.

The off-site or regional stormwater management practice must be located on property legally dedicated to that purpose, be designed and sized to meet the post-construction stormwater management criteria presented in this Manual, provide a level of stormwater quality and quantity control that is equal to or greater than that which would be provided by on-site green infrastructure and stormwater management practices, be in the same drainage catchment, as defined by Beaufort County Public Works Department, as the project area, and have an associated inspection and maintenance agreement and plan. In addition, appropriate stormwater management practices shall be installed, where necessary, to protect properties and drainage channels that are located between the development site and the location of the off-site or regional stormwater management practice.

To be eligible for compliance through the use of off-site stormwater management practices, the applicant must submit a stormwater management design plan to Beaufort County Stormwater Department that demonstrates the adequacy of the off-site or regional stormwater management practice, and demonstrates, to the satisfaction of the Beaufort County Public Works Department that the off-site or regional stormwater management practice will not result in any of the following impacts:

(1) Increased threat of flood damage or endangerment to public health or safety;

(2) Deterioration of existing culverts, bridges, dams, and other structures;

(3) Accelerated streambank or streambed erosion or siltation;

(4) Degradation of in-stream biological functions or habitat; or,

(5) Water quality impairment in violation of state water quality standards and/or violation of any other state or federal regulations.

3.11 Waivers

Individuals seeking a waiver from the requirements of this Ordinance may submit to the *(administrator)* a request for a waiver in accordance with the Southern Lowcountry Stormwater Design Manual.

(1) Request of a Waiver at Staff Level
A written request for a waiver is required and shall state the specific waiver sought and the reasons, with supporting data, a waiver should be granted. The request shall include all information necessary to evaluate the proposed waiver. Requests must outline the need for such a waiver, such as site constraints, soil characteristics, or similar engineering limitations. Cost shall not be considered cause for a waiver. This waiver would be for water quantity control only and best management practices to achieve water quality goals will still be required. The applicant will address the criteria below for consideration of a waiver approval:

a. What exceptional circumstances to the site are evident that on-site or off-site stormwater management requirements cannot be met?
b. What unnecessary hardship is being caused?
c. How will denial of the waiver be inconsistent with the intent of the Ordinance?
d. How will granting the waiver comply with the intent of the Ordinance?
e. How are state and federal regulations still being met?

(2) Review of Waivers
The Public Works Director and/or their designee will conduct a review of the request and will issue a decision within thirty (30) working days of receiving the request.

Chapter 4. Stormwater Best Management Practices (BMPs)

4.1 Standard Stormwater BMP Design Sections

This chapter summarizes and outlines performance criteria for 13 stormwater best management practice (BMP) categories that include:

- Bioretention (4.3)
- Permeable Pavements (4.4)
- Infiltration (4.5)
- Green Roofs (4.6)
- Rainwater Harvesting (4.7)
- Impervious Surface Disconnection (4.8)
- Open Channel Systems (4.9)
- Filtering Systems (4.10)
- Storage Practices (4.11)
- Ponds (4.12)
- Stormwater Wetlands (4.13)
- Tree Planting and Preservation (4.14)
- Proprietary Practices (4.15

Following these criteria is the criteria to credit for stormwater benefit the use of conservation areas and open space preservation.

4.1.1 Format of Standard Stormwater BMP Design Sections

BMP performance criteria are based on several critical design factors to ensure effective and long-lived BMPs. For each BMP, the following factors are discussed:

- General Feasibility
- Conveyance
- Pretreatment
- Design and Sizing
- Landscaping
- Construction Sequencing
- Maintenance
- Stormwater Compliance Calculations

Design components that differ from these specifications, but meet their intent, may be included at Beaufort County Public Works Department's discretion.

4.1.2 Standard Nomenclature

In this chapter, and throughout the guidebook, the terms, *must* or *shall*, denote required aspects of BMPs or their design and implementation. The term, *should*, denotes a recommendation, however, justification may be necessary for design or implementation that does not correspond to certain recommendations.

4.2 Summary of BMP Stormwater Management Capabilities, Site Applicability, & Physical Feasibility

Stormwater management requirements for a given site vary based on the site's location, and minimum control requirements discussed in detail in Section 3.5.

4.2.1 Stormwater Retention & Water Quality Treatment

It is important to note that this Manual, and the associated compliance calculators, make a distinction between stormwater retention volume and stormwater water quality treatment. Not all BMPs achieve stormwater retention and/or water quality treatment equally, as was summarized in Table 3.3. The level to which a BMP provides stormwater retention and water quality treatment is provided in the BMP summary table of each BMP. The stormwater runoff reduction (SWRv) rates are expressed as a percentage of the storage volume provided by the BMP. Calculations for determining storage volume are included in each BMP's specifications. Each BMP's performance on the water quality parameters of total suspended solids, nitrogen and bacteria are also included in the BMP summary table. Note that many BMPs whose main purpose is water quality treatment typically do not have enough volume control to manage larger storm events.

4.2.2 Site Applicability

Certain BMPs are more appropriate than others in certain land uses. Table 4.1 describes the site applicability for each BMP for the following factors:

- <u>Rural Use</u>: This column indicates whether or not the stormwater management practice is typically suited for use in rural areas and on low-density development sites.

- Suburban Use: This column indicates whether or not the stormwater management practice is typically suited for use in suburban areas and on medium-density development sites.
- Urban Use: This column identifies the stormwater management practices that are typically suited for use in urban and ultra-urban areas where space is at a premium.
- Construction Cost: This column assesses the relative construction cost of each of the stormwater management practices.
- Maintenance: This column assesses the relative maintenance burden associated with each stormwater management practice. Note that all stormwater management practices require routine inspection and maintenance.

Table 4.1. Site applicability for BMPs.

BMP	Rural Use	Suburban Use	Urban Use	Construction Cost	Maintenance
Bioretention	Yes	Yes	Yes	Medium	Medium
Permeable Pavement	Maybe	Yes	Yes	High	High
Infiltration	Yes	Yes	Yes	Medium	Medium
Green Roof	Maybe	Yes	Yes	High	Low
Rainwater Harvesting	Yes	Yes	Yes	Medium	Medium
Disconnection	Yes	Yes	Maybe	Low	Low
Open Channels	Yes	Yes	No	Low-Medium	Medium
Filtration	Maybe	Yes	Yes	High	High
Dry Ponds	Yes	Yes	No	Low	Low
Wet Ponds	Yes	Yes	No	Low	Low
Stormwater Wetlands	Yes	Yes	No	Low	Medium

4.2.3 Site Conditions & Physical Feasibility

While some BMPs can be applied almost anywhere, others require specific conditions to be most effective. Physical feasibility refers to the physical site conditions necessary to effectively design and install a BMP. Table 4.2 includes the feasibility factors listed below.

- Contributing Drainage Area (CDA): Volume of water received by a practice can affect BMP performance. This column indicates the contributing drainage areas that typically apply for each BMP.
- Slope: This column describes the influence that site slope can have on the performance of the BMP. It indicates the maximum slope on which the BMP should be installed.
- Minimum Head: This column provides an estimate of the minimum amount of elevation difference needed within the BMP, from the inflow to the outflow, to allow for gravity operation.
- Minimum Depth to Seasonal High Water Table: This column indicates the minimum distance that should be provided between the bottom of the stormwater management practice and the top of the water table.
- Soils: This column describes the influence that the underlying soils (i.e., hydrologic soil groups) can have on the performance of the stormwater management practice.

Table 4.2. Feasibility limitations for BMPs.

BMP	Contributing Drainage Area	Slope	Minimum Head	Minimum Depth to Water Table	Soils
Bioretention	Up to 2.5 acres	Up to 5%[2]	4 - 5 feet	0.5 feet	All soils[3]
Permeable Pavement	Up to 5 times practice surface area	Up to 5%	1 – 4 feet	0.5 feet	All soils[3]
Infiltration	Up to 2 acres	Up to 6%[2]	2 feet	0.5 feet	Must drain within 72 hours
Green Roof	Green roof area + 100%	Up to 30%[4]	N/A	N/A	N/A
Rainwater Harvesting	No limit	No limit	N/A	N/A	N/A
Disconnection	Up to 1,000 ft^2 per downspout	Up to 5%	N/A	N/A	All soils
Open Channels	Up to 2.5 acres	Up to 4%[2]	Varies	Varies	All soils
Filtration					

Irrigation from ponds is not included as a specific best management practice in this M*anual* but is included as Rainwater Harvesting (§4.5). Requirements and guidance for irrigation use of retained stormwater have been included in Hydrologic and Hydraulic Analysis (ARC requirements in §3.7.2); Ponds (§4.10); and Rainwater Harvesting Treatment and Management Requirements (Appendix J). The Rainwater Harvesting Calculator in Appendix K will be used to determine the SWRv credit for ponds used for irrigation, and then these ponds are entered in the Compliance Calculator in Appendix H as rainwater harvesting. Instructions for these entries are included in Appendix G Compliance Calculator Instructions.

Filtration	Up to 5 acres	Up to 6%	2 – 10 feet	0.5 feet	All soils
Storage Practices	Varies	No limit	5 feet	0.5 feet	All soils
Ponds	Greater than 10 acres[1]	Up to 15%	6 – 8 feet	No limit	Slow-draining soils preferred
Stormwater Wetlands	Varies	Up to 8%[2]	2 – 4 feet	No limit	Slow-draining soils preferred

[1] *CDA can be smaller if practice intersects the water table.*
[2] *Check dams may be necessary to create sufficient ponding volume.*
[3] *Slow-draining soils may require an underdrain.*
[4] *Roof slope.*

4.3 Bioretention

Bioretention					
Definition: Practices that capture and store stormwater runoff and pass it through a filter bed of engineered filter media composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil.					
Site Applicability		**BMP Performance Summary**			
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High			
▪ Urban ▪ Suburban ▪ Rural	**Small to Large**	**TSS**[1]	**Total N**[1,]	**Bacteria**[1,2]	
		85%–100%	75%–100%	80%–100%	
		Runoff Reduction			
Construction Costs	**Maintenance Burden**	**Volume**			
Moderate	Moderate	High			
Maintenance Frequency:		***SWRv***			
Routine	**Non-Routine**	No Underdrain	IWS	Standard	
Quarterly	Every 2–3 years	100% of Sv	75% of Sv	60%	
Advantages/Benefits		**Disadvantages/Limitation**			
▪ Easily incorporated into new development ▪ High community acceptance ▪ Good for small, highly paved drainage areas (i.e. parking lots)		▪ Maximum CDA is 1 to 2.5 acres ▪ Requires pretreatment to prevent clogging ▪ Requires detailed landscape planning ▪ Not appropriate for steep slopes			
Components		**Design considerations**			
▪ Pretreatment ▪ Conveyance system ▪ Ponding area ▪ Soils/Filter Media/Mulch ▪ Observation Well/Monitoring Port ▪ Plants		▪ Maximum ponding depth 18 inches ▪ Minimum filter media bed depth 18 inches ▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice ▪ Underdrain system may be needed			
Maintenance Activities					
▪ Mow turf cover periodically ▪ Replace mulch as needed to maintain depth of mulch		▪ Replace plant material, as needed ▪ Replace soil if it becomes clogged ▪ Clean conveyance system(s)			

[1]*Credited pollutant load removal*

Bioretention areas, shallow depressional areas that are filled with an engineered soil media and are planted with trees, shrubs, and other herbaceous vegetation, are one of the most effective stormwater management practices that can be used to reduce post-construction stormwater runoff rates, volumes, and pollutant loads. They also provide a number of other benefits, including improved aesthetics, wildlife habitat, urban heat island mitigation, and improved air quality. See Figure 4.1 for an example image.

They are designed to capture and temporarily store stormwater runoff in the engineered soil media, where it is subjected to the hydrologic processes of evaporation and transpiration, before being conveyed back into the storm drain system through an underdrain or allowed to infiltrate into the surrounding soils. The engineered soil media is comprised of sand, soil, and organic matter.

Typically, bioretention systems are not designed to provide stormwater detention of larger storms (e.g., 2-, 10-, 25-year), but in some circumstances that may be possible. Bioretention practices should generally be combined with a separate facility to provide those controls.

Figure 4.1. Bioretention in parking lot (photo credit: Center for Watershed Protection, Inc.).

Definition. Practices that capture and store stormwater runoff and pass it through a filter bed of engineered filter media composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil. Design variants include the following:

B-1 Bioretention

B-2 Streetscape bioretention

B-3 Engineered tree pits

B-4 Stormwater planters

B-5 Residential rain gardens (for single family homes)

There are three different bioretention design configurations:

- **No Underdrain**. Practices that can infiltrate the design storm volume within 72 hours, and therefore need no underdrain (see Figure 4.2).
- **Internal Water Storage (IWS)**. Practices that include an infiltration sump/storage layer (see) below the underdrain.
- **Standard**. Practices with underdrains (see Figure 4.4).

The particular design configuration to be implemented on a site is typically dependent on specific site conditions and the characteristics of the underlying soils. These criteria are further discussed in this chapter.

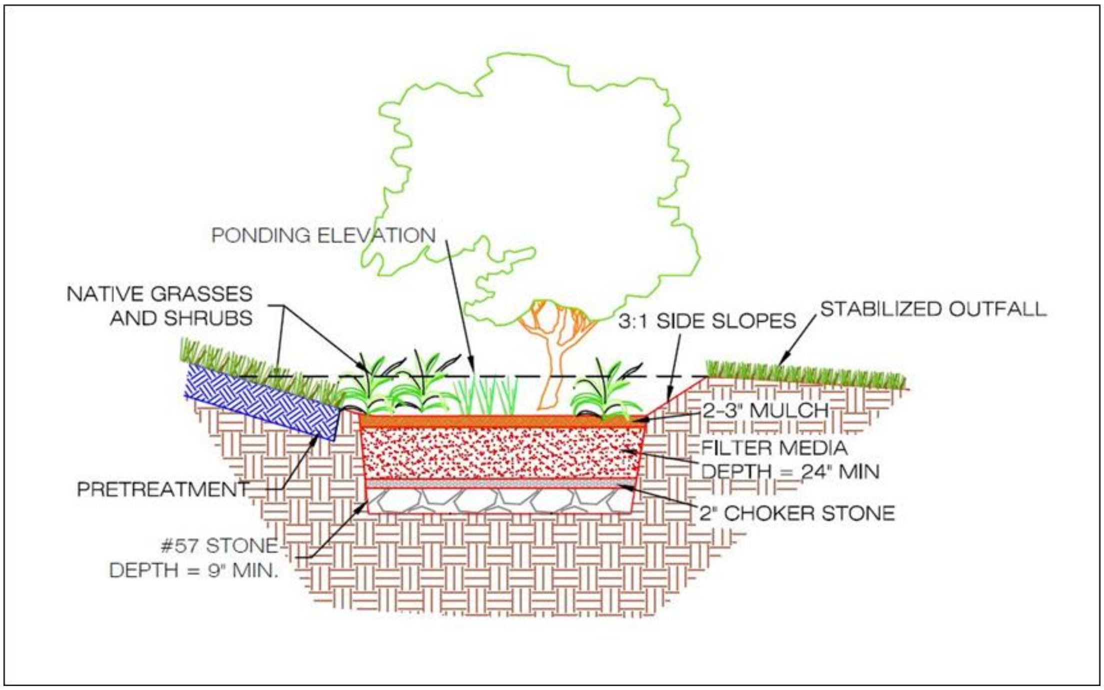


Figure 4.2. Example bioretention design without an underdrain.

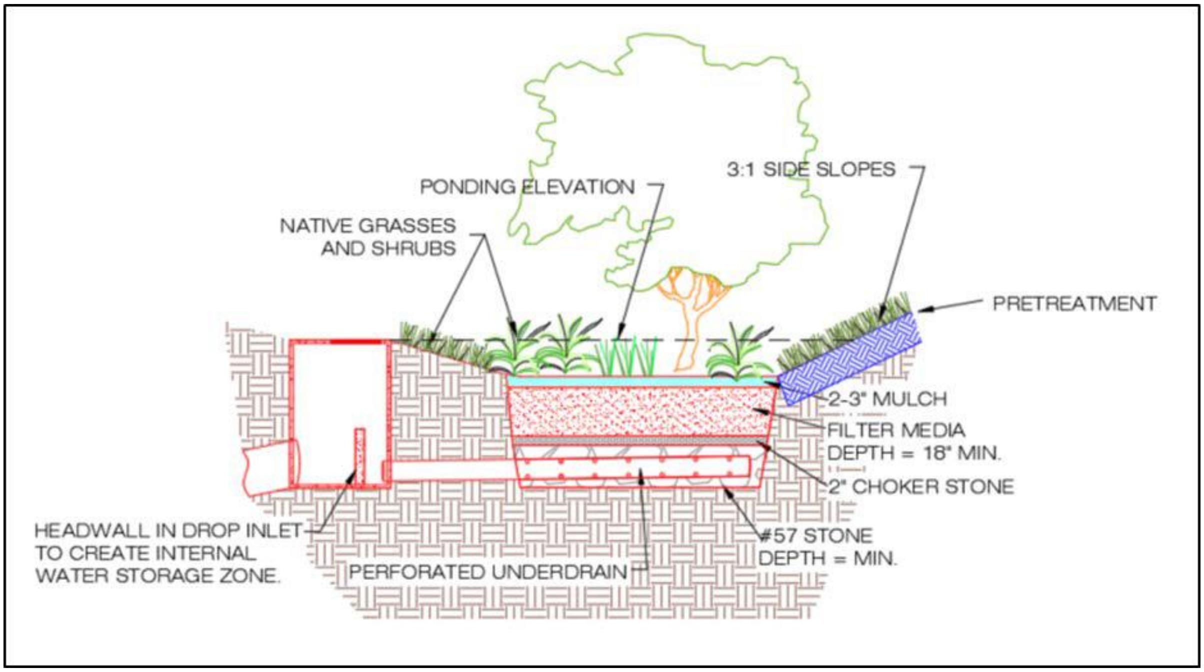


Figure 4.3. Example bioretention design with internal water storage (IWS).

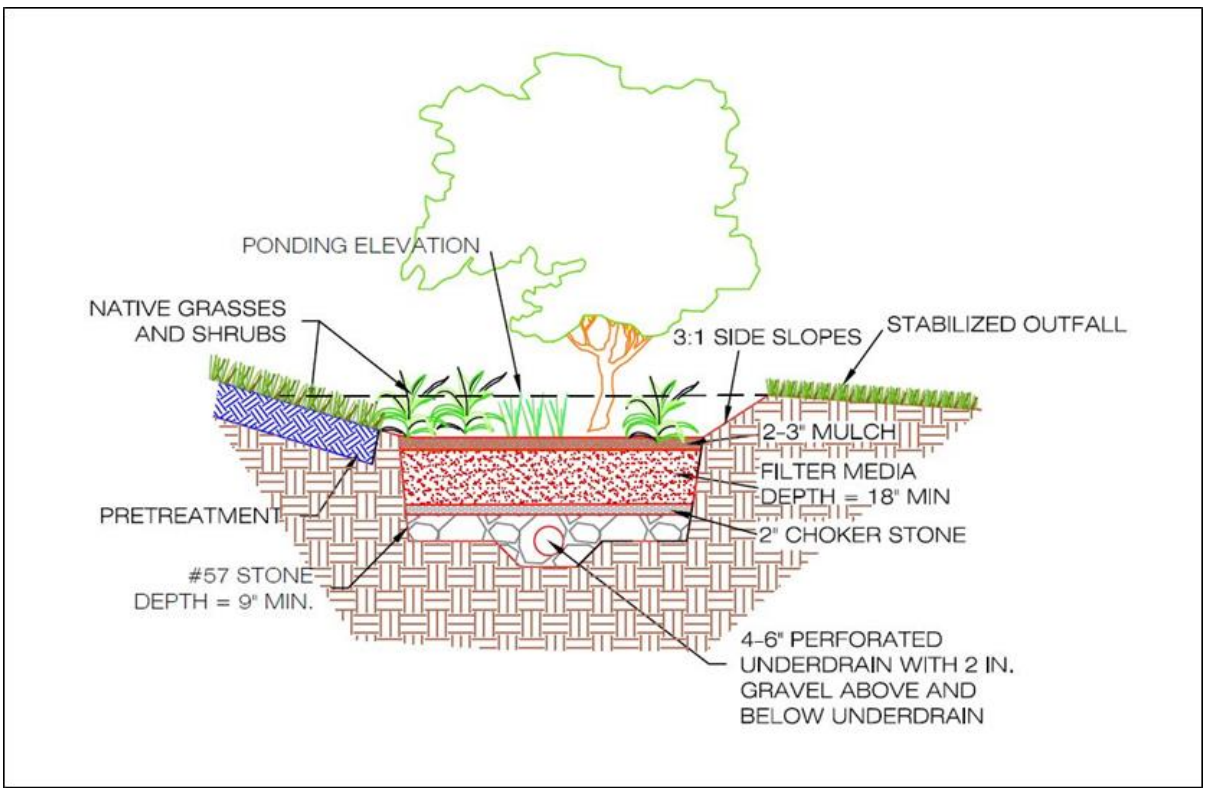


Figure 4.4. Example standard bioretention design.

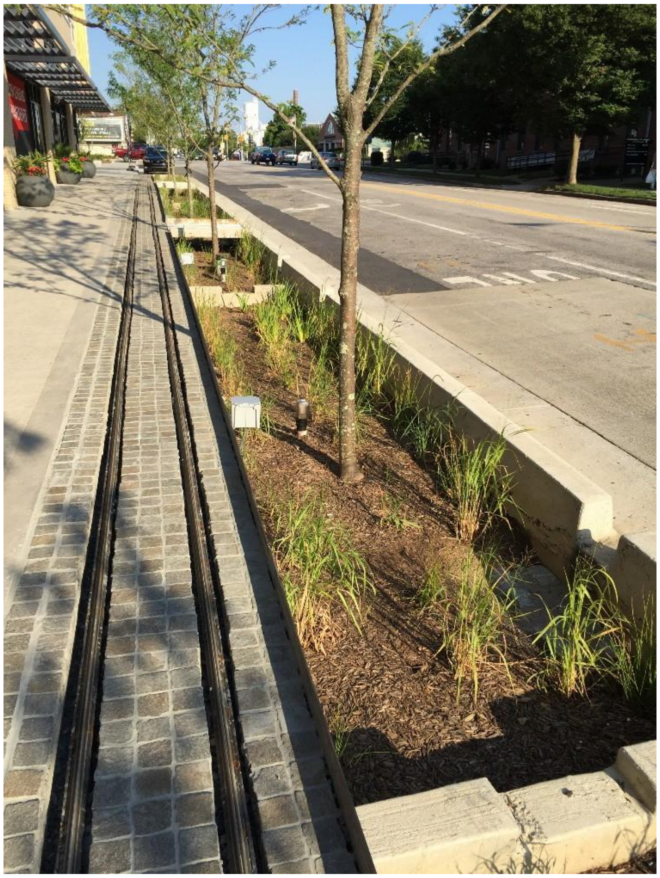


Figure 4.5. Example streetscape bioretention.

4.3.1 Bioretention Feasibility Criteria

Bioretention can be applied in most soils or topography, since runoff simply percolates through an engineered soil bed and is infiltrated or returned to the stormwater system via an underdrain. Key constraints with bioretention include the following:

Required Space

Planners and designers can assess the feasibility of using bioretention facilities based on a simple relationship between the CDA and the corresponding bioretention surface area. The surface area is recommended to be approximately 3 to 6% of CDA, depending on the imperviousness of the CDA and the desired bioretention ponding depth.

Site Topography

Bioretention can be used for sites with a variety of topographic conditions, but it is best applied when the grade of the area immediately adjacent to the bioretention practice (within approximately 15 to 20 feet) is greater than 1% and less than 5%.

Available Hydraulic Head

Bioretention is fundamentally constrained by the invert elevation of the existing conveyance system to which the practice discharges (i.e., the bottom elevation needed to tie the underdrain from the bioretention area into the storm drain system). In general, 4 to 5 feet of elevation above this invert is needed to accommodate the required ponding and filter media depths. If the practice does not include an underdrain or if an inverted or elevated underdrain design is used, less hydraulic head may be adequate.

Water Table

Bioretention must be separated from the water table to ensure that groundwater does not intersect the filter bed. Mixing can lead to possible groundwater contamination or failure of the bioretention facility. A separation distance of no less than 0.5 feet is required between the bottom of the excavated bioretention area and the seasonally high groundwater table.

Tidal Impacts

For systems with an underdrain, the underdrain should be located above the tidal mean high water elevation. For entirely infiltration-based systems, the bottom of the stone reservoir should be located above the mean high water elevation. Where this is not possible, portions of the practice below the tidal mean high water elevation cannot be included in the volume calculations. Also, salt-tolerant vegetation may be necessary in these areas.

Soils and Underdrains

Soil conditions do not typically constrain the use of bioretention, although they do determine whether an underdrain is needed. Underdrains may be required if the measured permeability of the underlying soils is less than 0.3 inches per hour. When designing a bioretention practice, designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B for Geotechnical Information Requirements for Underground BMPs. Impermeable soils will require an underdrain.

For fill soil locations, geotechnical investigations are required to determine if it is necessary to use an impermeable liner and underdrain.

Contributing Drainage Area

Bioretention cells work best with smaller CDAs, where it is easier to achieve flow distribution over the filter bed. The maximum CDA to a standard bioretention area (B-1) is 2.5 acres and can consist of up to 100% impervious cover. The CDA for smaller bioretention practices (B-2, B-3, B-4, and B-5) is a maximum of 1 acre. However, if hydraulic considerations are adequately addressed to manage the potentially large peak inflow of larger CDAs, such as off-line or low-flow diversions, or forebays, there may be case-by-case instances where the maximum CDAs can be adjusted. summarizes typical recommendations for bioretention CDAs.

Table 4.3. Maximum contributing drainage area (CDA) to bioretention.

Bioretention Type	Design Variants	Maximum CDA (acres of impervious cover)
Standard	B-1	2.5
Small-scale bioretention	B-2, B-3, B-4, and B-5	1.0

Pollutant Hotspot Land Uses

Bioretention may not be an appropriate stormwater management practice for certain pollutant-generating sites. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil- water separator or filtering device must be provided. These pretreatment facilities should be monitored and maintained frequently to avoid negative impacts to the bioretention area and subsequent water bodies.

On sites with existing contaminated soils, infiltration is not allowed. An impermeable bottom liner and an underdrain system must be employed when a bioretention area will receive untreated hotspot runoff, and the No Underdrain design configuration cannot be used.

Bioretention can still be used to treat parts of the site that are outside of the hotspot area. For instance, roof runoff can go to bioretention while vehicular maintenance areas would be treated by a more appropriate hotspot practice.

No Irrigation or Baseflow

The planned bioretention area should not receive baseflow, irrigation water, chlorinated wash-water or any other flows not related to stormwater. During the establishment period of the bioretention area, irrigation is allowed, however, to ensure plant survival. In addition, rain gardens or bioretention practices may be incorporated into the design of a Rainwater Harvesting System (See Section 4.7).

Setbacks

To avoid the risk of seepage, stormwater cannot flow from the bioretention area reservoir layer to the traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties.

Bioretention areas should be located at least:

- 10 feet from building foundations*
- 10 feet from property lines
- 150 feet from private water supply wells
- 50 feet from septic systems

*For building foundations, where the 10-foot setback is not possible, an impermeable liner may be used along the sides and bottom of the bioretention area (extending from the surface to the bottom of the practice and outward to meet the 10-foot setback) to prevent seepage or foundation damage.

Proximity to Utilities

Designers should ensure that future tree canopy growth in the bioretention area will not interfere with existing overhead utility lines. When large site development is undertaken the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the PROW. Consult with each utility company on recommended offsets, which will allow utility maintenance work with minimal disturbance to the bioretention system. Where conflicts cannot be avoided, follow these guidelines:

- Consider altering the location or sizing of the bioretention to avoid or minimize the utility conflict. Consider an alternate BMP type to avoid conflict.
- Use design features to mitigate the impacts of conflicts that may arise by allowing the bioretention and the utility to coexist. The bioretention design may need to incorporate impervious areas, through geotextiles or compaction, to protect utility crossings.
- Work with the utility to evaluate the relocation of the existing utility and install the optimum placement and sizing of the bioretention.

- If utility functionality, longevity, and vehicular access to manholes can be assured, accept the bioretention design and location with the existing utility. Incorporate into the bioretention design sufficient soil coverage over the utility or general clearances or other features such as an impermeable liner to assure all entities the conflict is limited to maintenance.

When accepting utility conflict into the bioretention location and design, it is understood the bioretention will be temporarily impacted during utility work but the utility owner will replace the bioretention or, alternatively, install a functionally comparable bioretention according to the specifications in the current version of this Manual. If the bioretention is located in the PROW, the bioretention restoration will also conform with the State of South Carolina Department of Transportation design specifications.

Minimizing External Impacts

Urban bioretention practices may be subject to higher public visibility, greater trash loads, pedestrian traffic, vandalism, and even vehicular loads. Designers should design these practices in ways that prevent, or at least minimize, such impacts. In addition, designers should clearly recognize the need to perform frequent landscaping maintenance to remove trash, check for clogging, and maintain vigorous vegetation. The urban landscape context may feature naturalized landscaping or a more formal design. When urban bioretention is used in sidewalk areas of high foot traffic, designers should not impede pedestrian movement or create a safety hazard. Designers may also install low fences, grates, or other measures to prevent damage from pedestrian short-cutting across the practices.

When bioretention will be included in public rights-of-way or spaces, design manuals and guidance developed by agencies or organizations other than Beaufort County Public Works Department may also apply (e.g., State Department of Transportation).

Economic Considerations

Bioretention areas can be particularly cost effective when they are included in areas of the site already planned for landscaping.

4.3.2 Bioretention Conveyance Criteria

There are two basic design approaches for conveying runoff into, through, and around bioretention practices:

1. Off-line: Flow is split or diverted so that only the design storm or design flow enters the bioretention area. Larger flows bypass the bioretention treatment.
2. On-line: All runoff from the CDA flows into the practice. Flows that exceed the design capacity exit the practice via an overflow structure or weir.

If runoff is delivered by a storm drain pipe or is along the main conveyance system, the bioretention area should be designed off-line so that flows do not overwhelm or damage the practice.

Off-line Bioretention

Overflows are diverted from entering the bioretention cell. Optional diversion methods include the following:

- Create an alternate flow path at the inflow point into the structure such that when the maximum ponding depth is reached, the incoming flow is diverted past the facility. In this case, the higher flows do not pass over the filter bed and through the facility, and additional flow is able to enter as the ponding water filters through the filter media. With this design configuration, an overflow structure in the bioretention area is not required.

- Utilize a low-flow diversion or flow splitter at the inlet to allow only the design storm volume (i.e., the SWRv) to enter the facility (calculations must be made to determine the peak flow from the 85th or 95th percentile storm). This may be achieved with a weir, curb opening, or orifice for the target flow, in combination with a bypass channel or pipe. Using a weir or curb opening helps minimize clogging and reduces the maintenance frequency. With this design configuration, an overflow structure in the bioretention area is required (see on-line bioretention below).

On-line Bioretention

An overflow structure must be incorporated into on-line designs to safely convey larger storms through the bioretention area (see Figure 4.6). The following criteria apply to overflow structures:

- An overflow shall be provided within the practice to pass storms greater than the design storm storage to a stabilized water course. A portion of larger events may be managed by the bioretention area so long as the maximum depth of ponding in the bioretention cell does not exceed 18 inches.
- The overflow device must convey runoff to a storm sewer, stream, or the existing stormwater conveyance infrastructure, such as curb and gutter or an existing channel.
- Common overflow systems within bioretention practices consist of an inlet structure, where the top of the structure is placed at the maximum ponding depth of the bioretention area, which is typically 6 to 18 inches above the surface of the filter bed.
- The overflow device should be scaled to the application. This may be a landscape grate or yard inlet for small practices or a commercial-type structure for larger installations.
- Sufficient depth must be provided between the top of the overflow device and the top of the bioretention area to ensure that the 25-year storm can be safely conveyed through the overflow device.
- The overflow associated with the 2- to 25-year design storms must be controlled so that velocities are non-erosive (generally less than 6 feet per second) at the outlet point, to prevent downstream erosion.

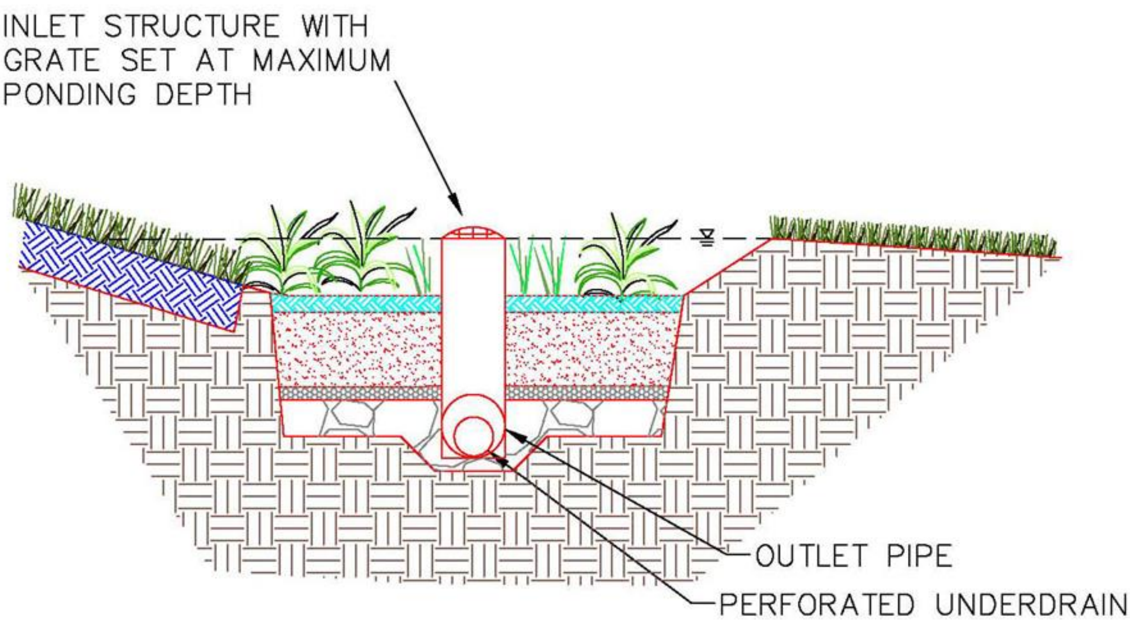


Figure 4.6. Example design of an on-line bioretention with an overflow structure.

4.3.3 Bioretention Pretreatment Criteria

Pretreatment of runoff entering bioretention areas is necessary to trap coarse sediment particles before they reach and prematurely clog the filter bed. Pretreatment measures must be designed to evenly spread runoff across the entire width of the bioretention area. Several pretreatment measures are feasible, depending on the type of the bioretention practice and whether it receives sheet flow, shallow concentrated flow, or deeper concentrated flows. The following are appropriate pretreatment options:

Standard Bioretention (B-1)

- **Pretreatment Cells** (for channel flow). Similar to a forebay, this cell is located at piped inlets or curb cuts leading to the bioretention area and consists of an energy dissipator sized for the expected rates of discharge. It has a storage volume equivalent to at least 15% of the total storage volume (inclusive) with a recommended 2:1 length-to-width ratio. The cell may be formed by a wooden or stone check dam or an earthen or rock berm. Pretreatment cells do not need underlying engineered filter media, in contrast to the main bioretention cell. However, if the volume of the pretreatment cell will be included as part of the bioretention storage volume, the pretreatment cell must de-water between storm events. It cannot have a permanent ponded volume.
- **Grass Filter Strips** (for sheet flow). Grass filter strips that are perpendicular to incoming sheet flow extend from the edge of pavement, with a slight drop at the pavement edge, to the bottom of the bioretention basin at a 5H:1V slope or flatter. Alternatively, if the bioretention basin has side slopes that are 3H:1V or flatter, a 5-foot grass filter strip can be used at a maximum 5% (20H:1V) slope.
- **Stone Diaphragms** (for sheet flow). A stone diaphragm located at the edge of the pavement should be oriented perpendicular to the flow path to pretreat lateral runoff, with a 2- to 4-inch drop from

the pavement edge to the top of the stone. The stone must be sized according to the expected rate of discharge.

- **Gravel or Stone Flow Spreaders** (for concentrated flow). The gravel flow spreader is located at curb cuts, downspouts, or other concentrated inflow points, and should have a 2- to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The gravel must extend the entire width of the opening and create a level stone weir at the bottom or treatment elevation of the basin.
- **Filter System** (see Section 4.10 Filtering Systems). If using a filter system as a pretreatment facility, the filter will not require a separate pretreatment facility.
- **Innovative or Proprietary Structure**. An approved proprietary structure with demonstrated capability of reducing sediment and hydrocarbons may be used to provide pretreatment. Refer to Section 0 Proprietary Practices for information on approved proprietary structures.

Other pretreatment options may be appropriate, but they must trap coarse sediment particles and evenly spread runoff across the entire width of the bioretention area.

Small-Scale Bioretention (B-2, B-3, B-4, and B-5)

- **Leaf Screens**. A leaf screen serves as part of the gutter system to keep the heavy loading of organic debris from accumulating in the bioretention cell.
- **Pretreatment Cells** (for channel flow). Pretreatment cells are located above ground or covered by a manhole or grate. Pretreatment cells are atypical in small-scale bioretention and are not recommended for residential rain gardens (B-5).
- **Grass Filter Strips** (for sheet flow). Grass filter strips are applied on residential lots, where the lawn area can serve as a grass filter strip adjacent to a rain garden.
- **Stone Diaphragm** (for either sheet flow or concentrated flow). The stone diaphragm at the end of a downspout or other concentrated inflow point should run perpendicular to the flow path to promote settling.

  Note: stone diaphragms are not recommended for school settings.
- **Trash Racks** (for either sheet flow or concentrated flow). Trash racks are located between the pretreatment cell and the main filter bed or across curb cuts to allow trash to collect in specific locations and make maintenance easier.

4.3.4 Bioretention Design Criteria

Design Geometry

Bioretention basins must be designed with an internal flow path geometry such that the treatment mechanisms provided by the bioretention are not bypassed or short-circuited. So that the bioretention area to have an acceptable internal geometry, the travel time from each inlet to the outlet should be maximized by locating the inlets and outlets as far apart as possible. In addition, incoming flow must be distributed as evenly as possible across the entire filter surface area.

Inlets and Energy Dissipation

Where appropriate, the inlet(s) to streetscape bioretention (B-2), engineered tree boxes (B-3), and stormwater planters (B-4) should be stabilized using No. 3 stone, splash block, river stone, or other acceptable energy dissipation measures. The following types of inlets are recommended:

- Downspouts to stone energy dissipators.
- Sheet flow over a depressed curb with a 3-inch drop.
- Curb cuts allowing runoff into the bioretention area.
- Covered drains that convey flows across sidewalks from the curb or downspouts.
- Grates or trench drains that capture runoff from a sidewalk or plaza area.
- Drop structures that appropriately dissipate water energy.

Inlets must be designed with sufficient width and slope to avoid unintended bypass. This is of particular concern for curb cuts on streetscape bioretention designs.

Ponding Depth

The recommended surface ponding depth is 6 to 12 inches. Minimum surface ponding depth is 3 inches (averaged over the surface area of the BMP). Ponding depths can be increased to a maximum of 18 inches. However, when higher ponding depths are utilized, the design must consider carefully issues such as safety, fencing requirements, aesthetics, the viability and survival of plants, and erosion and scour of side slopes. This is especially true where bioretention areas are built next to sidewalks or other areas were pedestrians or bicyclists travel. Shallower ponding depths (typically 6 to 12 inches) are recommended for streetscape bioretention (B-2), engineered tree boxes (B-3), and stormwater planters (B-4).

Side Slopes

Traditional bioretention areas (B-1) and residential rain gardens (B-5) should be constructed with side slopes of 3H:1V or flatter. In space-constrained areas, a drop curb design or a precast structure can be used to create a stable, vertical side wall. These drop curb designs should not exceed a vertical drop of more than 12 inches, unless safety precautions, such as railings, walls, grates, etc. are included.

Filter Media

The filter media of a bioretention practice consists of an engineered soil mixture that has been carefully blended to create a filter media that maintains long-term permeability while also providing enough nutrients to support plant growth. The final filter media shall consist of a well-blended mixture of medium to coarse **sand**, **loam soil**, and an **organic amendment** (compost). The sand maintains the desired permeability of the media while the limited amount of loam soil and organic amendments are considered adequate to help support initial plant growth. It is anticipated that the gradual increase of organic material through natural processes will continue to support plant growth without the need to add fertilizer, and the root structure of maturing plants and the biological activity of the media will maintain sufficient long-term permeability.

The following is the recommended composition of the three media ingredients:

- **Sand (Fine Aggregate).** Sand should consist of silica-based medium to coarse sand and be angular or round in shape. The materials shall not be derived from serpentine, shall be free of surface coatings or any other deleterious materials, and shall contain less than 0.5% mica by weight when tested with ASTM C295, Standard Guide for Petrographic Examination of Aggregates for Concrete.

ASTM C-33 concrete sand will typically meet the requirements for the sand to be used in filter media. However, some samples of ASTM C-33 sand may have too high a fraction of fine sand and silt- and clay-sized particles to meet the final filter media particle size distribution requirements. In general, coarser gradations of ASTM C-33 will better meet the filter media particle size distribution and hydraulic conductivity requirements.

Any other materials, such as manufactured sand, limestone-based sands, or crushed glass, shall meet the required particle size distribution (of final filter media mixture) and be demonstrated as adequately durable when tested by AASHTO T-103 or T-104.

- **Loam Soil.** Loam soil is generally defined as the combination of sand-sized material, fines (silt and clay), and any associated soil organic matter. Since the objective of the specification is to carefully establish the proper blend of these ingredients in the final filter media, the designer (or contractor or materials supplier) must carefully select the topsoil source material so as not exceed the amount of any one ingredient.

  Generally, a natural loamy sand, sandy loam, or loam (per the USDA Textural Triangle) A-horizon topsoil free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, viable noxious weed seed, plant propagules, brush, or other objectionable, extraneous matter or debris is suitable for the loam soil source material.

- **Organic Amendments.** Organic amendments shall consist of stable, well-composted, natural, carbon-containing organic materials such as leaf mulch, peat moss, humus, or yard waste (consistent with the material specifications found in Appendix C Soil Compost Amendment Requirements). The material shall be free of debris such as plastics, metal, concrete, stones larger than ½ inch, larger branches and roots, and wood chips over 1 inch in length or diameter.

Complete Filter Media

The complete filter media shall consist of a pug milled or mechanically blended mix of the three source materials. Mixing the filter media on site with excavation or loading equipment is not sufficient to achieve the required blending. The resulting filter media must meet the following particle size composition:

- 80%–90% sand
- 10%–20% silt and clay
- Maximum 10% clay

The particle size analysis must be conducted on the mineral fraction only or following **appropriate treatments to remove organic matter before particle size analysis. Note: The above percentages are based on weight rather than volume.**

Additionally, the final filter media mix must either meet the grain size distribution indicated in Table 4.4**, or have a saturated hydraulic conductivity of 2 to 6 inches per hour according to test procedure ASTM D2434 when compacted (at 60% to 80% optimum moisture content) to a minimum of 86% of the maximum density as determined by AASHTO T 99 (ASTM, 2006).**

Table 4.4. Filter media grain size distribution.

Sieve Type	Particle Size (mm)	Percent Passing (%)
-	8.0	100
No. 5	4.0	92–100
No. 10	2.0	72–100
No. 18	1.0	43–95
No. 35	0.5	20–65
No. 60	0.25	11–37
No. 140	0.105	10–25
No. 270	0.053	10–20
-	0.002	0–10

The filter media shall also meet the following criteria (see summary in Table 4.5):

- Organic content shall be between 3.0% and 5.0% by weight;
- pH shall be between 6.0 and 7.5;
- Cation exchange capacity (CEC) shall be a minimum of 5 meq/100g or cmol+/kg;
- Phosphorus content shall meet one of the following:
  - P-Index between 10 and 30;
  - 15 mg/kg Mehlich I Extraction;
  - 18 to 40 mg/kg Mehlich III Extraction; and
- Soluble salts shall be less than 500 ppm or less than 0.5 mmhos/cm.

Notes:

1. P-Index is an agronomic test used in North Carolina to indicate the potential for P leaching from soil. The test method has been revised to add P concentration to facilitate local lab testing. The value of the P-Index is the correlation between the CEC and P concentrations: higher CEC indicates greater adsorption sites within the media, thus increasing the ability to fix P within the soil, thereby allowing higher P concentrations without leaching. While P-Index may be a better overall representation of P, the test method may not be readily available.

Tests for organic content, CEC, soluble salts, and pH are referenced to be in accordance with Recommended Soil Testing Procedures from the Southeastern United States, Current Edition, Southern Cooperative Series Bulletin No. 419. Use the following tests from Southern Cooperative Series Bulletin No. 419:

(a) Test for soil content by loss of weight on ignition

(b) Test for soil CEC by exchangeable acidity method

(c) Test for soluble salts shall be by the 1:2 (v:v) soil:water Extract Method

(d) Test for pH by the SMP method

Table 4.5. Summary of filter media criteria for bioretention.

Filter Media Criterion	Description	Standard(s)
General Composition	Filter media must have the proper proportions of sand, loam soil, and organic amendments to promote plant growth, drain at the proper rate, and filter pollutants.	80%–90% sand; 10%–20% soil fines; maximum of 10% clay; and 3%–5% organic content Must meet final filter media grain size distribution OR have a saturated hydraulic conductivity of 2–6 inches per hour
Sand	Medium to coarse aggregate	Based on final filter media grain size distribution
Loam Soil	Loamy sand, sandy loam, or loam	USDA Textural Triangle
Organic Amendments	Stable, well-composted, natural, carbon-containing organic materials such as leaf mulch, peat moss, humus, or yard waste.	Appendix C
P-Index or Phosphorus (P) Content	Filter media with high P levels will export P through the media and potentially to downstream conveyances or receiving waters.	P-Index of 10–30 or P content = 5–15 mg/kg (Mehlich I) or 18–40 mg/kg (Mehlich III)
Cation Exchange Capacity (CEC)	The CEC is determined by the amount of soil fines and organic matter. Higher CEC will promote pollutant removal.	CEC > 5 milliequivalents per 100 grams
pH	Soil pH influences nutrient availability and microbial populations.	Between 6.0 and 7.5
Soluble Salts	Filter media with high levels of soluble salts can injure or kill plants.	Less than 500 ppm or less than 0.5 mmhos/cm.

In cases where greater removal of specific pollutants is desired, additives with documented pollutant removal benefits, such as water treatment residuals, alum, iron, or other materials, may be included in the filter media if accepted by Beaufort County Public Works Department.

Filter Media Depth

The filter media bed depth must be a minimum of 18 inches for the No Underdrain or Standard designs. The media depth must be 24 inches or greater for the IWS design **In order to receive the full credit for bacteria removal a minimum media depth of 24" is required.** The media depth must not exceed 6.0

feet. Turf, perennials, or shrubs should be used instead of trees to landscape shallower filter beds. See Table 4.7 and ~~,~~ Table 4.8 for a list of recommended native plants.

Surface Cover

Mulch is the recommended surface cover material, but other materials may be substituted, as described below:

- **Mulch**. A 2- to 3-inch layer of mulch on the surface of the filter bed enhances plant survival, suppresses weed growth, pretreats runoff before it reaches the filter media, and prevents rapid evaporation of rainwater. Shredded hardwood bark mulch, aged for at least 6 months, is recommended/required for surface cover, as it retains a significant amount of pollutants and typically will not float away. The maximum depth of the mulch layer is 3 inches.
- **Alternative to Mulch Cover**. In some situations, designers may consider alternative surface covers, such as turf, native groundcover, erosion control matting (e.g., coir or jute matting), river stone, or pea gravel. The decision regarding the type of surface cover to use should be based on function, expected pedestrian traffic, cost, and maintenance. When alternative surface covers are used, methods to discourage pedestrian traffic should be considered. Stone or gravel are not recommended in parking lot applications, since they increase soil temperature and have low water-holding capacity.
- **Media for Turf Cover**. One adaptation suggested for use with turf cover is to design the filter media primarily as a sand filter with organic content only at the top. Compost, as specified in Appendix C Soil Compost Amendment Requirements, tilled into the top layers will provide organic content for the vegetative cover. If grass is the only vegetation, the ratio of organic matter in the filter media composition may be reduced.

Choking Layer

A 2- to 4-inch layer of choker stone (e.g., typically ASTM D448 No. 8 or No. 89 washed gravel) should be placed beneath the filter media and over the underdrain stone.

Geotextile

If the available head is limited, or the depth of the practice is a concern, geotextile fabric may be used in place of the choking layer. An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements, and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used. Geotextile fabric may be used on the sides of bioretention areas as well.

Underdrains

Many bioretention designs will require an underdrain (see Section 4.3.1 Bioretention Feasibility Criteria). The underdrain should be a 4- or 6-inch perforated schedule 40 PVC pipe, or equivalent corrugated HDPE for small bioretention BMPs, with three or four rows of 3/8-inch perforations at 6 inches on center. The underdrain must be encased in a layer of clean, double washed ASTM D448 No.57 or smaller (No. 68, 8, or 89) stone. The maximum depth of the underdrain stone layer combined with the choking layer is 12 inches, and it cannot extend beyond the surface dimensions of the bioretention filter media. The underdrain must be sized so that the bioretention BMP fully drains within 72 hours or less.

Multiple underdrains may be necessary for bioretention areas wider than 40 feet, and each underdrain is recommended to be located no more than 20 feet from the next pipe or the edge of the bioretention.

For long and narrow applications, a single underdrain running the length of the bioretention is sufficient. Each underdrain must include a cleanout pipe (minimum 4 inches in diameter).

All bioretention practices should include at least one observation well and/or cleanout pipe (minimum 4 inches in diameter). The observation wells should be tied into any of the Ts or Ys in the underdrain system and must extend upward above the surface of the bioretention area.

Internal Water Storage (IWS)
In cases where limited head is a site constraint and the bioretention must be designed to be relatively shallow (e.g., depth to groundwater, relatively flat sites, or other factors), or where increased nitrogen removal is desired, an internal water storage design that creates an infiltration sump below the underdrain can be used. The internal water storage zone may be created by an upturned elbow in the underdrain, a weir in the outlet structure, or other means that create a permanently saturated depth above the underdrain. The internal water storage zone must be kept at least 12 inches below the surface of the bioretention area. For more information on this design consult North Carolina Stormwater Design Manual Chapter C-2. (NCDEQ, 2017)

Observation Wells

All bioretention practices must include at least one observation well consisting of a well-anchored, 4- to 6-inch diameter PVC pipe (see Figure 4.7). For standard and IWS bioretention designs, the non-perforated observation wells should be tied into any of the Ts or Ys in the underdrain system and must extend upward above the ponding level. These observation wells can also double as cleanouts. Observation wells for bioretention designs without underdrains should be perforated in the gravel layer only and also must extend upward to the top of ponding.

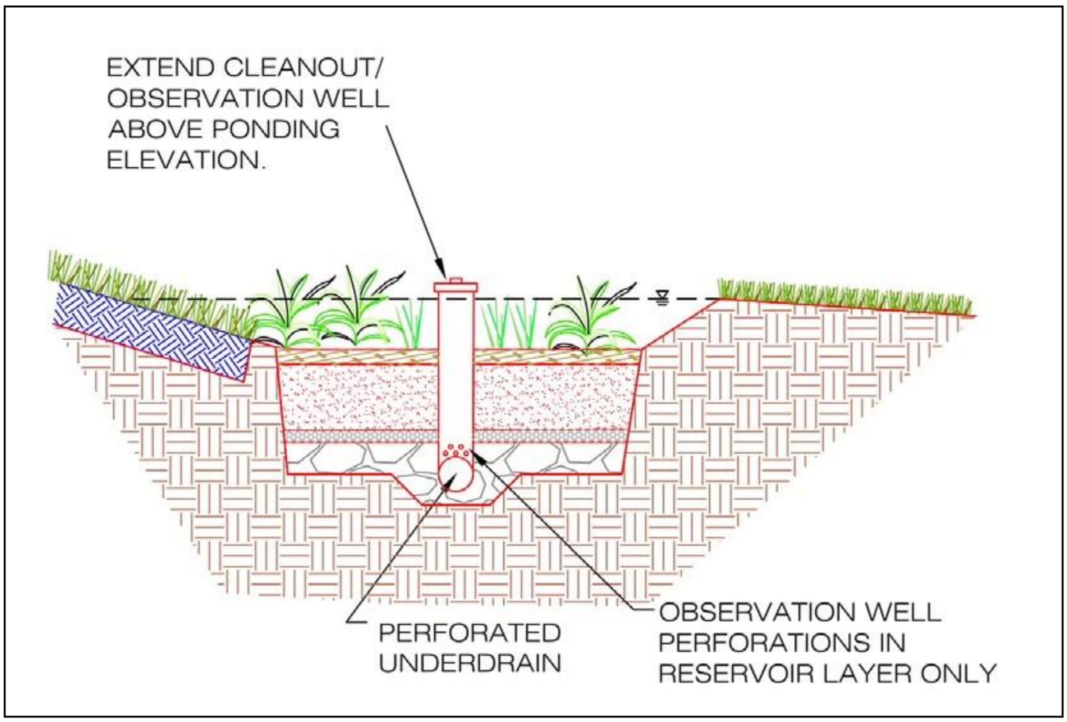


Figure 4.7. Example design of a bioretention with an observation well/cleanout device.

Underground Storage Layer (optional)

For IWS bioretention designs, an underground storage layer consisting of chambers, perforated pipe, stone, or other acceptable material can be incorporated below the filter media layer and underdrain to increase the storage for larger storm events. Unlike the underdrain stone layer, this storage layer can be extended beyond the surface dimensions of the bioretention filter media if additional storage volume is needed. The underground storage layer may be designed to provide detention for the 2- to 25-year, or 100-year storms, as needed. The depth and volume of the storage layer will depend on the target storage volumes needed to meet the applicable detention criteria. Suitable conveyance must also be provided to ensure that the storage is fully utilized without overflow of the bioretention area.

Impermeable Liner (optional)

An impermeable liner is not typically required, although it may be utilized for Standard designs in fill applications where deemed necessary by a geotechnical investigation, on sites with contaminated soils, or on the sides of the practice to protect adjacent structures from seepage. Use a PVC geomembrane liner or equivalent of an appropriate thickness (follow manufacturer's instructions for installation). Field seams must be sealed according to the liner manufacturer's specifications. A minimum 6-inch overlap of material is required at all seams.

Material Specifications

Recommended material specifications for bioretention areas are shown in Table 4. 6.

Table 4.6. Bioretention material specifications.

Material	Specification	Notes
Filter Media	▪ See Table 4.5 and Table 4.6	Minimum depth of 24 inches (18 inches for standard design). To account for settling/compaction, it is recommended that 110% of the plan volume be utilized.
Mulch Layer	Use aged, shredded hardwood bark mulch	Lay a 2- to 3-inch layer on the surface of the filter bed.
Alternative Surface Cover	Use river stone or pea gravel, coir and jute matting, or turf cover.	Lay a 2- to 3-inch layer of to suppress weed growth.
Topsoil for Turf Cover	Loamy sand or sandy loam texture, with less than 5% clay content, pH corrected to between 6 and 7, and an organic matter content of at least 2%.	3-inch tilled into surface layer.
Geotextile or Choking Layer	An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used	Can use in place of the choking layer where the depth of the practice is limited. Geotextile fabric may be used on the sides of bioretention areas as well.
	Lay a 2- to 4-inch layer of choker stone (e.g., typically No.8 or No.89 washed gravel) over the underdrain stone.	
Underdrain Stone	1-inch diameter stone must be double-washed and clean and free of all fines (e.g., ASTM D448 No. 57 or smaller stone).	At least 2 inches above and below the underdrain.
Storage Layer (optional)	To increase storage for larger storm events, chambers, perforated pipe, stone, or other acceptable material can be incorporated below the filter media layer.	
Impermeable Liner (optional)	Where appropriate, use a PVC Geomembrane liner or equivalent material of an appropriate thickness.	
Underdrains, Cleanouts, and Observation Wells	Use 4- or 6-inch rigid schedule 40 PVC pipe, or equivalent corrugated HDPE for small bioretention BMPs, with three or four rows of 3/8-inch perforations at 6 inches on center. Multiple underdrains may be necessary for bioretention areas wider than 40 feet, and each underdrain is recommended to be located no more than 20 feet from the next pipe or the edge of the bioretention.	Lay the perforated pipe under the length of the bioretention cell and install non-perforated pipe as needed to connect with the storm drain system or to daylight in a stabilized conveyance. Install T's and Y's as needed, depending on the underdrain configuration. Extend cleanout pipes to the surface of ponding.
Plant Materials	See Section 4.3.5 Bioretention Landscaping Criteria	Establish plant materials as specified in the landscaping plan and the recommended plant list.

Signage

Bioretention units in highly urbanized areas should be stenciled or otherwise permanently marked to designate it as a structural BMP. The stencil or plaque should indicate (1) its water quality purpose, (2) that it may pond briefly after a storm, and (3) that it is not to be disturbed except for required maintenance.

Specific Design Issues for Streetscape Bioretention (B-2)

Streetscape bioretention is installed in the road right-of-way either in the sidewalk area or in the road itself. In many cases, streetscape bioretention areas can also serve as traffic-calming or street-parking control devices. The basic design adaptation is to move the raised concrete curb closer to the street or in the street, and then create inlets or curb cuts that divert street runoff into depressed vegetated areas within the right-of-way. Roadway stability can be a design issue where streetscape bioretention practices are installed. Designers should consult design standards pertaining to roadway drainage. It may be necessary to provide an impermeable liner on the road-side of the bioretention area to keep water from saturating the road's sub-base. Streetscape bioretention in the PROW should comply with State Department of Transportation requirements, where applicable.

Specific Design Issues for Engineered Tree Boxes (B-3)

Engineered tree boxes are installed in the sidewalk zone near the street where urban street trees are normally installed (see Figure 4.8). The soil volume for the tree pit is increased and used to capture and treat stormwater. Treatment is increased by using a series of connected tree planting areas together in a row. The surface of the enlarged planting area may be mulch, grates, permeable pavers, or conventional pavement. The large and shared rooting space and a reliable water supply increase the growth and survival rates in this otherwise harsh planting environment. Engineered tree boxes in the PROW should comply with State Department of Transportation requirements, where applicable.

When designing engineered tree boxes, the following criteria may apply.

- Engineered tree box designs sometimes cover portions of the filter media with pervious pavers or cantilevered sidewalks (see Figure 4.9). In these situations, the following design considerations must be incorporated:
    - The filter media must be connected beneath the surface so that stormwater and tree roots can share this space.
    - As with all bioretention areas, a minimum surface ponding depth of 3 inches, averaged over the surface area of the bioretention area, is required. For example, if the additional surface area under the pavement doubles the overall surface area, then the ponding depth will need to be at least 6 inches.
    - Sand based structural soil (SBSS) may be considered as bioretention filter media if it meets the same phosphorus content limits. However, if the SBSS is to be compacted beyond the State Standards' maximum compaction for bioretention, it shall be assigned a porosity of 0.10. The State Standards call for bioretention soil to be compacted to 84% maximum dry density while SBSS is to be compacted to 93%.
- Installing an engineered tree pit grate over filter bed media is one possible solution to prevent pedestrian traffic and trash accumulation.

- Low, wrought iron fences can help restrict pedestrian traffic across the tree pit bed and serve as a protective barrier if there is a drop-off from the pavement to the micro-bioretention cell.
- A removable grate may be used to allow the tree to grow through it.
- Each tree needs a minimum rootable soil volume as described in Section 4.14~~4.12~~ Tree Planting and Preservation.
- See Section 4.14.2 Planting Trees for further guidance and requirements on tree planting.

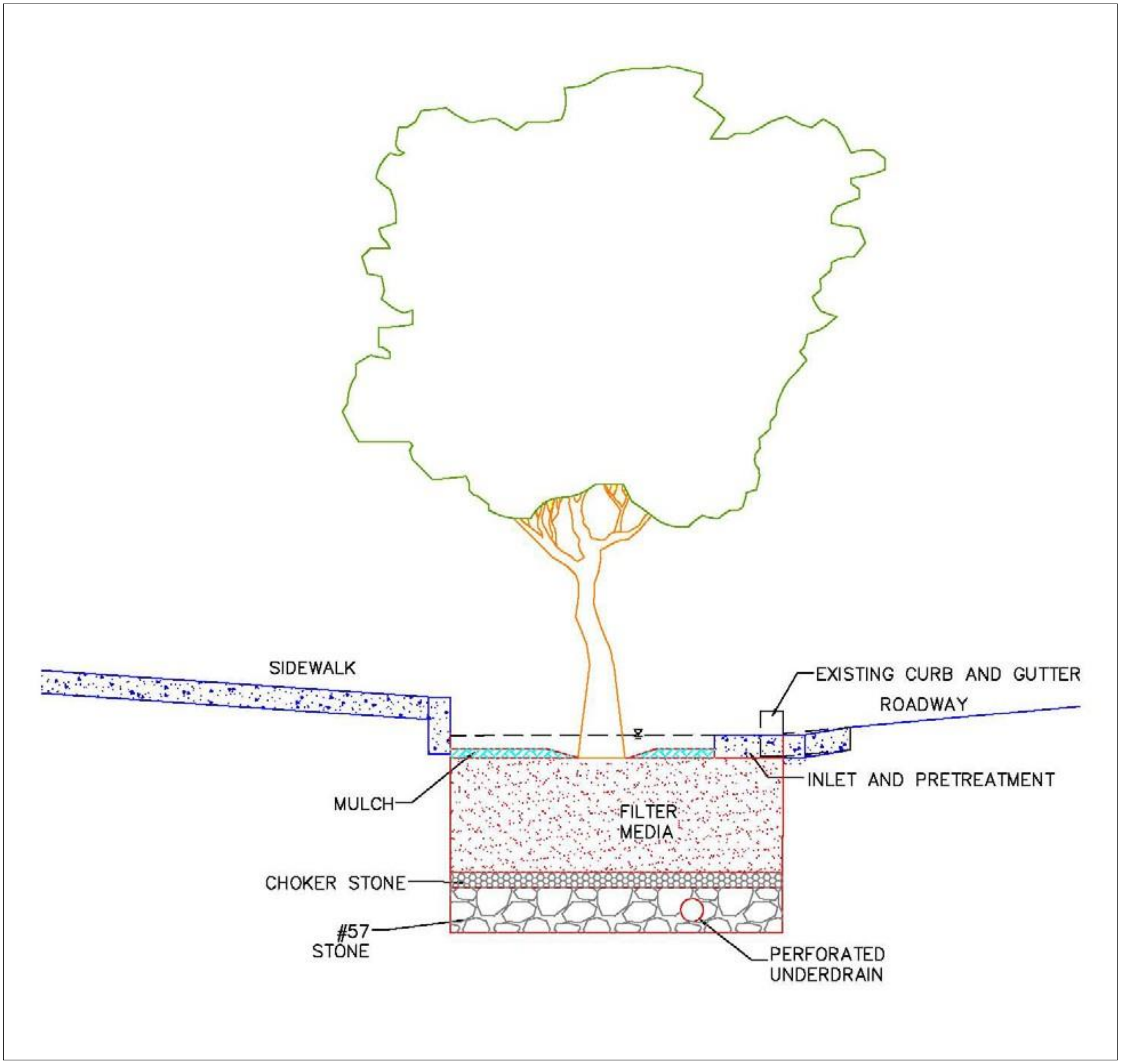


Figure 4.8. Example design of a tree box.

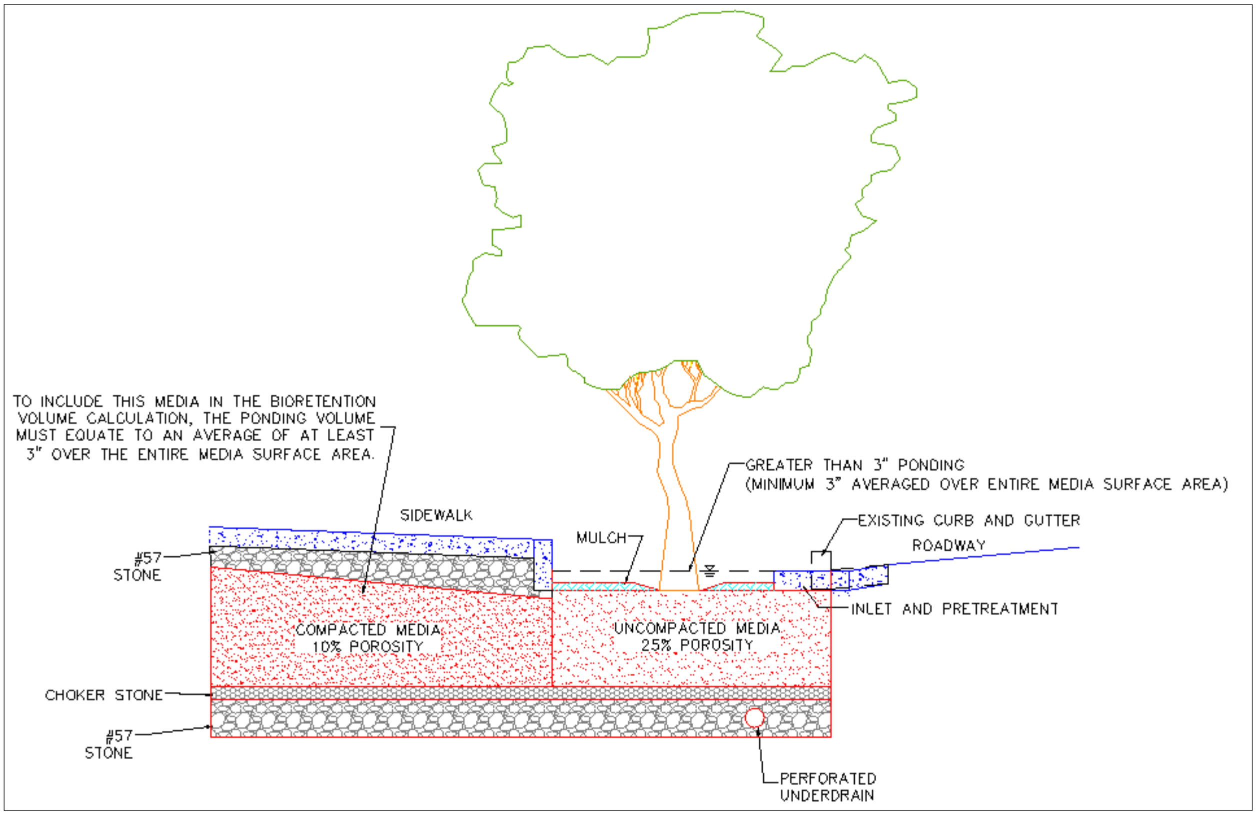


Figure 4.9. Example design of a tree box with compacted media extending below sidewalk.

Specific Design Issues for Stormwater Planters (B-4)

Stormwater planters are a useful option to disconnect and treat rooftop runoff, particularly in ultra-urban areas. Stormwater planters combine an aesthetic landscaping feature with a functional form of stormwater treatment. Stormwater planters generally receive runoff from adjacent rooftop downspouts and are landscaped with plants that tolerate periods of both drought and inundation. The two basic design variations for stormwater planters are the infiltration planter and the filter planter. A filter planter is illustrated in Figure 4.10.

An infiltration planter filters rooftop runoff through soil in the planter followed by infiltration into soils below the planter. Infiltration planters should be placed at least 10 feet away from a building to prevent possible flooding or basement seepage damage.

A filter planter does not allow for infiltration and is constructed with a watertight concrete shell or an impermeable liner on the bottom to prevent seepage. Since a filter planter is self-contained and does not infiltrate into the ground, it can be installed right next to a building. Runoff is captured and temporarily ponded above the planter bed. Overflow pipes are installed to discharge runoff when maximum ponding depths are exceeded, to avoid water spilling over the side of the planter. In addition, an underdrain is used to carry runoff to the storm sewer system.

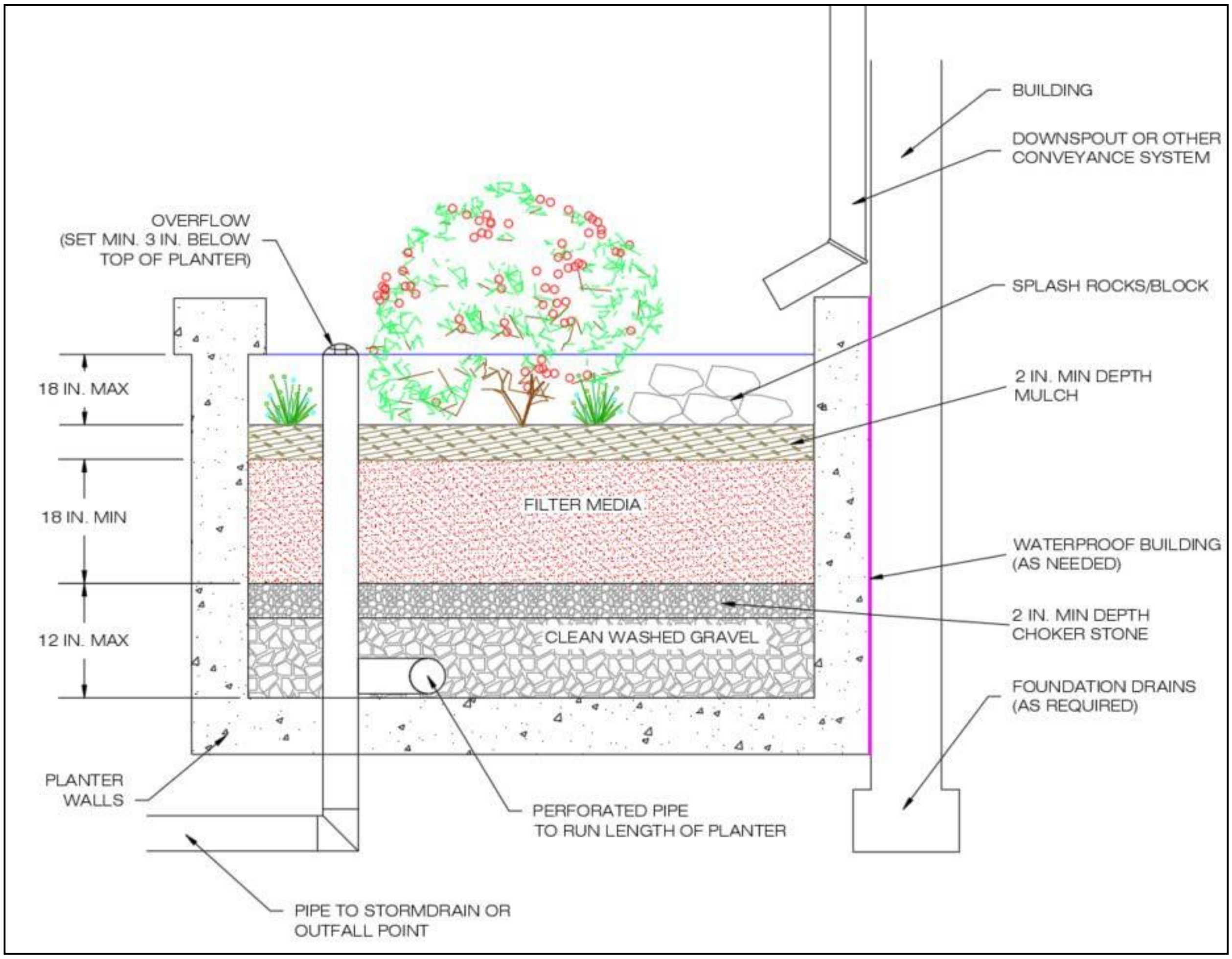


Figure 4.10. Example design of a stormwater planter (B-4).

Plant materials must be capable of withstanding moist and seasonally dry conditions. The planter can be constructed of stone, concrete, brick, wood, or other durable material. If treated wood is used, care should be taken so that trace metals and creosote do not leach out of the planter.

Specific Design Issues for Residential Rain Gardens (B-5)

For some residential applications, front, side, and/or rear yard bioretention may be an attractive option. This form of bioretention captures roof, lawn, and driveway runoff from low- to medium- density residential lots in a depressed area (i.e., 6 to 12 inches) between the home and the primary stormwater conveyance system (i.e., roadside ditch or pipe system).

BMP Sizing

Bioretention is typically sized to capture the SWRv or larger design storm volumes in the surface ponding area, filter media, and gravel reservoir layers of the BMP.

Total storage volume of the BMP is calculated using Equation 4.1.

Equation 4.1. Bioretention storage volume.

$$S_v = SA_{bottom} \times \left((d_{media} \times \eta_{media}) + (d_{gravel} \times \eta_{gravel})\right) + (SA_{average} \times d_{ponding})$$

Where:

Sv =	Total storage volume of bioretention (cubic feet)
SA_{bottom} =	Bottom surface area of bioretention (square feet)
d_{media} =	Depth of filter media, including mulch later (ft)
η_{media} =	Effective porosity of the filter media (typically 0.25)
d_{gravel} =	Depth of the underdrain and underground storage gravel layer, including choker stone (ft)
η_{gravel} =	Effective porosity of the gravel layer (typically 0.4)
$SA_{average}$ =	Average surface area of the bioretention (square feet), where SA_{top} is the surface area of the top of the bioretention $$SA_{average} = \frac{SA_{bottom} + SA_{top}}{2}$$
$d_{ponding}$ =	Maximum ponding depth of bioretention (ft)

Equation 4.1 can be modified if the storage depths of the filter media, gravel layer, or ponded water vary in the actual design or with the addition of any surface or subsurface storage components (e.g., additional area of surface ponding, subsurface storage chambers, etc.). The maximum depth of ponding in the bioretention must not exceed 18 inches. If storage practices will be provided off-line or in series with the bioretention area, the storage practices should be sized using the guidance in Section 4.11, and section 4.9 Storage Practices.

Note: In order to increase the storage volume of a bioretention area, the ponding surface area may be increased beyond the filter media surface area. However, the top surface area of the practice (i.e., at the top of the ponding elevation) may not be more than twice the size of the surface area of the filter media (SA_{bottom}).

For bioretention designs without an underdrain, the storage volume must infiltrate within 72 hours, as in Equation 4.2.

Equation 4.2. Bioretention infiltration rate check equation.

$$Sv_{infiltrate} = \frac{SA_{bottom}(K_{sat} \times t_d)}{12}$$

$Sv_{infiltrate}$ =	Storage volume that will infiltration within 72 hours (cubic feet)
SA_{bottom} =	Bottom surface area of bioretention (square feet)
K_{sat} =	Field-verified saturated hydraulic conductivity for the native soils (ft/day)
t_d =	Drawdown time (3 days)

If $Sv_{infiltrate}$ is greater than or equal to Sv, then the entire Sv will infiltrate within 72 hours. If it is not, the storage volume of the bioretention area should be reduced accordingly.

Bioretention can be designed to address, in whole or in part, the detention storage needed to comply with channel protection and/or flood control requirements. The Sv can be counted as part of the 2- to 25-year runoff volumes to satisfy stormwater quantity control requirements.

4.3.5 Bioretention Landscaping Criteria

Landscaping is critical to the performance and function of bioretention areas. Therefore, a landscaping plan shall be provided for bioretention areas.

Minimum plan elements include the proposed bioretention template to be used, delineation of planting areas, and the planting plan including the following:

- Common and botanical names of the plants used
- Size of planted materials
- Mature size of the plants
- Light requirements
- Maintenance requirements
- Source of planting stock
- Any other specifications
- Planting sequence

It is recommended that the planting plan be prepared by a qualified landscape architect professional (e.g., licensed professional landscape architect, certified horticulturalist) to tailor the planting plan to the site-specific conditions.

Native plant species are preferred over non-native species, but some ornamental species may be used for landscaping effect if they are not aggressive or invasive. Some popular native species that work well in bioretention areas and are commercially available can be found in Table 4.7 and Table 4.8.

The degree of landscape maintenance that can be provided will determine some of the planting choices for urban bioretention areas. Plant selection differs if the area will be frequently mowed, pruned, and weeded, in contrast to a site that will receive minimum annual maintenance. In areas where less maintenance will be provided and where trash accumulation in shrubbery or herbaceous plants is a concern, consider a “turf and trees” landscaping model where the turf is mowed along with other turf areas on the site. Spaces for herbaceous flowering plants can be included.

Table 4.7. Bioretention-appropriate plants: perennial and grass

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Aletris farinosa	White Colicroot	FAC	Moist soil	None	
Andropogon gerardii	Big Bluestem	FAC	No	Moderate	
Aquilegia canadensis	Wild Columbine	FACU	No	None	
Asclepias incarnata	Swamp Milkweed	OBL	Saturated	None	
Asclepias lanceolata	Red Milkweed	OBL	Wet soils	Moderate / brackish	
Aster novae-angliae	New England Aster	FACW	Moist soils, yes	Yes	
Athyrium filix-femina	Lady Fern	FAC	Moist to wet soils	None	
Canna glauca	Water Canna	OBL	Moist to wet soils	None	
Canna flaccida	Golden Canna	OBL	Moist to wet soils	None	
Carex stricta	Tussock Sedge	OBL	Saturated, 0-6”	None	
Chasmanthium latifolium	River Oats	FAC	Moist soils	None	
Chelone glabra	White Turtlehead	OBL	Moist to wet soils		
Conoclinium coelestinum	Blue Mistflower	FAC	Moist to Wet soils		
Crinum americanum	Southern Swamp Lily	OBL	Saturated		
Dulichium arundinaceum	Threeway Sedge	OBL	Saturated, shallow	None	
Echinodorus cordifolius	Creeping Burhead	OBL	Saturated, shallow		
Equisetum hyemale	Scouring Rush	FACW	Saturated, shallow		
Eupatorium fistulosum	Joe Pye Weed	FACW	Moist to Wet Soils		
Geranium maculatum	Spotted Geranium	FACU	Moist Soils		

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Helianthus angustifolius	Swamp Sunflower, Narrowleaf Sunflower	FACW	Wet Soils		
Hibiscus coccineus	Scarlet Swamp Hibiscus	OBL	Saturated, shallow		
Hibiscus moscheutos	Rose Mallow, Hibiscus	OBL	Saturated, shallow	Low	
Hymenocallis caroliniana	Spider Lily	OBL	Saturated, shallow	None	
Iris versicolor	Virginia Iris	OBL	Shallow	None	
Juncus effuses	Common Rush	OBL	Shallow <6”	Low	
Liatris spicata	Gayfeather, Blazing Star	FAC	Moist Soils	Low	
Lobelia cardinalis	Cardinal Flower	FACW	Moist to Wet Soils	None	
Lobelia siphilitica	Blue Lobelia	OBL	Moist to wet soils		
Lysimachia ciliata	Fringed Loosestrife	FACW	Moist to wet soils, seasonal flooding		
Mimulus ringens	Allegheny Monkeyflower	OBL	Saturated, shallow		
Onoclea sensibilis	Sensitive Fern	FACW	Moist to wet soils		
Osmunda cinnamomea	Cinnamon Fern	FACW	Moist to wet soils	Low	
Osmunda spectabilis	Royal Fern	OBL	Moist to wet soils	None	
Orontium aquaticum	Golden Club	OBL	Up to 10”		
Panicum virgatum	Switch Grass	FAC	Moist soil	Moderate	
Peltandra virginica	Green Arrow Arum	OBL	Shallow < 1’	Low (< 2 ppt)	
Pontederia cordata	Pickerelweed	OBL	Shallow < 1’	Low (< 3 ppt)	
Physostegia virginiana	Obedient Plant	FACW	Moist soil		
Polygonatum biflorum	Great Solomon’s Seal	FACU	Moist soil		

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Rhynchospora colorata	Starrush Whitetop	FACW	Saturated		
Rudbeckia laciniata	Cutleaf Coneflower	FACW	Moist soil	None	
Sagittaria latifolia	Common Arrowhead, Duck Potato	OBL	Up to 2.0’	None	
Saururus cernuus	Lizard’s Tail	OBL	Shallow < 4”	None	
Schizachyrium scoparium	Little Bluestem	FACU	Moist soil	None	
Schoenoplectus tabernaemontani	Softstem Bulrush	OBL	Wet soil to standing water	Fresh or Brackish	
Solidago sempervirens	Seaside Goldenrod	FACW	Yes	High	
Sorghastrum nutans	Indiangrass	FACU	Moist soil	Moderate	
Spartina alterniflora	Saltmarsh Cordgrass	OBL	Yes	High	
Spartina bakeri	Sand cordgrass	FACW	Moist to wet soils	Fresh - Saline	
Spartina patens	Saltmeadow Cordgrass	FACW	Wet soils	High	
Thalia dealbata	Powdery Alligator-flag	OBL	up to 1.5’	Yes	
Tradescantia virginiana	Virginia Spiderwort	FAC	Moist soils	None	
Vernonia noveboracensis	Ironweed	FACW	Moist soils	None	

1. Wetland Indicator Notes:

FAC = Facultative, equally likely to occur in wetlands or non-wetlands (estimated probability 34%–66%).

FACU = Facultative Upland, usually occurs in non-wetlands (estimated probability 67%–99%), but occasionally found on wetlands (estimated probability 1%–33%).

FACW = FACW Facultative Wetland, usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in non-wetlands.

OBL = Obligate Wetland, occurs almost always (estimated probability 99%) under natural conditions in wetlands

Table 4.8. Bioretention-appropriate plants: shrubs and bushes

Scientific Name	**Common Name**	**Wetland Indicator** [1]	**Inundation Tolerance**	**Salt Tolerance**	**Notes**
Baccharis halimifolia	Groundsel Tree, Salt Myrtle	FAC	Wet soils	High	
Callicarpa americana	Beautyberry	FACU	Moist soils	None	
Cephalanthus occidentalis	Button Bush	OBL	Up to 3 ft	Low	
Clethra alnifolia	Summersweet Sweet Pepperbush	FACW	Moist to wet soils	None	
Cyrilla racemiflora	Swamp Titi	FACW	Moist to wet soils	Low	
Hamamelis virginiana	Witch Hazel	FACU	Moist to wet soils	None	
Hypericum prolificum	Shrubby St. John's Wort	FAC	Moist soils, flood tolerant	None	
Ilex glabra	Inkberry	FACW	Wet soils, flood tolerant	Moderate	
Ilex verticillata	Winterberry Holly	FACW	Moist to wet soils	None	
Ilex vomitoria	Yaupon Holly	FAC	Moist soils	Moderate	
Itea virginica	Virginia Sweetspire	FACW	Moist to wet soils	None	
Kosteletzkya virginica	Seashore Mallow	OBL	Moist to wet soils	Moderate	
Lindera benzoin	Spicebush	FACW	Seasonal inundation	None	
Myrica cerifera	Wax Myrtle	FAC	Moist to wet soils	Moderate	
Photinia pyrifolia	Red Chokeberry	FACW	Moist soils	Low	
Rhododendron canescens	Dwarf Azalea	FACW	Moist soils	None	
Rhododendron viscosum	Swamp Azalea	OBL	Wet soil	None	
Rosa carolina	Carolina Rose	FACU	Moist to wet soils	Moderate	
Sabal minor	Dwarf Palmetto	FACW	Moist to wet soils	None	
Sambucus canadensis	Elderberry	FACW	Moist to wet soils	None	

Scientific Name	Common Name	Wetland Indicator 1	Inundation Tolerance	Salt Tolerance	Notes
Serenoa repens	Saw Palmetto	FACU	Occasionally wet	None	
Vaccinium corymbosum	Highbush Blueberry	FACW	Wet soil	High	
Viburnum dentatum	Arrowwood	FAC	Moist to wet	None	

1. Wetland Indicator Notes:
FAC = Facultative, equally likely to occur in wetlands or non-wetlands (estimated probability 34%–66%).
FACU = Facultative Upland, usually occurs in non-wetlands (estimated probability 67%–99%), but occasionally found on wetlands (estimated probability 1%–33%).
FACW = FACW Facultative Wetland, usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in non-wetlands.
OBL = Obligate Wetland, occurs almost always (estimated probability 99%) under natural conditions in wetlands.

Planting recommendations for bioretention facilities are as follows:

- The primary objective of the planting plan is to cover as much of the surface areas of the filter bed as quickly as possible. Herbaceous or ground cover layers are as or more important than more widely spaced trees and shrubs.
- Native plant species should be specified over non-native species.
- Plants should be selected based on a specified zone of hydric tolerance and must be capable of surviving both wet and dry conditions ("Wet footed" species should be planted near the center, whereas upland species do better planted near the edge).
- Woody vegetation should not be located at points of inflow; trees should not be planted directly above underdrains but should be located closer to the perimeter.
- Shrubs and herbaceous vegetation should generally be planted in clusters and at higher densities (i.e., 5 feet on-center and 1 to 1.5 feet on-center, respectively).
- If trees are part of the planting plan, a tree density of approximately one tree per 250 square feet (i.e., 15 feet on-center) is recommended.
- Designers should also remember that planting holes for trees must be at least 3 feet deep to provide enough soil volume for the root structure of mature trees. This applies even if the remaining filter media layer is shallower than 3 feet.
- Tree species should be those that are known to survive well in the compacted soils and the polluted air and water of an urban landscape.
- If trees are used, plant shade-tolerant ground covers within the drip line.

4.3.6 Bioretention Construction Sequence

Soil Erosion and Sediment Controls

The following soil erosion and sediment control guidelines must be followed during construction:

- All bioretention areas must be fully protected by silt fence or construction fencing.
- Bioretention areas intended to infiltrate runoff must remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment and loss of design infiltration rate.
  - Where it is infeasible keep the proposed bioretention areas outside of the limits of disturbance, there are several possible remedies for the impacted area. If excavation in the proposed bioretention area can be restricted, then the remediation can be achieved with deep tilling practices. This is only possible if in situ soils are not disturbed any deeper than 2 feet above the final design elevation of the bottom of the bioretention. In this case, when heavy equipment activity has ceased, the area is excavated to grade, and the impacted area must be tilled to a depth of 12 inches below the bottom of the bioretention.
  - Alternatively, if it is infeasible to keep the proposed bioretention areas outside of the limits of disturbance, and excavation of the area cannot be restricted, then infiltration tests will be required prior to installation of the bioretention to ensure that the design infiltration rate is still present. If tests reveal the loss of design infiltration rates, then deep tilling practices may be used in an effort to restore those rates. In this case further testing must be done to establish design rates exist before the bioretention area can be installed.
  - Finally, if it is infeasible to keep the proposed bioretention areas outside of the limits of disturbance, excavation of the area cannot be restricted, and infiltration tests reveal design rates cannot be restored, then a resubmission of the SWMP will be required.
- Bioretention areas must be clearly marked on all construction documents and grading plans.
- Large bioretention applications may be used as small sediment traps or basins during construction. However, these must be accompanied by notes and graphic details on the soil erosion and sediment control plan specifying that:

  (1) the maximum excavation depth of the trap or basin at the construction stage must be at least 1 foot higher than the post-construction (final) invert (bottom of the facility), and
  (2) the facility must contain an underdrain.

The plan must also show the proper procedures for converting the temporary sediment control practice to a permanent bioretention BMP, including dewatering, cleanout, and stabilization.

Bioretention Installation

The following is a typical construction sequence to properly install a bioretention basin. These steps may be modified to reflect different bioretention applications or expected site conditions:

1. Stabilize Contributing Drainage Area

Construction of the bioretention area may only begin after the entire CDA has been stabilized with vegetation. It may be necessary to block certain curb or other inlets while the bioretention area is being constructed. The proposed site should be checked for existing utilities prior to any excavation.

2. Preconstruction Meeting

The designer, the installer, and Beaufort County Public Works Department inspector may have a preconstruction meeting, checking the boundaries of the CDA and the actual inlet elevations to ensure they conform to original design. Since other contractors may be responsible for constructing portions of the site, it is quite common to find subtle differences in site grading, drainage and paving elevations that can produce hydraulically important differences for the proposed bioretention area. The designer should clearly communicate, in writing, any project changes determined during the preconstruction meeting to the installer and the inspector. Material certifications for aggregate, filter media, and any geotextiles should be submitted for approval to the inspector at the preconstruction meeting.

3. Install Soil Erosion and Sediment Control Measures to Protect the Bioretention

Temporary soil erosion and sediment controls (e.g., diversion dikes, reinforced silt fences) are needed during construction of the bioretention area to divert stormwater away from the bioretention area until it is completed. Special protection measures, such as erosion control fabrics, may be needed to protect vulnerable side slopes from erosion during the construction process.

4. Install Pretreatment Cells

Any pretreatment cells should be excavated first and then sealed to trap sediment.

5. Avoid Impact of Heavy Installation Equipment

Excavators or backhoes should work from the sides to excavate the bioretention area to its appropriate design depth and dimensions. Excavating equipment should have scoops with adequate reach so they do not have to sit inside the footprint of the bioretention area. Contractors should use a cell construction approach in larger bioretention basins, whereby the basin is split into 500- to 1,000-square foot temporary cells with a 10- to 15-foot earth bridge in between, so that cells can be excavated from the side.

6. Promote Infiltration Rate

It may be necessary to rip the bottom soils to a depth of 6 to 12 inches to promote greater infiltration.

7. Order of Materials

If using a geotextile fabric, place the fabric on the sides of the bioretention area with a 6-inch overlap on the sides. If a stone storage layer will be used, place the appropriate depth of No. 57 stone (clean, double washed) on the bottom, install the perforated underdrain pipe, pack No. 57 stone at least 2 inches above the underdrain pipe, and add the choking layer or appropriate geotextile layer as a filter between the underdrain and the filter media layer. If no stone storage layer is used, start with at least 2 inches of No. 57 stone on the bottom and proceed with the layering as described above.

8. Layered Installation of Media

Apply the media in 12-inch lifts until the desired top elevation of the bioretention area is achieved. Wait a few days to check for settlement and add additional media, as needed, to achieve the design elevation.

Note: The batch receipt confirming the source of the filter media should be submitted to the Beaufort County Public Works Department inspector.

9. Prepare Filter Media for Plants
Prepare planting holes for any trees and shrubs, install the vegetation, and water accordingly. Install any temporary irrigation.

10. Planting
Install the plant materials as shown in the landscaping plan, and water them as needed.

11. Secure Surface Area
Place the surface cover (i.e., mulch, river stone, or turf) in both cells, depending on the design. If coir or jute matting will be used in lieu of mulch, the matting will need to be installed prior to planting (Step 10), and holes or slits will have to be cut in the matting to install the plants.

12. Inflows
If curb cuts or inlets are blocked during bioretention installation, unblock these after the CDA and side slopes have good vegetative cover. It is recommended that unblocking curb cuts and inlets take place after two to three storm events if the CDA includes newly installed asphalt, since new asphalt tends to produce a lot of fines and grit during the first several storms.

13. Final Inspection
Conduct the final construction inspection using a qualified professional, providing Beaufort County Public Works Department with an as-built, then log the GPS coordinates for each bioretention facility, and submit them for entry into the maintenance tracking database.

14. Construction Supervision
Supervision during construction is recommended to ensure that the bioretention area is built in accordance with the approved design and this specification. Qualified individuals should use detailed inspection checklists that include sign-offs at critical stages of construction, to ensure that the contractor's interpretation of the plan is consistent with the designer's intentions.

Construction phase inspection checklist can be found in Appendix E Construction Inspection Checklists.

4.3.7 Bioretention Maintenance Criteria

When bioretention practices are installed, it is the owner's responsibility to ensure they, or those managing the practice:

(1) be educated about their routine maintenance needs,
(2) understand the long-term maintenance plan, and
(3) be subject to a maintenance covenant or agreement, as described below.

Maintenance of bioretention areas should be integrated into routine landscape maintenance tasks. If landscaping contractors will be expected to perform maintenance, their contracts should contain specifics on unique bioretention landscaping needs, such as maintaining elevation differences needed for ponding, proper mulching, sediment and trash removal, and limited use of fertilizers and pesticides.

Maintenance tasks and frequency will vary depending on the size and location of the bioretention, the landscaping template chosen, and the type of surface cover in the practice. A generalized summary of common maintenance tasks and their frequency is provided in Table 4.9.

Table 4.9. Typical maintenance tasks for bioretention practices.

Frequency	Maintenance Tasks
Upon establishment	▪ For the first 6 months following construction, the practice and CDA should be inspected at least twice after storm events that exceed 0.5 inch of rainfall. Conduct any needed repairs or stabilization. ▪ Inspectors should look for bare or eroding areas in the CDA or around the bioretention area and make sure they are immediately stabilized with grass cover. ▪ One-time, spot fertilization may be needed for initial plantings. ▪ Watering is needed once a week during the first 2 months, and then as needed during first growing season (April through October), depending on rainfall. ▪ Remove and replace dead plants. Up to 10% of the plant stock may die off in the first year, so construction contracts should include a care and replacement warranty to ensure that vegetation is properly established and survives during the first growing season following construction.
At least 4 times per year	▪ Mow grass filter strips and bioretention with turf cover ▪ Check curb cuts and inlets for accumulated grit, leaves, and debris that may block inflow
Twice during growing season	▪ Spot weed, remove trash, and rake the mulch
Annually	▪ Conduct a maintenance inspection ▪ Supplement mulch in devoid areas to maintain a 3-inch layer ▪ Prune trees and shrubs ▪ Remove sediment in pretreatment cells and inflow points
Once every 2–3 years	▪ Remove sediment in pretreatment cells and inflow points ▪ Remove and replace the mulch layer
As needed	▪ Add reinforcement planting to maintain desired vegetation density ▪ Remove invasive plants using recommended control methods ▪ Remove any dead or diseased plants ▪ Stabilize the CDA to prevent erosion

Standing water is the most common problem outside of routine maintenance. If water remains on the surface for more than 72 hours after a storm, adjustments to the grading may be needed or underdrain repairs may be needed. The surface of the filter bed should also be checked for accumulated sediment or a fine crust that builds up after the first several storm events. There are several methods that can be used to rehabilitate the filter. These are listed below, starting with the simplest approach and ranging to more involved procedures (i.e., if the simpler actions do not solve the problem):

- Open the underdrain observation well or cleanout and pour in water to verify that the underdrains are functioning and not clogged or otherwise in need of repair. The purpose of this check is to see if there is standing water all the way down through the soil. If there is standing water on top, but not in the underdrain, then there is a clogged soil layer. If the underdrain and stand pipe indicates standing water, then the underdrain must be clogged and will need to be cleaned out.
- Remove accumulated sediment and till 2 to 3 inches of sand into the upper 6 to 12 inches of soil.

- Install sand wicks from 3 inches below the surface to the underdrain layer. This reduces the average concentration of fines in the media bed and promotes quicker drawdown times. Sand wicks can be installed by excavating or auguring (i.e., using a tree auger or similar tool) down to the top of the underdrain layer to create vertical columns that are then filled with a clean open-graded coarse sand material (e.g., ASTM C-33 concrete sand or similar approved sand mix for bioretention media). A sufficient number of wick drains of sufficient dimension should be installed to meet the design dewatering time for the facility.
- Remove and replace some or all of the filter media.

Maintenance Inspections

It is recommended that a qualified professional: state law states anyone that can stamp a set of plans (surveyors, engineers, landscape architects) conduct a spring maintenance inspection and cleanup at each bioretention area. Maintenance inspections should include information about the inlets, the actual bioretention facility (sediment buildup, outlet conditions, etc.), and the state of vegetation (water stressed, dead, etc.) and are intended to highlight any issues that need or may need attention to maintain stormwater management functionality. Reporting to the Beaufort County Public Works Department may be required to be submitted on an annual basis.

Maintenance inspection checklists for bioretention areas and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.3.8 Bioretention Stormwater Compliance Calculations

Bioretention performance varies depending on the design configuration of the system.

No Underdrain

Bioretention designs with no underdrain are credited with100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (Table 4.10).

Table 4.10. Retention and pollutant removal for bioretention practices without underdrains.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

Internal Water Storage (IWS)

Bioretention designs with IWS are credited with75% retention for the storage volume (Sv) provided by the practice as well as 85% TSS, 85% TN, and 80% bacteria removal (Table 4.11).

Table 4.11. Retention and pollutant removal for bioretention practices with IWS design.

Retention	= 75%
TSS Removal	= 85%
TN Removal	= 85%
Bacteria Removal	= 80%

Standard

Standard bioretention designs are credited with 60% retention for the storage volume (Sv) provided as well as 85% TSS, 75% TN, and 80% bacteria removal. (Table 4.12).

Table 4.12. Retention and pollutant removal for standard bioretention practices.

Retention	= 60%
TSS Removal	= 85%
TN Removal	= 75%
Bacteria Removal	= 80%

The practice must be sized using the guidance detailed in Section 4.1.4 Bioretention Design Criteria. Note: Additional retention can be achieved if trees are utilized as part of a bioretention area (see Section 4.14 Tree Planting and Preservation).

Bioretention also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) from the total runoff volume for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.4 Permeable Pavement Systems

Permeable Pavement Systems					
Definition: Paving systems that capture and temporarily store the SWRv by filtering runoff through voids in an alternative pavement surface into an underlying stone reservoir. Filtered runoff may be collected and returned to the conveyance system or allowed to partially (or fully) infiltrate into the soil.					
Site Applicability		**BMP Performance Summary**			
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High			
▪ Urban ▪ Suburban ▪ Rural	**Small**	**TSS[1]**	**Total N[1]**	**Bacteria[1]**	
		80-100%	45-100%	30-100%	
		Runoff Reduction			
Construction Costs	**Maintenance Burden**	**Volume**			
High	High	Moderate			
Maintenance Frequency:		***SWRv***			
Routine	**Non-Routine**	**Standard Design**	**Enhanced Design**		
2-4 times per year	Every 2-3 years	30%	100%		
Advantages/Benefits		**Disadvantages/Limitation**			
▪ Reduces runoff volume, attenuates peak runoff rate and outflow ▪ Reduces slick surfaces during rain ▪ Water quality enhancement from filtration of stormwater		▪ Sediment-laden runoff can clog pervious pavement, causing it to fail ▪ Incorrect installation practices can clog pores			
Components		**Design considerations**			
▪ Open graded pavement mix or pavers with open surfaces ▪ Bedding course ▪ Open-graded base material ▪ Underdrain (where required) ▪ Subgrade with minimal compaction		▪ Same basic considerations as any paved area ▪ Infiltration rate of native soil determines applicability and need for underdrain ▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice ▪ Not appropriate for heavy or high traffic areas ▪ Accessibility, aesthetics, maintainability			
Installation Considerations		**Maintenance Activities**			
▪ Proper construction sequencing and installation is crucial to ensure proper functioning ▪ Subgrade cannot be overly compacted		▪ Vacuum or jet wash to increase pavement life and avoid clogging ▪ Ensure that contributing area is clear of debris and sediment.			

[1]*Credited pollutant load removal*

Permeable pavement systems represent alternative paving surfaces that capture and temporarily store the design volume by filtering runoff through voids in the pavement surface into an underlying stone reservoir (see Figure 4.11**). Filtered runoff may be collected and returned to the conveyance system, or it may be allowed to infiltrate into the soil.**

Permeable pavement systems may also provide stormwater detention of larger storms (e.g., 2- to 25-year).

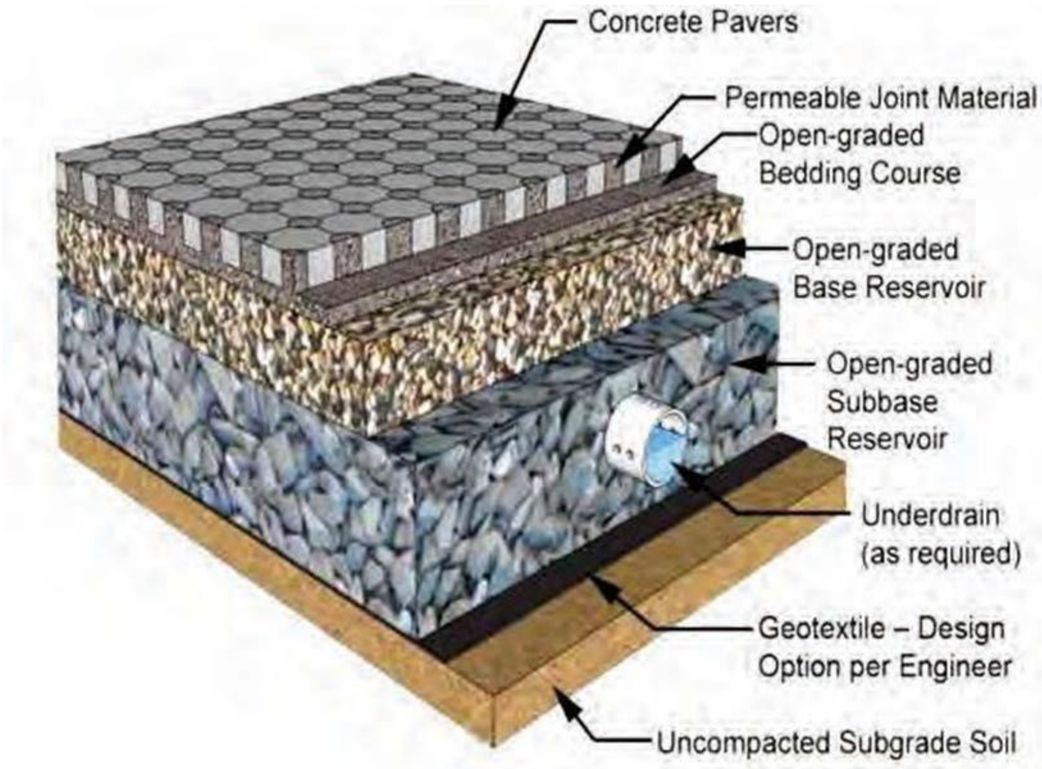


Figure 4.11. Cross-section of permeable pavement (source: ICPI).

Definition

This is a paving system that captures and temporarily stores the SWRv by filtering runoff through voids in an alternative pavement surface into an underlying stone reservoir. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil.

Design variants include the following:

- P-1 Porous asphalt (PA)
- P-2 Pervious concrete (PC)
- P-3 Permeable pavers (PP)

Other surface material variations of permeable pavement that can be part of a permeable pavement system, such as porous rubber, plastic grid pavers, and synthetic turf systems are also encompassed in this section.

Porous Asphalt

Porous asphalt (also known as pervious asphalt) consists of a special open-graded surface course bound together by asphalt cement. The open-graded surface course in a typical porous asphalt installation is 3 to 7 inches thick and has a void ratio of between 15% and 20%. Porous asphalt is thought to have a limited ability to maintain its structure and permeability during hot summer months and, consequently, is currently not recommended for use in coastal South Carolina. If it is used on a development site in the coastal region, it should be carefully monitored and maintained over time.

Pervious Concrete

Pervious concrete (also known as porous concrete) is similar to conventional concrete in structure and form but consists of a special open-graded surface course, typically 4 to 8 inches thick, that is bound together with Portland cement. This open-graded surface course has a void ratio of 15% to 25% (conventional concrete pavement has a void ratio of between 3% and 5%), which gives it a high permeability that is often many times more than that of the underlying native soils, and allows rainwater and stormwater runoff to rapidly pass through it and into the underlying stone reservoir. Although this particular type of permeable pavement surface may not require an underlying base layer to support traffic loads, site planning and design teams may wish to provide it to increase the stormwater storage capacity provided by a pervious concrete system.

Permeable Pavers

Permeable pavers (PP) are solid structural units (e.g., blocks, bricks) that are installed in a way that provides regularly spaced openings through which stormwater runoff can rapidly pass through the pavement surface and into the underlying stone reservoir. The regularly spaced openings, which generally make up between 8% and 20% of the total pavement surface, are typically filled with pea gravel (i.e., ASTM D 448 Size No. 8, 3/8 inch to 1/8 inch). Typical PP systems consist of the pavers, a 1.5- to 3-inch thick fine gravel bedding layer and an underlying stone reservoir.

Design Configurations

There are two types of permeable pavement design configurations:

- **Standard Design**
  Practice with a standard underdrain design and no infiltration sump or water quality filter (see Figure 4.12).
- **Enhanced Design**
  Practice with underdrains that contain a water quality filter layer and an infiltration sump beneath the underdrain sized to drain the design storm in 48 hours (see Figure 4.13) or practices with no underdrains that can infiltrate the entire design storm volume in 48 hours (see Figure 4.14).

The particular design configuration to be implemented on a site is typically dependent on specific site conditions and the characteristics of the underlying soils. These criteria are further discussed below.

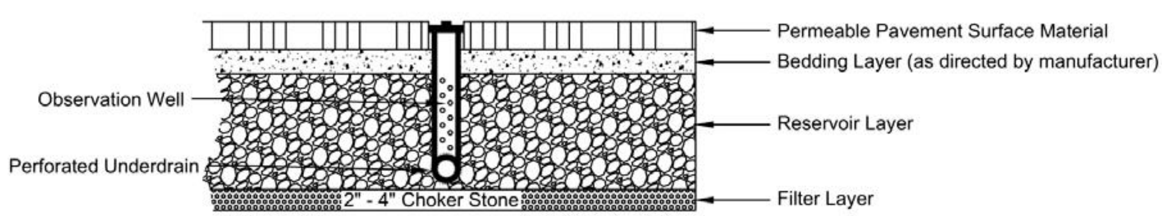


Figure 4.12. Cross-section of a standard permeable pavement design.

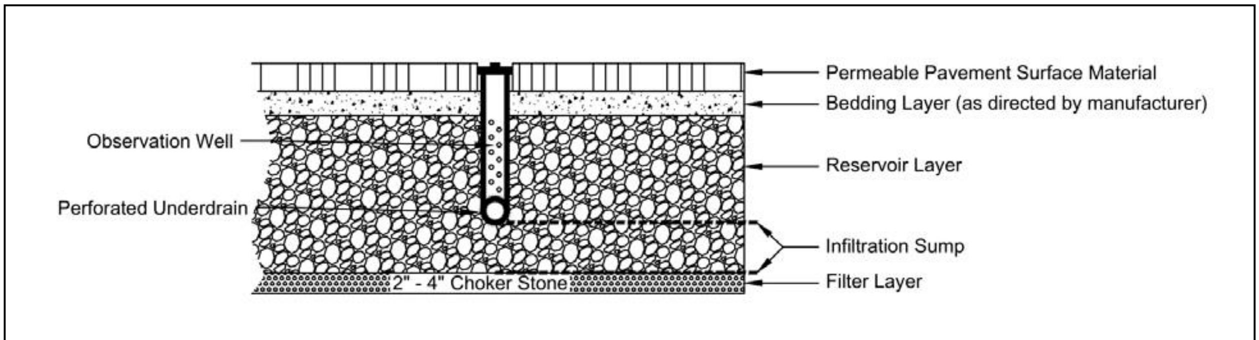


Figure 4.13. Cross-section of an enhanced permeable pavement design with an underdrain.

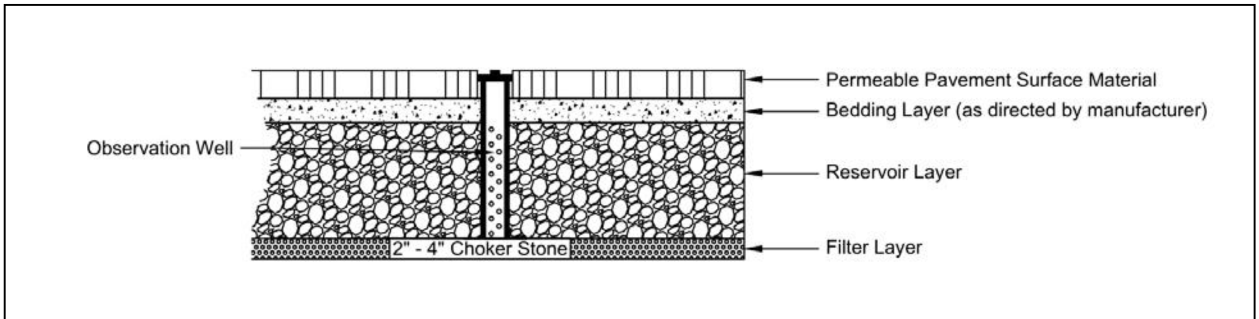


Figure 4.14. Cross-section of an enhanced permeable pavement design without an underdrain.

4.4.1 Permeable Pavement Feasibility Criteria

Since permeable pavement has a very high retention capability, it should always be considered as an alternative to conventional pavement. Permeable pavement is subject to the same feasibility constraints as most infiltration practices, as described below.

Required Space

A prime advantage of permeable pavement is that it does not normally require additional space at a new development or redevelopment site, which can be important for tight sites or areas where land prices are high.

Soils

Soil conditions do not typically constrain the use of permeable pavement, although they do determine whether an underdrain is needed. Underdrains may be required if the measured permeability of the underlying soils is less than 0.5 inches per hour (although utilization of an infiltration sump may still be feasible). When designing an infiltrating permeable pavement practice, designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B Geotechnical Information Requirements for Underground BMPs. Impermeable soils will require an underdrain.

In fill soil locations, geotechnical investigations are required to determine if the use of an impermeable liner and underdrain are necessary or if the use of an infiltration sump is permissible (see Section 4.4.4 Permeable Pavement Design Criteria).

Contributing Drainage Area

The portion of the CDA that does not include the permeable pavement may not exceed 5 times the surface area of the permeable pavement (2 times is recommended) and it should be as close to 100% impervious as possible to reduce sediment loading.

Pavement Surface Slope

Steep pavement surface slopes can reduce the stormwater storage capability of permeable pavement and may cause shifting of the pavement surface and base materials. The permeable pavement slope must be less than 5%. Designers may consider using a terraced design for permeable pavement in areas with steeper slopes (3%–5%). In all cases, designs must ensure that the slope of the pavement does not lead to flow occurring out of the stone reservoir layer onto lower portions of the pavement surface.

Minimum Hydraulic Head

The elevation difference needed for permeable pavement to function properly is generally nominal, although 1 to 4 feet of head from the pavement surface to the underdrain outlet is typically necessary. This value may vary based on several design factors, such as required storage depth and underdrain location.

Minimum Depth to Water Table

A high groundwater table may cause runoff to pond at the bottom of the permeable pavement system. Therefore, a minimum vertical distance of 0.5 feet (preferably 2 feet) must be provided between the bottom of the permeable pavement installation (i.e., the bottom invert of the reservoir layer) and the seasonal high water table.

Tidal Impacts

For systems with an underdrain, the underdrain should be located above the tidal mean high water elevation. For entirely infiltration-based systems, the bottom of the stone reservoir should be located above the mean high water elevation. Where this is not possible, portions of the practice below the tidal mean high water elevation cannot be included in the volume calculations.

Setbacks

To avoid the risk of seepage, stormwater cannot flow from the permeable pavement reservoir layer to the traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements. Where the 10-foot setback is not possible, an impermeable liner may be used along the sides and bottom of the permeable pavement practice (extending from the surface to the bottom of the practice and outward to meet the 10-foot setback).

Proximity to Utilities

Interference with underground utilities should be avoided if possible. When large site development is undertaken the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the public right-of-way (PROW). Consult with each utility company on recommended offsets, which will allow utility maintenance work with minimal disturbance to the permeable pavement. Permeable pavement in the public right-of-way (PROW) must conform with the State of South Carolina Department of Transportation design specifications. Where conflicts cannot be avoided, follow these guidelines:

- Consider altering the location or sizing of the permeable pavement to avoid or minimize the utility conflict. Consider an alternate BMP type to avoid conflict.
- Use design features to mitigate the impacts of conflicts that may arise by allowing the permeable pavement and the utility to coexist. The permeable pavement design may need to incorporate impervious areas, through geotextiles or compaction, to protect utility crossings.
- Work with the utility company to evaluate the relocation of the existing utility and install the optimum placement and sizing of the permeable pavement.
- If utility functionality, longevity, and vehicular access to manholes can be assured, accept the permeable pavement design and location with the existing utility. Design sufficient soil coverage over the utility or general clearances or other features, such as an impermeable liner, to assure all entities that the conflict is limited to maintenance.

When accepting utility conflict into the permeable pavement location and design, it is understood the permeable pavement will be temporarily impacted during utility work, but the utility owner will replace the permeable pavement or, alternatively, install functionally comparable permeable pavement according to the specifications in the current version of this guidebook. Restoration of permeable pavement that is located in the PROW will also conform with the State of South Carolina Department of Transportation design specifications.

Pollutant Hotspot Land Uses

Permeable pavement is not appropriate for certain pollutant-generating sites. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil-water separator or filtering device must be provided, or the areas should be diverted from the permeable pavement.

On sites with existing contaminated soils, infiltration is not allowed. Permeable pavement areas must include an impermeable liner, and the Enhanced Design configuration cannot be used.

High Loading Situations

Permeable pavement is not intended to treat sites with high sediment or trash/debris loads, since such loads will cause the practice to clog and fail. Sites with considerable pervious area (e.g., newly established turf and landscaping) can be considered high loading sites and the pervious areas should be diverted if possible, from the permeable pavement area. If unavoidable, pretreatment measures, such as a gravel or a sod filter strip should be employed (see Section 4.4.3 Permeable Pavement Pretreatment Criteria).

High Speed Roads

Permeable pavement should not be used for high speed roads, although it has been successfully applied for low speed residential streets, parking lanes, and roadway shoulders.

Economic Considerations

Permeable pavement tends to be expensive relative to other practices, but when the cost of land and traditional paving are included in the calculations, permeable pavement becomes much more competitive. Permeable pavement is very space-efficient, since it combines a useful pavement surface with stormwater management for runoff and, in standard design configurations, water quality treatment.

4.4.2 Permeable Pavement Conveyance Criteria

Permeable pavement designs must include methods to convey larger storms (e.g., 2- to 25-year) to the storm drain system. Conveyance methods include the following:

- Place an overdrain—a horizontal perforated pipe near the top of the reservoir layer—to pass excess flows after water has filled the base.
- Increase the thickness of the top of the reservoir layer by as much as 6 inches to increase storage (i.e., create freeboard). The design computations used to size the reservoir layer often assume that no freeboard is present.
- Create underground detention within the reservoir layer of the permeable pavement system. Reservoir storage may be augmented by corrugated metal pipes, plastic or concrete arch structures, etc.
- Route overflows to another detention or conveyance system.
- Set the storm drain inlets flush with the elevation of the permeable pavement surface to effectively convey excess stormwater runoff past the system. The design should also make allowances for relief of unacceptable ponding depths during larger rainfall events.

4.4.3 Permeable Pavement Pretreatment Criteria

Pretreatment for most permeable pavement applications is not necessary. Additional pretreatment is recommended if the pavement receives runoff from adjacent pervious areas. For example, a gravel or sod filter strip can be placed adjacent to pervious (landscaped) areas to trap coarse sediment particles before they reach the pavement surface in order to reduce clogging.

4.4.4 Permeable Pavement Design Criteria

Type of Surface Pavement

The type of pavement should be selected based on a review of the pavement specifications and properties and designed according to the product manufacturer’s recommendations.

Pavement Bottom Slope

For unlined designs, the bottom slope of a permeable pavement installation should be as flat as possible (i.e., 0% longitudinal and lateral slopes) to enable even distribution and infiltration of stormwater. On sloped sites, internal check dams or barriers, as shown in Figure 4.15 can be incorporated into the subsurface to encourage infiltration. Barriers may be constructed of concrete, earthen berms, impermeable membranes, or low permeability geotextile. In this type of design, the depth of the infiltration sump would be the depth behind the check dams. The depth and spacing of the barriers are dependent upon the underlying slope and the saturated hydraulic conductivity, as any water retained by the flow barriers must infiltrate within 48 hours. If an underdrain will be used in conjunction with the flow barriers, it can be installed over the top of the barriers, or parallel to the barriers with an underdrain in each cell.

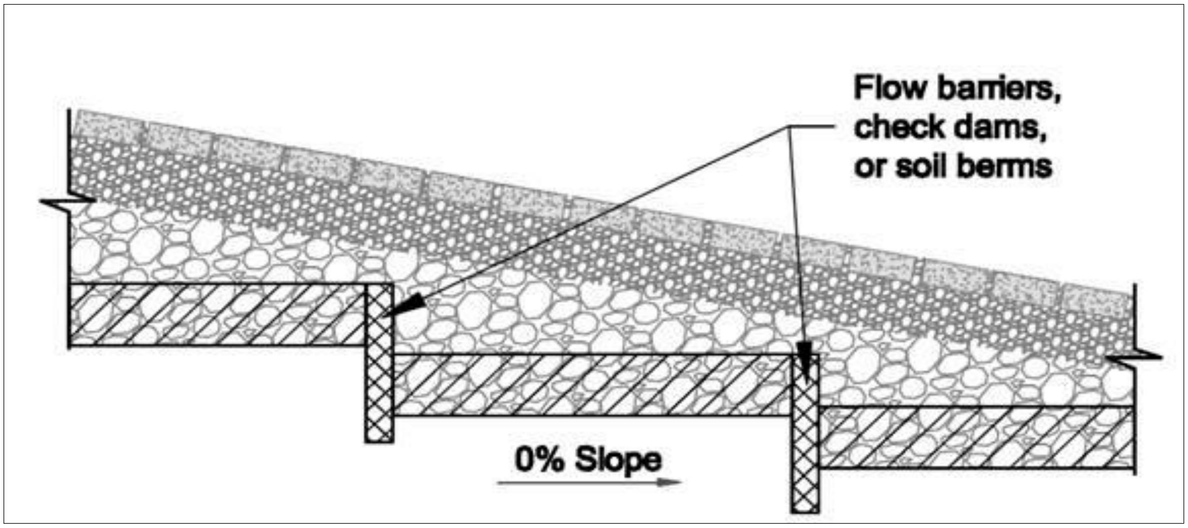


Figure 4.15. Use of flow barriers to encourage infiltration on sloped sites.

Internal Geometry and Drawdowns

- **Rapid Drawdown**
  Permeable pavement must be designed so that the target storage volume is detained in the reservoir for as long as possible, 36 to 48 hours, before completely discharging through an underdrain. A minimum orifice size of 1 inch is recommended regardless of the calculated drawdown time.

  Note: A 48-hour maximum drawdown time is utilized for permeable pavement rather than the 72-hour value used for other BMPs. This shorter drawdown time, in accordance with industry standards, is intended to ensure that the subgrade does not stay saturated for too long and cause problems with the pavement.

- **Infiltration Sump**
  To promote greater retention for permeable pavement located on marginal soils, an infiltration sump can be installed to create a storage layer below the underdrain invert. This design configuration is discussed further below.

Reservoir Layer

The reservoir layer consists of the stone underneath the pavement section and above the bottom filter layer or underlying soils, including the optional infiltration sump. The total thickness of the reservoir layer is determined by runoff storage needs, the saturated hydraulic conductivity of in-situ soils, structural requirements of the pavement sub-base, depth to water table, and frost depth conditions (see Section 4.4.1 Permeable Pavement Feasibility Criteria). A geotechnical engineer should be consulted regarding the suitability of the soil subgrade.

- The reservoir below the permeable pavement surface should be composed of clean, double-washed stone aggregate and sized for both the storm event to be treated and the structural requirements of the expected traffic loading. Additional chamber structures may also be used to create larger storage volumes.

- The storage layer may consist of clean, double-washed No. 57 stone, although No. 2 stone is preferred because it provides additional structural stability. Other appropriate materials may be used if accepted by the Beaufort County Public Works Department.
- The bottom of the reservoir layer should be completely flat so that runoff will be able to infiltrate evenly through the entire surface. The use of terracing and check dams is permissible.

Underdrains

Most permeable pavement designs will require an underdrain (see Section 4.4.1 Permeable Pavement Feasibility Criteria). Underdrains can also be used to keep detained stormwater from flooding permeable pavement during extreme rain events. Multiple underdrains are typically necessary for permeable pavement wider than 40 feet, and each underdrain is recommended to be located 20 feet or less from the next pipe or the edge of the permeable pavement. For long and narrow applications, a single underdrain running the length of the permeable pavement is sufficient. The underdrain should be perforated schedule 40 PVC pipe (corrugated HDPE may be used for smaller load-bearing applications), with three or four rows of 3/8-inch perforations at 6 inches on center. The underdrain must be encased in a layer of clean, double-washed No. 57 stone, with a minimum 2-inch cover over the top of the underdrain. The underdrain system must include a flow control to ensure that the reservoir layer drains slowly (within 36 to 48 hours).

- The underdrain outlet can be fitted with a flow-reduction orifice within a weir or other easily inspected and maintained configuration in the downstream manhole as a means of regulating the stormwater detention time. The minimum diameter of any orifice is 1 inch. The designer should verify that the volume will draw down completely within 36 to 48 hours.
- On infiltration designs, an underdrain(s) can be installed and capped at the downstream structure as an option for future use if maintenance observations indicate a reduction in the soil permeability.

Observation Wells

All permeable pavement practices must include observation wells. The observation well is used to observe the rate of drawdown within the reservoir layer following a storm event and to facilitate periodic inspection and maintenance. The observation well should consist of a well-anchored, perforated 4- to 6-inch diameter PVC pipe. There should be no perforation within 1 foot of the surface. If the permeable pavement has an underdrain, tie the observation well into any Ts or Ys in the underdrain system. The observation well should extend vertically to the bottom of the reservoir layer and extend upwards to be flush with the surface (or just under pavers) with a lockable cap.

Infiltration Sump (optional, required for enhanced designs with an underdrain)

For unlined permeable pavement systems, an optional upturned elbow or elevated underdrain configuration can be used to promote greater retention for permeable pavement located on marginal soils. The infiltration sump must be installed to create a storage layer below the underdrain or upturned elbow invert. The depth of this layer must be sized so that the design storm can infiltrate into the subsoils in a 48-hour period. The bottom of the infiltration sump must be at least 0.5 feet above the seasonally high water table. The inclusion of an infiltration sump is not permitted for designs with an impermeable liner. In fill soil locations, geotechnical investigations are required to determine if the use of an infiltration sump is permissible.

Filter Layer (optional)
To protect the bottom of the reservoir layer from intrusion by underlying soils, a filter layer can be used. The underlying native soils should be separated from the stone reservoir by a 2- to 4-inch layer of choker stone (e.g., No. 8).

Geotextile (optional)
Geotextile fabric is another option to protect the bottom of the reservoir layer from intrusion by underlying soils, although some practitioners recommend avoiding the use of fabric beneath permeable pavements since it may become a future plane of clogging within the system. Geotextile fabric is still recommended to protect the excavated sides of the reservoir layer, in order to prevent soil piping. An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude higher (10 times) than the soil subgrade permeability must be used.

Impermeable Liner
An impermeable liner is not typically required, although it may be utilized in fill applications where deemed necessary by a geotechnical investigation, on sites with contaminated soils, or on the sides of the practice to protect adjacent structures from seepage. Use a PVC geomembrane liner or equivalent of an appropriate thickness (follow manufacturer's instructions for installation). Field seams must be sealed according to the liner manufacturer's specifications. A minimum 6-inch overlap of material is required at all seams.

Material Specifications
Permeable pavement material specifications vary according to the specific pavement product selected. A general comparison of different permeable pavements is provided in Table 4.13, but designers should consult manufacturer's technical specifications for specific criteria and guidance. Table 4.14 provides general material specifications for the component structures installed beneath the permeable pavement. Note that the size of stone materials used in the reservoir and filter layers may differ depending on the type of surface material.

Table 4.13. Permeable pavement specifications for a variety of typical surface materials.

Material	Specification	Notes
Permeable Pavers (PP)	Void content, thickness, and compressive strength vary based on type and manufacturer Open void fill media: aggregate, topsoil and grass, coarse sand, etc.	Reservoir layer required to support the structural load.
Pervious Concrete (PC)	Void content: 15–20% Thickness: Typically 4–8 inches Compressive strength: 2.8–28 MPa Open void fill media: None	May not require a reservoir layer to support the structural load, but a layer may be included to increase the storage or infiltration. Requires certified supplier and installer.
Porous Asphalt (PA)	Void content: 15–20% Thickness: Typically 3–7 inches (depending on traffic load) Open void fill media: None	Reservoir layer required to support the structural load. Requires certified supplier and installer.

Table 4.14. Material specifications for typical layers beneath the surface of permeable pavements.

Material	Specification	Notes
Bedding Layer	PC: 3–4 inches of No. 57 stone if No. 2 stone is used for Reservoir Layer PA: 3–4 inches of No. 57 stone PP: Follow manufacturer specifications	ASTM D448 size No. 57 stone (i.e., 1/2 to 1 1/2 inches in size). Must be double-washed and clean and free of all fines.
Reservoir Layer	PC: No. 57 stone or No. 2 stone PA: No. 2 stone PP: Follow manufacturer specifications	ASTM D448 size No. 57 stone (i.e., 1/2 to 1 1/2 inches in size); No. 2 Stone (i.e., 3/4 to 3 inches in size). Depth is based on the pavement structural and hydraulic requirements. Must be double-washed and clean and free of all fines. Other appropriate materials may be used if accepted by Beaufort County Public Works Department.
Underdrain	Use 4- to 6-inch diameter perforated PVC pipe (or equivalent corrugated HDPE may be used for smaller load-bearing applications), with 3 or 4 rows of 3/8-inch perforations at 6 inches on center. Perforated pipe installed for the full length of the permeable pavement cell, and non-perforated pipe, as needed, is used to connect with the storm drain system. T's and Y's should be installed as needed, depending on the underdrain configuration. Extend cleanout pipes to the surface.	
Infiltration Sump (optional)	An aggregate storage layer below the underdrain invert. The material specifications are the same as Reservoir Layer.	
Filter Layer (optional)	The underlying native soils should be separated from the stone reservoir by a 2- to 4-inch layer of choker stone (e.g., No. 8).	
Geotextile (optional)	Use an appropriate geotextile fabric for both sides and/or bottom that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude higher than (10 times) the soil subgrade permeability. Low-permeability geotextile fabric may be used as a check dam material.	
Impermeable Liner (optional)	Where appropriate, use PVC geomembrane liner or equivalent.	
Observation Well	Use a perforated 4- to 6-inch vertical PVC pipe (AASHTO M-252) with a lockable cap, installed flush with the surface.	

Permeable Pavement Sizing

The thickness of the reservoir layer is determined by both a structural and hydraulic design analysis. The reservoir layer serves to retain stormwater and to support the design traffic loads for the pavement. Permeable pavement structural and hydraulic sizing criteria are discussed below.

Structural Design

If permeable pavement will be used in a parking lot or other setting that involves vehicles, the pavement surface must be able to support the maximum anticipated traffic load. The structural design process will vary according to the type of pavement selected, and the manufacturer's specific recommendations should be consulted. The thickness of the permeable pavement and reservoir layer must be sized to support structural loads and to temporarily store the design storm volume (i.e., the water quality, channel protection, and/or flood control volumes). On most new development and redevelopment sites, the structural support requirements will dictate the depth of the underlying stone reservoir.

The structural design of permeable pavements involves consideration of four main site elements:

- Total traffic
- In situ soil strength
- Environmental elements
- Bedding and reservoir layer design

The resulting structural requirements may include the thickness of the pavement, filter, and reservoir layer. Designers should note that if the underlying soils have a low California Bearing Ratio (less than 4%), they may need to be compacted to at least 95% of the Standard Proctor Density, which may limit their use for infiltration.

Designers should determine structural design requirements by consulting transportation design guidance sources, such as the following:

- ASCE/T&DI/ICPI 68-18 Permeable Interlocking Concrete Pavement (2018)
- AASHTO Guide for Design of Pavement Structures (1993)
- AASHTO Supplement to the Guide for Design of Pavement Structures (1998)

Hydraulic Design. Permeable pavement is typically sized to store the SWRv or larger design storm volumes in the reservoir layer. The storage volume in the pavements must account for the underlying saturated hydraulic conductivity and outflow through any underdrains. The design storm should be routed through the pavement to accurately determine the required reservoir depth. The depth of the reservoir layer or infiltration sump needed to store the design storm can be determined by using Equation 4.3.

Equation 4.3. Reservoir layer or infiltration sump depth.

$$d_p = \frac{\left(\frac{P \times Rv_I \times CDA}{A_p}\right) - (K_{sat} \times t_f)}{\eta_r}$$

Where:

d_p = Depth of the reservoir layer, or depth of the infiltration sump for enhanced designs with underdrains (ft)

P = Rainfall depth for the SWRv or other design storm (ft)

Rv_I = 0.95 (runoff coefficient for impervious cover)

CDA = Total contributing drainage area, including permeable pavement surface area (square feet)
A_p = Permeable pavement surface area (square feet)
K_{sat} = Field-verified saturated hydraulic conductivity for subgrade soils (ft/day). If an impermeable liner is used in the design, then this value is 0
t_f = Time to fill the reservoir layer (days; assume 2 hours or 0.083 day)
η_r = 0.4 (effective porosity for the reservoir layer)

This equation makes the following design assumptions:

- The CDA does not contain pervious areas.
- If the subgrade will be compacted to meet structural design requirements of the pavement section, the measured saturated hydraulic conductivity shall be based on measurement of the subgrade soil subjected to the compaction requirements.

The depth of the reservoir layer cannot be less than the depth required to meet the pavement structural requirement. The depth of the reservoir layer may need to be increased to meet structural or larger storage requirements.

For infiltration designs without underdrains or designs with infiltration sumps, the captured volume must drain from the practice within 48 hours. Equation 4.4 can be used to determine the drawdown time in the reservoir layer or infiltration sump.

Equation 4.4. Drawdown time.

$$t_d = \frac{d_p \times \eta_r}{K_{sat}}$$

Where:

t_d = Drawdown time (days)
d_p = Depth of the reservoir layer, or depth of the infiltration sump for enhanced designs with underdrains (ft)
η_r = 0.4 (effective porosity for the reservoir layer)
K_{sat} = Field-verified saturated hydraulic conductivity for subgrade soils (ft/day). If an impermeable liner is used in the design, then this value is 0

For designs with underdrains, the captured volume must drain in 36-48 hours. The drawdown time should be determined using the hydrologic routing or modeling procedures used for detention systems with the depth and head adjusted for the porosity of the aggregate.

The total storage volume provided by the practice, Sv, should be determined using Equation 4.5.

Equation 4.5. Permeable pavement storage volume.

$$Sv = A_p[(d_p \times \eta_r) + K_{sat} \times t_f]$$

Where:

Sv = Storage volume (cubic feet)
d_p = Depth of the reservoir layer, or depth of the infiltration sump for enhanced designs with underdrains (ft)
η_r = 0.4 (effective porosity for the reservoir layer)
A_p = Permeable pavement surface area (square feet)
K_{sat} = Field-verified saturated hydraulic conductivity for subgrade soils (ft/day). If an impermeable liner is used in the design, then this value is 0
t_f = Time to fill the reservoir layer (days; assume 2 hours or 0.083 day)

Detention Storage Design

Permeable pavement can also be designed to address, in whole or in part, the detention storage for larger storm events. The designer can model various approaches by factoring in storage within the stone aggregate layer (including chamber structures that increase the available storage volume), expected infiltration, and any outlet structures used as part of the design. Routing calculations can also be used to provide a more accurate solution of the peak discharge and required storage volume.

Once runoff passes through the surface of the permeable pavement system, designers should calculate outflow pathways to handle subsurface flows. Subsurface flows can be regulated using underdrains, the volume of storage in the reservoir layer, the bed slope of the reservoir layer, and/or a control structure at the outlet (see Section 4.4.2 Permeable Pavement Conveyance Criteria).

4.4.5 Permeable Pavement Landscaping Criteria

Permeable pavement does not have any landscaping needs. However, large-scale permeable pavement applications should be carefully planned to integrate the typical landscaping features of a parking lot, such as trees and islands, in a manner that maximizes runoff treatment and minimizes the risk that sediment, mulch, grass clippings, leaves, and other plant matter will inadvertently clog the paving surface. Bioretention areas (see Section 4.3 Bioretention) may be a good design option to meet these landscaping goals.

4.4.6 Permeable Pavement Construction Sequence

Experience has shown that proper installation is critical to the effective operation of a permeable pavement system.

Soil Erosion and Sediment Controls

The following soil erosion and sediment control guidelines must be followed during construction:

- All permeable pavement areas must be fully protected from sediment intrusion by silt fence or construction fencing, particularly if they are intended to infiltrate runoff.
- Permeable pavement areas intended to infiltrate runoff must remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment and loss of design infiltration rate (unless the area has been determined to have a low California Bearing Ratio and will require compaction during the permeable pavement construction phase). Where it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, there are several possible remedies for the impacted area.
  - If excavation in the proposed permeable pavement areas can be restricted, then remediation can be achieved with deep tilling practices. This is only possible if in situ soils

are not disturbed any deeper than 2 feet above the final design elevation of the bottom of the aggregate reservoir course. In this case, when heavy equipment activity has ceased, the area is excavated to grade, and the impacted area must be tilled to a depth of 12 inches below the bottom of the reservoir layer.

  - Alternatively, if it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, and excavation of the area cannot be restricted, then infiltration tests will be required prior to installation of the permeable pavement to ensure that the design infiltration rate is still present. If tests reveal the loss of design infiltration rates, then deep tilling practices may be used in an effort to restore those rates. In this case, further testing must be done before the permeable pavement can be installed to establish that design rates have been achieved.
  - Finally, if it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, excavation of the area cannot be restricted, and infiltration tests reveal design rates cannot be restored, then a resubmission of the SWMP will be required.

- Permeable pavement areas must be clearly marked on all construction documents and grading plans.
- During construction, care should be taken to avoid tracking sediments onto any permeable pavement surface to avoid post-construction clogging and long-term maintenance issues.
- Any area of the site intended ultimately to be a permeable pavement area with an infiltration component should not be used as the site of a temporary sediment trap or basin. If locating a temporary sediment trap or basin on an area intended for permeable pavement is unavoidable, the remedies are similar to those discussed for heavy equipment compaction.
- If it is possible, restrict the invert of the sediment trap or basin to at least 1 foot above the final design elevation of the bottom of the aggregate reservoir course of the proposed permeable pavement. Then remediation can be achieved with proper removal of trapped sediments and deep tilling practices.
- An alternate approach to deep tilling is to use an impermeable linear to protect the in situ soils from sedimentation while the sediment trap or basin is in use.
- In each case, all sediment deposits in the excavated area must be carefully removed prior to installing the sub-base, base, and surface materials. The plan must also show the proper procedures for converting the temporary sediment control practice to a permeable pavement BMP, including dewatering, cleanout, and stabilization.

Permeable Pavement Installation

The following is a typical construction sequence to properly install permeable pavement, which may need to be modified depending on the particular type of permeable pavement that is being installed.

1. Stabilize Contributing Drainage Area

Construction of the permeable pavement should only begin after the entire CDA has been stabilized. The proposed site should be checked for existing utilities prior to any excavation. Do not install the system in rain.

2. Install Soil Erosion and Sediment Control Measures for the Permeable Pavement

As noted above, temporary soil erosion and sediment controls are needed during installation to divert stormwater away from the permeable pavement area until it is completed. Special protection measures, such as erosion control fabrics, may be needed to protect vulnerable side slopes from erosion during the excavation process. The proposed permeable pavement area must be kept free from sediment during the entire construction process. Construction materials contaminated by sediment must be removed and replaced with clean material.

3. Minimize Impact of Heavy Installation Equipment
Where possible, excavators or backhoes should work from the sides to excavate the reservoir layer to its appropriate design depth and dimensions. For small pavement applications, excavating equipment should have arms with adequate extension so they do not have to work inside the footprint of the permeable pavement area (to avoid compaction). Contractors can utilize a cell construction approach, whereby the proposed permeable pavement area is split into 500- to 1,000-square foot temporary cells with a 10- to 15-foot-wide earth bridge in between, so cells can be excavated from the side. Excavated material should be placed away from the open excavation so as to not jeopardize the stability of the side walls.

4. Promote Infiltration Rate
The native soils along the bottom of the permeable pavement system should be scarified or tilled to a depth of 3 to 4 inches prior to the placement of the filter layer or geotextile fabric. In large-scale paving applications with weak soils, the soil subgrade may need to be compacted to 95% of the Standard Proctor Density to achieve the desired load-bearing capacity.

Note: This may reduce or eliminate the infiltration function of the installation, and it must be addressed during hydrologic design.

5. Order of Materials
Geotextile fabric should be installed on the sides of the reservoir layer (and the bottom if the design calls for it). Geotextile fabric strips should overlap down-slope by a minimum of 2 feet and be secured a minimum of 4 feet beyond the edge of the excavation. Where the filter layer extends beyond the edge of the pavement (to convey runoff to the reservoir layer), install an additional layer of geotextile fabric 1 foot below the surface to prevent sediment from entering into the reservoir layer. Excess geotextile fabric should not be trimmed until the site is fully stabilized.

6. Install Base Material Components
Provide a minimum of 2 inches of aggregate above and below the underdrains. The up-gradient end of underdrains in the reservoir layer should be capped. Where an underdrain pipe is connected to a structure, there shall be no perforations within 1 foot of the structure. Ensure there are no perforations in clean-outs and observation wells within 1 foot of the surface.

7. Stone Media
Spread 6-inch lifts of the appropriate clean, double-washed stone aggregate (usually No. 2 or No. 57 stone). Place at least 4 inches of additional aggregate above the underdrain, and then compact it using a vibratory roller in static mode until there is no visible movement of the aggregate. Do not crush the aggregate with the roller.

8. Reservoir Media
Install the desired depth of the bedding layer, depending on the type of pavement, as indicated in Table 4.14.

9. Paving Media
Paving materials shall be installed in accordance with manufacturer or industry specifications for the particular type of pavement.

10. Installation of Porous Asphalt

The following has been excerpted from various documents, most notably Jackson (2007):

- Install porous asphalt pavement similarly to regular asphalt pavement. The pavement should be laid in a single lift over the filter course. The laying temperature should be between 230°F and 260°F, with a minimum air temperature of 50°F, to ensure the surface does not stiffen before compaction.
- Complete compaction of the surface course when the surface is cool enough to resist a 10-ton roller. One or two passes of the roller are required for proper compaction. More rolling could cause a reduction in the porosity of the pavement.
- The mixing plant must provide certification of the aggregate mix, abrasion loss factor, and asphalt content in the mix. Test the asphalt mix for its resistance to stripping by water using ASTM D1664. If the estimated coating area is not above 95%, additional anti-stripping agents must be added to the mix.
- Transport the mix to the site in a clean vehicle with smooth dump beds sprayed with a non-petroleum release agent. The mix shall be covered during transportation to control cooling.
- Test the full permeability of the pavement surface by application of clean water at a rate of at least 5 gallons per minute over the entire surface. All water must infiltrate directly, without puddle formation or surface runoff.
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding to determine if the facility is draining properly.

11. Pervious Concrete Installation
The basic installation sequence for pervious concrete is outlined by the National Ready Mixed Concrete Association (NRMCA; NRMCA, 2004). Concrete installers are required to be certified by a recognized pervious concrete installers training program, such as the Pervious Concrete Contractor Certification Program offered by the NRMCA. The basic installation procedure is as follows:

- Drive the concrete truck as close to the project site as possible.
- Water the underlying aggregate (reservoir layer) before the concrete is placed, so the aggregate does not draw moisture from the freshly laid pervious concrete.
- After the concrete is placed, approximately 3/8 to 1/2 inches is struck off, using a vibratory screed. This is to allow for compaction of the concrete pavement.
- Compact the pavement with a steel pipe roller. Care should be taken to ensure over-compaction does not occur.
- Cut joints for the concrete to a depth of 1/4 inch.
- The curing process is very important for pervious concrete. Concrete installers should follow manufacturer specifications to the extent allowed by on-site conditions when curing pervious concrete. This typically requires covering the pavement with plastic sheeting within 20 minutes of the strike-off and may require keeping it covered for at least 7 days. Do not allow traffic on the pavement during the curing period.
- Remove the plastic sheeting only after the proper curing time. Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding, to determine if the facility is draining properly.

12. Permeable Interlocking Concrete Paver Installation

The basic installation process is described in greater detail by Smith (2006):

- Place edge restraints for open-jointed pavement blocks before the bedding layer and pavement blocks are installed. Permeable interlocking concrete pavement systems require edge restraints to prevent vehicle loads from moving the paver blocks. Edge restraints may be standard curbs or gutter pans, or precast or cast-in-place reinforced concrete borders a minimum of 6 inches wide and 18 inches deep, constructed with Class A3 concrete. Edge restraints along the traffic side of a permeable pavement block system are recommended.
- Place the double-washed No. 57 stone in a single lift. Level the filter course and compact it into the reservoir course beneath with at least four passes of a 10-ton steel drum static roller until there is no visible movement. The first two passes are in vibratory mode, with the final two passes in static mode. The filter aggregate should be moist to facilitate movement into the reservoir course.
- Place and screed the bedding course material (typically No. 8 stone).
- Fill gaps at the edge of the paved areas with cut pavers or edge units. When cut pavers are needed, cut the pavers with a paver splitter or masonry saw. Cut pavers no smaller than 1/3 of the full unit size.
- Pavers may be placed by hand or with mechanical installers. Fill the joints and openings with stone. Joint openings must be filled with ASTM D448 No. 8 stone; although, No. 8P or No. 9 stone may be used where needed to fill narrower joints. Remove excess stones from the paver surface.
- Compact and seat the pavers into the bedding course with a minimum low-amplitude 5,000-pound-foot, 75- to 95-Hz plate compactor.
- Do not compact within 6 feet of the unrestrained edges of the pavers.
- The system must be thoroughly swept by a mechanical sweeper or vacuumed immediately after construction to remove any sediment or excess aggregate.
- Inspect the area for settlement. Any blocks that settle must be reset and re-inspected.
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding to determine whether the facility is draining properly.

13. Construction Supervision

Supervision before, during, and after construction by a qualified professional is recommended to ensure permeable pavement is built in accordance with these specifications. ASTM test C1781 or C1701 must be performed to ensure initial pavement permeability of at least 6 inches per hour. Inspection checklists that require sign-offs by qualified individuals should be used at critical stages of construction to ensure the contractor’s interpretation of the plan is consistent with the designer’s intent.

Construction phase inspection checklist for permeable pavement practices can be found in Appendix E Construction Inspection Checklists.

Some common pitfalls can be avoided by careful construction supervision that focuses on the following key aspects of permeable pavement installation:

- Store materials in a protected area to keep them free from mud, dirt, and other foreign materials.
- The CDA should be stabilized prior to directing water to the permeable pavement area.
- Check the aggregate material to confirm it is clean and washed, meets specifications and is installed to the correct depth. Aggregate loads that do not meet the specifications or do not appear to be sufficiently washed may be rejected.
- Check elevations (i.e., the invert of the underdrain, inverts for the inflow, and outflow points) and the surface slope.
- Make sure the permeable pavement surface is even, runoff spreads evenly across it, and the storage bed drains within 48 hours.
- Ensure caps are placed on the upstream (but not the downstream) ends of the underdrains.
- Inspect the pretreatment structures (if applicable) to make sure they are properly installed and working effectively.
- Once the final construction inspection has been completed, log the GPS coordinates for each facility and submit them for entry into the BMP maintenance tracking database.

Runoff diversion structures are recommended to protect larger permeable pavement applications from early runoff-producing storms, particularly when up-gradient conventional asphalt areas drain to the permeable pavement. This can help reduce the input of fine particles often produced shortly after conventional asphalt is laid.

4.4.7 Permeable Pavement Maintenance Criteria

Maintenance is a required and crucial element to ensure the long-term performance of permeable pavement. The most frequently cited maintenance problem is surface clogging caused by organic matter and sediment. Periodic street sweeping will remove accumulated sediment and help prevent clogging; however, it is also critical to ensure that surrounding land areas remain stabilized.

The following tasks must be avoided on all permeable pavements:

- Sanding
- Resealing
- Resurfacing
- Power washing
- Storage of mulch or soil materials
- Construction staging on unprotected pavement

It is difficult to prescribe the specific types or frequency of maintenance tasks that are needed to maintain the hydrologic function of permeable pavement systems over time. The frequency of maintenance will depend largely on the pavement use, traffic loads, and the surrounding land use.

One preventative maintenance task for large-scale applications (e.g., parking lots) involves vacuum sweeping on a frequency consistent with the use and loadings encountered in the site. Many experts consider an annual, dry-weather sweeping in the spring months to be important. The contract for sweeping should specify that a vacuum sweeper be used that does not use water spray, since spraying may lead to subsurface clogging. Typical maintenance tasks are outlined in Table 4.15.

Table 4.15. Typical maintenance tasks for permeable pavement practices.

Frequency	Maintenance Tasks
After installation	▪ For the first 6 months following construction, the practice and CDA should be inspected at least twice after storm events that exceed 0.5 inch of rainfall. Conduct any needed repairs or stabilization.
Once every 1–2 months during the growing season	▪ Mow grass in grid paver applications (clippings should be removed from the pavement area).
As needed	▪ Stabilize the CDA to prevent erosion. ▪ Remove any soil or sediment deposited on pavement. ▪ Replace or repair any pavement surfaces that are degenerating or spalling.
2–4 times per year (depending on use)	▪ Mechanically sweep pavement with a standard street sweeper to prevent clogging.
Annually	▪ Conduct a maintenance inspection ▪ Remove weeds as needed.
Once every 2–3 years	▪ Remove any accumulated sediment in pretreatment cells and inflow points.
If clogged	▪ Conduct maintenance using a regenerative street sweeper or a vacuum sweeper ▪ Replace any necessary joint material.

When permeable pavements are installed on private residential lots, homeowners will need to (1) be educated about their routine maintenance needs and (2) understand the long-term maintenance plan.

It is recommended that a qualified professional conduct a spring maintenance inspection and cleanup at each permeable pavement site, particularly at large-scale applications. Maintenance inspection checklists for permeable pavements and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.4.8 Permeable Pavement Stormwater Compliance Calculations

Permeable pavement retention credit varies depending on the design configuration of the system.

Enhanced Designs

These permeable pavement applications have an infiltration sump and water-quality filter, but no underdrain. Enhanced designs are credited with 100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (Table 4.16).

Table 4.16. Retention and pollutant removal for enhanced permeable pavement practices.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

Note: If using an infiltration sump design, only the volume stored in the sump can be counted as the Enhanced Design Storage Volume (Sv). Any volume stored in the practice above the sump is counted as a standard design. When using the SoLoCo Compliance Calculator, the Sv of the infiltration sump should be entered into the cell "Storage Volume Provided by BMP" in the Permeable Pavement – Enhanced row. Permeable Pavement – Standard should then be selected as the downstream practice. Next, in the Permeable Pavement - Standard row, the Sv provided above the infiltration sump should be entered into the cell "Storage Volume Provided by BMP."

Standard Designs

These permeable pavement applications have an underdrain, but no infiltration sump or water quality filter. Standard designs are credited with 30% retention for the storage volume (Sv) provided as well as 80% TSS, 45% TN, and 30% bacteria removal. (Table 4.17).

Table 4.17. Retention and pollutant removal for standard permeable pavement practices.

Retention	= 30%
TSS Removal	= 80%
TN Removal	= 45%
Bacteria Removal	= 30%

The practice must be sized using the guidance detailed in Section 4.2.4 Permeable Pavement Design Criteria.

Permeable pavement also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) achieved by the practice from the total runoff volumes for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.5 Infiltration Practices

Infiltration			
Definition: Practices that capture and temporarily store the design storm volume before allowing it to infiltrate into the soil over a three-day period.			
Site Applicability		**BMP Performance Summary**	
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High	
▪ Urban ▪ Suburban ▪ Rural	**Small**	**TSS[1]** / **Total N[1]** / **Bacteria[1]**	100% / 100% / 100%
		Runoff Reduction	
Construction Costs	**Maintenance Burden**	**Volume**	
Moderate	Moderate	High	
Maintenance Frequency:		***SWRv***	
Routine	**Non-Routine**	**Basin**	**Trench**
Quarterly	Every 5-10 years	100%	100%

Advantages/Benefits	Disadvantages/Limitation
▪ Excellent in impervious CDAs ▪ Helps restore pre-development hydrologic conditions through groundwater recharge ▪ Reduces runoff rates, volumes, and pollutant loads ▪ Attractive landscaping features ▪ Good for small sites with porous soils	▪ CDA should be less than 2 acres. ▪ Potential for groundwater contamination ▪ High clogging potential; ▪ Not for sites with fine soils (clays/silts) in CDA ▪ Geotechnical testing required
Components	**Design considerations**
▪ Pretreatment ▪ Conveyance system ▪ Ponding area ▪ Soils/Filter Media/Mulch ▪ Observation Well/Monitoring Port ▪ Plants	▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice ▪ Must infiltrate within 72 hours
Maintenance Activities	
▪ Inspect for clogging	▪ Replace soil/stone if it becomes clogged ▪ Clean conveyance system(s)

[1]*Credited pollutant load removal*

Infiltration practices are suitable for use in residential and other urban areas where field measured soil infiltration rates are sufficient. To prevent possible groundwater contamination, infiltration must not be utilized at sites designated as stormwater hotspots. If properly designed, they can provide significant reductions in post-construction stormwater runoff rates, volumes, and pollutant loads on development sites (Figure 4.16**)**

Figure 4.16. Infiltration practice in median strip.

Definition

Practices that capture and temporarily store the design storm volume before allowing it to infiltrate into the soil over a three-day period. Infiltration practices use temporary surface or underground storage to allow incoming stormwater runoff to exfiltrate into underlying soils. Runoff first passes through multiple pretreatment mechanisms to trap sediment and organic matter before it reaches the practice. As the stormwater penetrates the underlying soil, chemical and physical adsorption processes remove pollutants. Infiltration practices are suitable for use in residential and other urban areas where field-verified saturated hydraulic conductivity is sufficient.

Design variants include the following:

I-1 Infiltration trench

I-2 Infiltration basin

Infiltration Trenches

Infiltration trenches are excavated trenches filled with stone. Stormwater runoff is captured and temporarily stored in the stone reservoir, where it is allowed to infiltrate into the surrounding and underlying native soils. Infiltration trenches can be used to “receive” stormwater runoff from contributing drainage areas of up to 2 acres in size and should only be used on development sites where sediment loads can be kept relatively low (see Figure 4.17 and Figure 4.18).

Infiltration Basins

Infiltration basins are shallow, landscaped excavations filled with an engineered soil mix. They are designed to capture and temporarily store stormwater runoff in the engineered soil mix, where it is subjected to the hydrologic processes of evaporation and transpiration, before being allowed to infiltrate into the surrounding soils. They are essentially non-underdrained bioretention areas and should also only be used on drainage areas up to 5 acres where sediment loads can be kept relatively low (Figure 4.19).

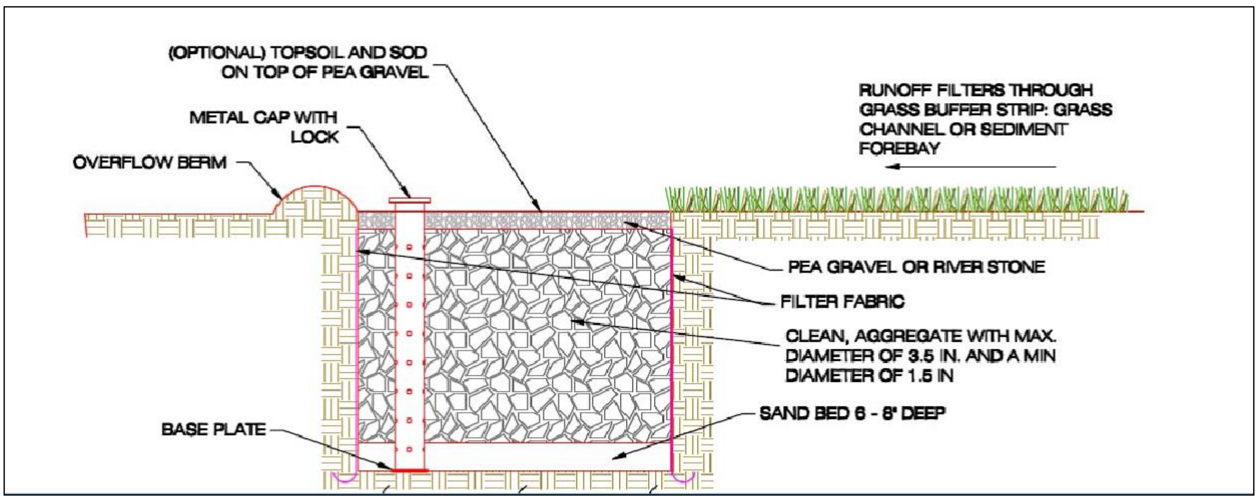


Figure 4.17. Example design of an infiltration trench.

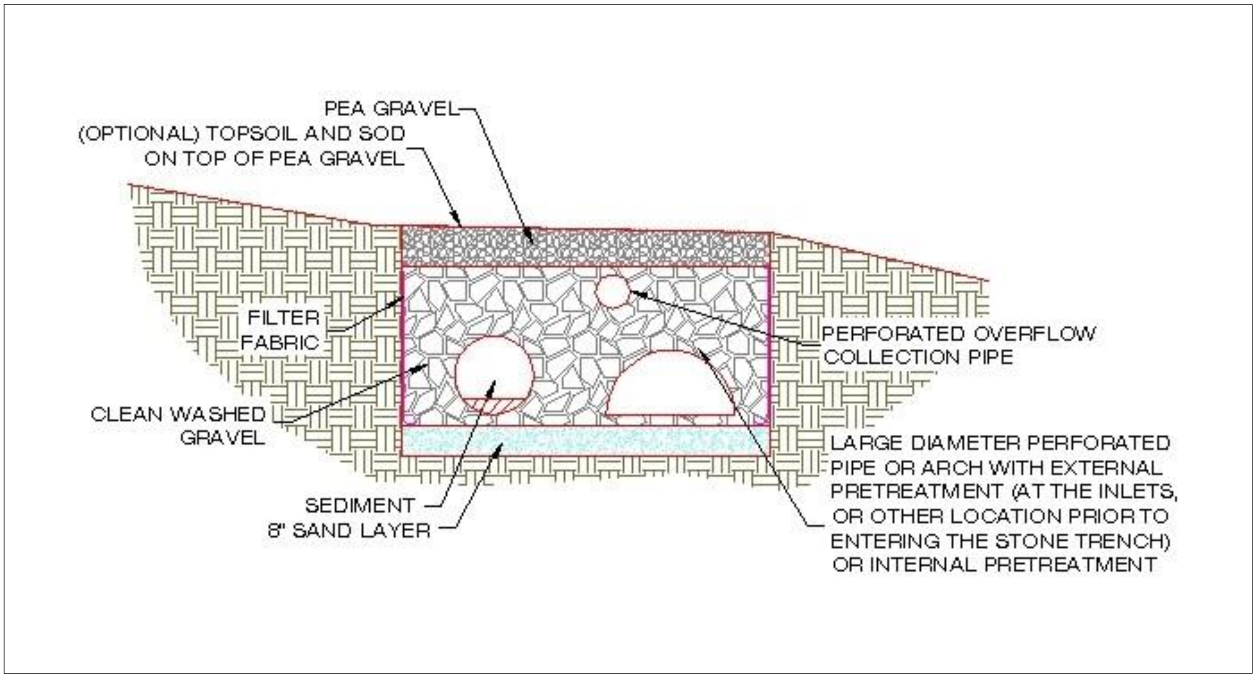


Figure 4.18. Example design of an infiltration practice with supplemental pipe storage.

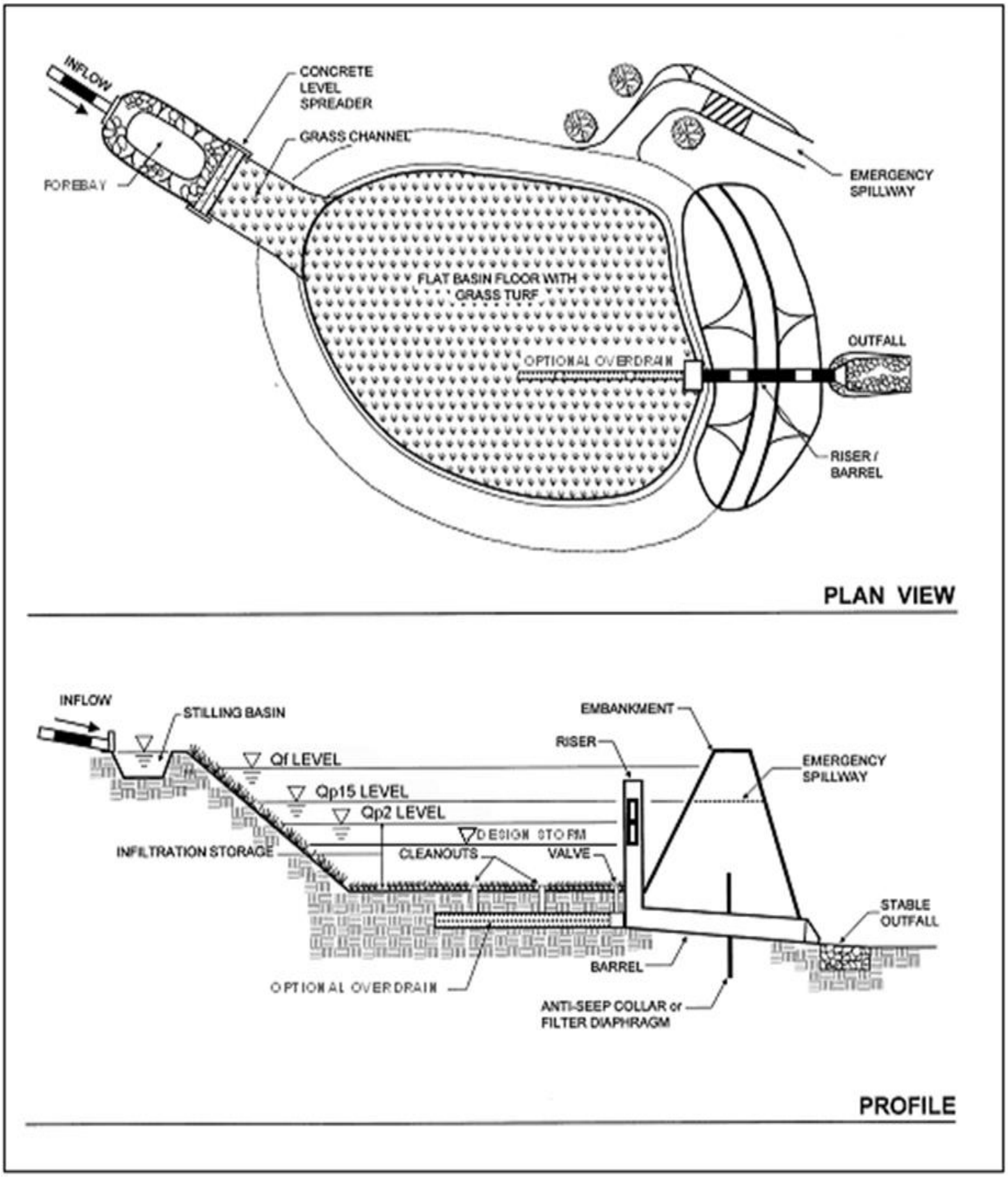


Figure 4.19. Example design of an infiltration basin.

4.5.1 Infiltration Feasibility Criteria

Infiltration practices have very high storage and retention capabilities when sited and designed appropriately. Designers should evaluate the range of soil properties during initial site layout and seek to configure the site to conserve and protect the soils with the greatest recharge and infiltration rates. In particular, areas of HSG A or B soils, shown on the U.S. Department of Agriculture's NRCS soil surveys, should be considered as primary locations for infiltration practices. Additional information about soil and infiltration are described in more detail later in this section. During initial design phases, designers should carefully identify and evaluate constraints on infiltration, as follows:

Underground Injection Control for Class V Wells

In order for an infiltration practice to avoid classification as a Class V well, which is subject to regulation under the Federal Underground Injection Control program, the practice must be wider than the practice is deep. If an infiltration practice is "deeper than its widest surface dimension" or if it includes an underground distribution system, then it will likely be considered a Class V injection well. Class V injection wells are subject to permit approval by the U.S. Environmental Protection Agency (EPA).

Contributing Drainage Area

The maximum CDA to an individual infiltration practice should be less than 2 acres and as close to 100% impervious as possible. The design, pretreatment, and maintenance requirements will differ depending on the size of the infiltration practice.

Site Topography

The infiltration practice shall not be located on slopes greater than 6%, although check dams or other devices may be employed to reduce the effective slope of the practice. Further, unless slope stability calculations demonstrate otherwise, infiltration practices should be located a minimum horizontal distance of 200 feet from down-gradient slopes greater than 20%.

Minimum Hydraulic Head

Two or more feet of head may be needed to promote flow through infiltration practices.

Minimum Depth to Water Table

A minimum vertical distance of 0.5 feet must be provided between the bottom of the infiltration practice.

Tidal Impacts

The bottom of an infiltration practice should be located above the tidal mean high water elevation. Where this is not possible, portions of the practice below the tidal mean high water elevation cannot be included in the volume calculations.

Soils

Initially, soil infiltration rates can be estimated from NRCS soil data for feasibility purposes, but designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B Geotechnical Information Requirements for Underground BMPs for their design.

Use on Urban Fill Soils/Redevelopment Sites

Sites that have been previously graded or disturbed do not typically retain their original soil permeability due to compaction. Therefore, such sites are often not good candidates for infiltration practices unless the geotechnical investigation shows that a sufficient saturated hydraulic conductivity exists.

Dry Weather Flows

Infiltration practices should not be used on sites receiving regular dry-weather flows from sump pumps, irrigation water, chlorinated wash-water, or flows other than stormwater.

Setbacks

To avoid the risk of seepage, stormwater cannot flow from infiltration practices to traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements. Where the 10-foot setback is not possible, an impermeable liner may be used along the sides and bottom of the infiltration area (extending from the surface to the bottom of the practice and outward to meet the 10-foot setback). Areas where the liner blocks infiltration should be excluded from surface area calculations for the practice. In locations where the surface soil consists of highly permeable soils with little separation of the infiltration trench or basin bottom, the extent of ground water mounding should be considered. Mounding can occur in areas where infiltrating water intersects a groundwater table and the rate of water entering the subsurface is greater than the rate at which water is conveyed away from the infiltration system (MPCA, 2019). Ground water mounding may impact building foundations, soil stability, underground utilities and potentially on-site treatment systems (septic leach beds).

All setbacks must be verified by a professional geotechnical engineer registered in the State of South Carolina.

Proximity to Utilities

Interference with underground utilities should be avoided, if possible. When large site development is undertaken the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the PROW. Consult with each utility company on recommended offsets, which will allow utility maintenance work with minimal disturbance to the infiltration BMP. Infiltration BMPs in the PROW will also conform with the State of South Carolina Department of Transportation design specifications. Where conflicts cannot be avoided, follow these guidelines:

- Consider altering the location or sizing of the infiltration BMP to avoid or minimize the utility conflict. Consider an alternate BMP type to avoid conflict.
- Use design features to mitigate the impacts of conflicts that may arise by allowing the infiltration BMP and the utility to coexist. The infiltration BMP design may need to incorporate impervious areas, through geotextiles or compaction, to protect utility crossings. Other key design features may need to be moved, added, or deleted.
- Evaluate the relocation of the existing utility and install an optimally placed and sized infiltration BMP.
- If utility functionality, longevity and vehicular access to manholes can be assured, accept the infiltration BMP design and location with the existing utility. Incorporate into the infiltration BMP design sufficient soil coverage over the utility or general clearances or other features such as an impermeable linear to assure all entities the conflict is limited to maintenance.

Note: When accepting utility conflict into the infiltration BMP location and design, it is understood the infiltration BMP will be temporarily impacted during utility work. At the conclusion of this work, the utility owner will replace the infiltration BMP or, alternatively, install a functionally comparable infiltration BMP according to the specifications in the current version of this guidebook. If the infiltration BMP is located in the PROW the infiltration BMP restoration will also conform with the State of South Carolina Department of Transportation design specification.

Pollutant Hotspots and High Loading Situations

Infiltration practices are not intended to treat sites with high sediment or trash or debris loads, because such loads will cause the practice to clog and fail. Infiltration practices must be avoided at potential stormwater hotspots that pose a risk of groundwater contamination. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil-water separator or filtering device must be provided. These pretreatment facilities should be monitored and maintained frequently to avoid negative impacts to the infiltration area and groundwater.

On sites with existing contaminated soils, infiltration is not allowed.

Economic Considerations

Infiltration practices do require a designated space on the site, which in space-constrained areas, may reduce available building space. However, infiltration practices have a relatively low construction cost, and high space efficiency. In some cases, they can even be incorporated into the detention design or landscaped areas

4.5.2 Infiltration Conveyance Criteria

The nature of the conveyance and overflow to an infiltration practice depends on the scale of infiltration and whether the facility is on-line or off-line. Where possible, conventional infiltration practices should be designed off-line to avoid damage from the erosive velocities of larger design storms. If runoff is delivered by a storm drain pipe or along the main conveyance system, the infiltration practice shall be designed as an off-line practice. Pretreatment shall be provided for storm drain pipes and conveyance systems discharging directly to infiltration systems.

Off-line Infiltration

Overflows can either be diverted from entering the infiltration practice or dealt with via an overflow inlet. Optional overflow methods include the following:

- Utilize a low-flow diversion or flow splitter at the inlet to allow only the design SWRv to enter the facility. This may be achieved with a weir or curb opening sized for the target flow, in combination with a bypass channel. Using a weir or curb opening helps minimize clogging and reduces the maintenance frequency (further guidance on determining the peak flow rate will be necessary in order to ensure proper design of the diversion structure).
- Use landscaping type inlets or standpipes with trash guards as overflow devices.

On-line Infiltration

An overflow structure must be incorporated into on-line designs to safely convey the 25-year storm through the infiltration area. Mechanisms such as elevated drop inlets and overflow weirs are examples of how to direct high flows to a non-erosive down-slope overflow channel, stabilized water course, or storm sewer system designed to convey the 25-year design storm.

4.5.3 Infiltration Pretreatment Criteria

Every infiltration system shall have pretreatment mechanisms to protect the long-term integrity of the infiltration rate. One of the following techniques must be installed to pretreat 100% of the inflow in every facility:

- Grass channel
- Grass filter strip (minimum 20 feet and only if sheet flow is established and maintained)
- Forebay or sump pit (must accommodate a minimum 15% of the design storm volume)
- Gravel diaphragm (minimum 1 foot deep and 2 feet wide and only if sheet flow is established and maintained)
- Filter system (see Section 4.10 Filtering Systems) If using a filter system as a pretreatment facility, the sand filter will not require its own separate pretreatment facility.
- A proprietary structure with demonstrated capability of reducing sediment and hydrocarbons may be used to provide pretreatment. Refer to Section 0 Proprietary Practices.

If the basin serves a CDA greater than 20,000 square feet, a forebay, sump pit, filter system, or proprietary practice must be used for pretreatment.

Exit velocities from the pretreatment chamber shall not be erosive (above 6 fps) during the 25-year design storm and flow from the pretreatment chamber should be evenly distributed across the width of the practice (e.g., using a level spreader).

4.5.4 Infiltration Design Criteria <u>Geometry</u>

Where possible, an infiltration practice should be designed to be wider than it is deep, to avoid classification as a Class V injection well.

<u>Practice Slope</u>

The bottom of an infiltration practice should be flat (i.e., 0% longitudinal and lateral slopes) to enable even distribution and infiltration of stormwater.

<u>Infiltration Basin Geometry</u>

The maximum vertical depth to which runoff may be ponded over an infiltration basin is 24 inches. The side-slopes should be no steeper than 4H:1V.

<u>Surface Cover (optional)</u>

Designers may choose to install a layer of topsoil and grass above the infiltration practice.

<u>Surface Stone</u>

A 3-inch layer of clean, washed river stone or No. 8 or 89 stone should be installed over the stone layer.

<u>Stone Layer</u>

Stone layers must consist of clean, washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches.

<u>Observation Wells</u>

All infiltration practices must include at least one observation well. The observation well is used to observe the rate of drawdown within the infiltration practice following a storm event and to facilitate periodic inspection and maintenance. The observation well should consist of a well-anchored, perforated 4- to 6-inch diameter PVC pipe. There should be no perforation within 1 foot of the surface. The observation well should extend vertically to the bottom of the stone layer and extend upward to the top of ponding.

Underground Storage (optional)
In the underground mode, runoff is stored in the voids of the stones and infiltrates into the underlying soil matrix. Perforated corrugated metal pipe, plastic pipe, concrete arch pipe, or comparable materials can be used in conjunction with the stone to increase the available temporary underground storage. In some instances, a combination of filtration and infiltration cells can be installed in the floor of a dry extended detention (ED) pond.

Overflow Collection Pipe (Overdrain)
An optional overflow collection pipe can be installed in the stone layer to convey collected runoff from larger storm events to a downstream conveyance system.

Trench Bottom
To protect the bottom of an infiltration trench from intrusion by underlying soils, a sand layer must be used. The underlying native soils must be separated from the stone layer by a 6- to 8-inch layer of coarse sand (e.g., ASTM C-33, 0.02–0.04 inches in diameter).

Geotextile Fabric
An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used. This layer should be applied only to the sides of the practice.

Material Specifications
Recommended material specifications for infiltration areas are shown in Table 4.18.

Table 4.18. Infiltration practice material specifications.

Material	Specification	Notes
Surface Layer (optional)	Topsoil and grass layer	
Surface Stone	Install a 3-inch layer of river stone or pea gravel.	Provides an attractive surface cover that can suppress weed growth.
Stone Layer	Clean, double-washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches.	
Observation Well	Install a vertical 6-inch Schedule 40 PVC perforated pipe, with a lockable cap and anchor plate.	Install one per 50 feet of length of infiltration practice.
Overflow Collection Pipe (optional)	Use 4- or 6-inch rigid schedule 40 PVC pipe, with three or four rows of 3/8-inch perforations at 6 inches on center.	
Trench Bottom	Install a 6- to 8-inch sand layer (e.g., ASTM C-33, 0.02–0.04 inches in diameter)	
Geotextile Fabric (sides only)	An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used.	

Practice Sizing

The proper approach for designing infiltration practices is to avoid forcing a large amount of infiltration into a small area. Therefore, individual infiltration practices that are limited in size due to soil permeability and available space need not be sized to achieve the full design storm volume (SWRv) for the CDA, as long as other stormwater treatment practices are applied at the site to meet the remainder of the design storm volume.

Several equations (see following page) are needed to size infiltration practices. The first equations establish the maximum depth of the infiltration practice, depending on whether it is a surface basin (Equation 4.6) or trench with an underground reservoir (Equation 4.7)

Equation 4.6. Maximum surface basin depth for infiltration basins.

$$d_{max} = K_{sat} \times t_d$$

Equation 4.7. Maximum underground reservoir depth for infiltration trenches.

$$d_{max} = \frac{(K_{sat} \times t_d)}{\eta_r}$$

Where:

d_{max} = Maximum depth of the infiltration practice (ft)
K_{sat} = Field-verified saturated hydraulic conductivity for the native soils (ft/day)
t_d = Maximum drawdown time (days, normally 3 days)
η_r = Available porosity of the stone reservoir (assume 0.4)

These equations make the following design assumptions:

- **Stone Layer Porosity**
  A porosity value of 0.4 shall be used in the design of stone reservoirs, although a larger value may be used if perforated corrugated metal pipe, plastic pipe, concrete arch pipe, or comparable materials are installed within the reservoir.
- **Rapid Drawdown**
  Infiltration practices must be sized so that the design volume infiltrates within 72 hours, to prevent nuisance ponding conditions.

Designers should compare these results to the maximum allowable depths in Table 4.19 and use whichever value is less for the subsequent design.

Table 4.19. Maximum facility depth for infiltration practices.

Mode of Entry	**Scale of Infiltration**		
	Micro Infiltration ($250–2,500\ ft^2$)	**Small Scale Infiltration ($2,500–20,000\ ft^2$)**	**Conventional Infiltration ($20,000–100,000\ ft^2$)**
Surface Basin	1.0	1.5	2.0
Underground Reservoir	3.0	5.0	varies

Once the maximum depth is known, calculate the surface area needed for an infiltration practice using Equation 4.8 or Equation 4.9.

Equation 4.8. Surface basin surface area for infiltration basins.

$$SA = \frac{\text{DesignStorm}}{d + (K_{sat} \times t_f)}$$

Equation 4.9. Underground reservoir surface area for infiltration trenches.

$$SA = \frac{\text{DesignStorm}}{(\eta_r \times d) + (0.5 \times K_{sat} \times t_f)}$$

Where:

SA =	Surface area (square feet)
DesignStorm =	SWRv or other design storm volume (e.g., portion of the SWRv; cubic feet)
η_r =	Available porosity of the stone reservoir (assume 0.4)
d =	Infiltration depth (feet; maximum depends on the scale of infiltration and the results of Equation 4.6 or Equation 4.7)
K_{sat} =	Field-verified saturated hydraulic conductivity for the native soils (ft/day)
t_f =	Time to fill the infiltration facility (days; typically 2 hours or 0.083 days)

The storage volume (Sv) captured by the infiltration practice is defined as the volume of water that is fully infiltrated through the practice (i.e., no overflow). Designers may choose to infiltrate less than the full design storm (SWRv). In this case, the design volume captured must be treated as the Sv of the practice (see Section 4.5.4 Infiltration Design Criteria). Sv can be determined by rearranging Equation 4.8 and Equation 4.9 to yield Equation 4.10 and Equation 4.11.

Equation 4.10. Storage volume for surface basin area for infiltration basins.

$$Sv = SA \times [d + (K_{sat} \times t_f)]$$

Equation 4.11. Storage volume for underground reservoir surface area for infiltration trenches.

$$Sv = SA \times [(\eta_r \times d) + (K_{sat} \times t_f)]$$

Infiltration practices can also be designed to address, in whole or in part, the detention storage needed to comply with channel protection and/or flood control requirements. The designer can model various approaches by factoring in storage within the stone aggregate layer, any perforated corrugated metal pipe, plastic pipe, concrete arch pipe, or comparable materials installed within the reservoir, expected infiltration, and any outlet structures used as part of the design. Routing calculations can also be used to provide a more accurate solution of the peak discharge and required storage volume.

4.5.5 Infiltration Landscaping Criteria

Infiltration trenches can be effectively integrated into the site plan and aesthetically designed with adjacent native landscaping or turf cover, subject to the following additional design considerations:

- Infiltration practices should not be installed until all up-gradient construction is completed and pervious areas are stabilized with dense and healthy vegetation, unless the practice can be kept off-line so it receives no runoff until construction and stabilization is complete.
- Vegetation associated with the infiltration practice buffers should be regularly maintained to limit organic matter in the infiltration device and maintain enough vegetation to prevent soil erosion from occurring.

4.5.6 Infiltration Construction Sequence

Infiltration practices are particularly vulnerable to failure during the construction phase for two reasons. First, if the construction sequence is not followed correctly, construction sediment can clog the practice. Second, loading from heavy construction equipment can result in compaction of the soil, which can then reduce the soil's infiltration rate. For this reason, a careful construction sequence needs to be followed.

During site construction, the following protective measures are absolutely critical:

- All areas proposed for infiltration practices should be fully protected from sediment intrusion by silt fence or construction fencing, particularly if they are intended to infiltrate runoff.
- Avoid excessive compaction by preventing construction equipment and vehicles from traveling over the proposed location of the infiltration practice. To accomplish this, areas intended to infiltrate runoff must remain outside the limits of disturbance during construction.
- When this is unavoidable, there are several possible remedies for the impacted area.
    - If excavation at the impacted area can be restricted then remediation can be achieved with deep tilling practices. This is only possible if in situ soils are not disturbed below 2 feet above the final design elevation of the bottom of the infiltration practice. In this case, when heavy equipment activity has ceased, the area is excavated to grade, and the impacted area must be tilled a minimum of 12 inches below the bottom of the infiltration practice.

- o Alternatively, if it is infeasible to keep the proposed infiltration practice outside of the limits of disturbance, and excavation of the area cannot be restricted, then infiltration tests will be required prior to installation of the infiltration practice to ensure that the design infiltration rate is still present. If tests reveal the loss of design infiltration rates then deep tilling practices may be used in an effort to restore those rates. In this case further testing must be done to establish design rates exist before the infiltration practice can be installed.
- o Finally, if it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, excavation of the area cannot be restricted, and infiltration tests reveal design rates cannot be restored, then a resubmission of the SWMP will be required.

- Any area of the site intended ultimately to be an infiltration practice should not be used as the site of a temporary sediment trap or basin. If locating a sediment trap or basin on an area intended for infiltration is unavoidable, the remedies are similar to those discussed for heavy equipment compaction. If it is possible, restrict the invert of the sediment trap or basin to at least 2 feet above the final design elevation of the bottom of the proposed infiltration practice. Then remediation can be achieved with proper removal of trapped sediments and deep tilling practices. An alternate approach to deep tilling is to use an impermeable linear to protect the in situ soils from sedimentation while the sediment trap or basin is in use. In each case, all sediment deposits must be carefully removed prior to installing the infiltration practice.
- Keep the infiltration practice off-line until construction is complete. Prevent sediment from entering the infiltration site by using super silt fence, diversion berms, or other means. In the soil erosion and sediment control plan, indicate the earliest time at which stormwater runoff may be directed to a conventional infiltration basin. The soil erosion and sediment control plan must also indicate the specific methods to be used to temporarily keep runoff from the infiltration site.
- Upland CDAs need to be completely stabilized with a well-established layer of vegetation prior to commencing excavation for an infiltration practice.

Infiltration Installation

The actual installation of an infiltration practice is done using the following steps:

1. Avoid Impact of Heavy Installation Equipment

Excavate the infiltration practice to the design dimensions from the side using a backhoe or excavator. The floor of the pit should be completely level, but equipment should be kept off the floor area to prevent soil compaction.

2. Hang Geotextile Walls

Install geotextile fabric on the trench sides. Large tree roots should be trimmed flush with the sides of infiltration trenches to prevent puncturing or tearing of the geotextile fabric during subsequent installation procedures. When laying out the geotextile, the width should include sufficient material to compensate for perimeter irregularities in the trench and for a 6-inch minimum overlap at the top of the trench. The geotextile fabric itself should be tucked under the sand layer on the bottom of the infiltration trench. Stones or other anchoring objects should be placed on the fabric at the trench sides, to keep the trench open during windy periods. Voids may occur between the fabric and the excavated sides of a trench. Natural soils should be placed in all voids, to ensure the fabric conforms smoothly to the sides of excavation.

3. Promote Infiltration Rate
Scarify the bottom of the infiltration practice and spread 6 inches of sand on the bottom as a filter layer.

4. Observation Wells
Anchor the observation well(s) and add stone to the practice in 1-foot lifts.

5. Stabilize Surrounding Area
Use sod, where applicable, to establish a dense turf cover for at least 10 feet around the sides of the infiltration practice, to reduce erosion and sloughing.

Construction Supervision
Supervision during construction is recommended to ensure that the infiltration practice is built in accordance with the approved design and this specification. Qualified individuals should use detailed inspection checklists to include sign-offs at critical stages of construction, to ensure that the contractor's interpretation of the plan is consistent with the designer's intentions.

4.5.7 Infiltration Maintenance Criteria

Maintenance is a crucial and required element that ensures the long-term performance of infiltration practices. The most frequently cited maintenance problem for infiltration practices is clogging of the stone layer by organic matter and sediment. The following design features can minimize the risk of clogging:

Stabilized CDA
Infiltration systems may not receive runoff until the entire CDA has been completely stabilized.

Observation Well
Infiltration practices must include an observation well to facilitate periodic inspection and maintenance. Design criteria must include an anchored 6-inch diameter perforated PVC pipe fitted with a lockable cap installed flush with the ground surface.

No Geotextile Fabric on Bottom
Avoid installing geotextile fabric along the bottom of infiltration practices. Experience has shown that geotextile fabric is prone to clogging. However, permeable geotextile fabric should be installed on the trench sides to prevent soil piping.

Direct Maintenance Access
Access must be provided to allow personnel and heavy equipment to perform atypical maintenance tasks, such as practice reconstruction or rehabilitation. While a turf cover is permissible for small-scale infiltration practices, the surface must never be covered by an impermeable material, such as asphalt or concrete.

Maintenance Inspections
Effective long-term operation of infiltration practices requires a dedicated and routine maintenance inspection schedule with clear guidelines and schedules, as shown in Table 4.20. Where possible, facility maintenance should be integrated into routine landscaping maintenance tasks.

Table 4.20. Typical maintenance activities for infiltration practices.

Schedule	Maintenance Activity
Quarterly	▪ Ensure that the CDA, inlets, and facility surface are clear of debris. ▪ Ensure that the CDA is stabilized. Perform spot-reseeding if where needed. ▪ Remove sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, and overflow structures. ▪ Repair undercut and eroded areas at inflow and outflow structures.
Semi-annual inspection	▪ Check observation wells 3 days after a storm event in excess of 0.5 inch in depth. Standing water observed in the well after 3 days is a clear indication of clogging. ▪ Inspect pretreatment devices and diversion structures for sediment build-up and structural damage.
Annually	▪ Clean out accumulated sediment from the pretreatment cell.
As needed	▪ Replace pea gravel/topsoil and top surface geotextile fabric (when clogged). ▪ Mow vegetated filter strips as necessary and remove the clippings.

It is highly recommended that a qualified professional conduct annual site inspections for infiltration practices to ensure the practice performance and longevity of infiltration practices.

Beaufort County Public Works Departments's maintenance inspection checklist for infiltration systems and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.5.8 Infiltration Stormwater Compliance Calculations

Infiltration practices are credited with 100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (Table 4.21).

Table 4.21. Retention and pollutant removal for infiltration practices.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

The practice must be sized using the guidance detailed in Section 4.3.4 Infiltration Design Criteria.

Infiltration practices also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) from the total runoff volume for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.6 Green Roofs

<table>
<tr><th colspan="6">Green Roofs</th></tr>
<tr><td colspan="6">Definition: Practices that capture and store rainfall in an engineered growing media installed over a waterproof membrane that is designed to support plant growth on the roof of a building or other structure.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="4">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="4">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban</td><td rowspan="3">Small</td><th colspan="2">TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td colspan="2">100%</td><td>100%</td><td>100%</td></tr>
<tr><th colspan="4">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="4">Volume</th></tr>
<tr><td>High</td><td>Low</td><td colspan="4">High</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="4">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="4" rowspan="2">100% of Sv</td></tr>
<tr><td>Semi-annually</td><td>As needed</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="4">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Reduces runoff volume and pollutant loads
▪ Energy savings: keep buildings cool, prolongs roof life
▪ Possible amenity space for public or users
▪ Sound absorption
▪ Life cycle costs comparable to traditional roof</td><td colspan="4">▪ For retrofits, strengthening structure may be required
▪ If roof leaks occur, may be harder to trace
▪ Design and installation require specialized knowledge
▪ Typically applied on flat roofs (1%–2% pitch)
▪ Installation costs higher than for traditional roof</td></tr>
<tr><th colspan="2">Components</th><th colspan="4">Design considerations</th></tr>
<tr><td colspan="2">▪ Vegetation that thrives in rooftop climate.
▪ Engineered planting medium (not soil).
▪ Containment (Modular systems - plant containers; Non-modular systems - barriers at roof perimeter/drainage structures).
▪ Drainage layer, sometimes with built-in water reservoirs.
▪ Water proofing layer or roof membrane with root repellant.</td><td colspan="4">▪ Good waterproofing material and installation are essential.
▪ Materials used must be lightweight.
▪ Building structure must be able to support saturated weight.
▪ Roofs with moderate to flat slopes are most appropriate. Maximum roof slope of 30%.</td></tr>
<tr><th colspan="6">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Watering and fertilization until well-established
▪ Occasional weeding</td><td colspan="4">▪ Inspection for proper drainage and plant health
▪ Ordinary life cycle roof replacement</td></tr>
</table>

[1]*Credited pollutant load removal*

Green roofs are practices that capture and store rainfall in an engineered growing media that is designed to support plant growth (see Figure 4.20**). A portion of the captured rainfall evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. Green roofs typically contain a layered system of roofing, which is designed to support plant growth and retain water for plant uptake while preventing ponding on the roof surface. The roofs are designed so that water drains vertically through the media and then horizontally along a waterproofing layer towards the outlet. Extensive green roofs are designed to have minimal maintenance requirements. Plant species are selected so that the roof does not need supplemental irrigation or fertilization after vegetation is initially established.**

Green roofs are typically not designed to provide stormwater detention of larger storms (e.g., 2 - 25**-year) although some intensive green roof systems may be designed to meet these criteria. Green roof designs should generally be combined with a separate facility to provide large storm controls.**

Figure 4.20. Green roof (photo: Center for Watershed Protection, Inc.)

Definition

Practices that capture and store rainfall in an engineered growing media installed over a waterproof membrane that is designed to support plant growth on the roof of a building or other structure. A portion of the captured rainfall evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. Green roofs typically contain a layered system of roofing, which is designed to support plant growth and retain water for plant uptake while preventing ponding on the roof surface. The roofs are designed so that water drains vertically through the media and then horizontally along a waterproofing layer towards the outlet. Plant species are selected so that the roof does not need supplemental irrigation and requires minimal, infrequent fertilization after vegetation is initially established.

Design variants include extensive and intensive green roofs.

G-1 Extensive green roofs have a much shallower growing media layer that typically ranges from 3 to 8 inches thick and are designed to have minimal maintenance requirements.

G-2 Intensive green roofs have a growing media layer that typically ranges from 8 to 48 inches thick.

Green roofs are typically not designed to provide stormwater detention of larger storms (e.g., 2 - 25-year) although some intensive green roof systems may be designed to meet these criteria. Most green roof designs shall generally be combined with a separate facility to provide large storm controls.

This specification is intended for situations where the primary design objective of the green roof is stormwater management and, unless specified otherwise, addresses the design of extensive roof systems. While rooftop practices such as urban agriculture may provide some retention, their primary design objective is not stormwater management and is not addressed in this specification.

4.6.1 Green Roof Feasibility Criteria

Green roofs are ideal for use on commercial, institutional, municipal, and multi-family residential buildings. They are particularly well-suited for use on ultra-urban development and redevelopment sites. Key constraints with green roofs include the following:

Structural Capacity of the Roof

When designing a green roof, designers must not only consider the stormwater storage capacity of the green roof but also its structural capacity to support the weight of the additional water. A conventional rooftop should typically be designed to support an additional 15 to 30 pounds per square foot (psf) for an extensive green roof. As a result, a structural engineer, architect, or other qualified professional should be involved with all green roof designs to ensure that the building has enough structural capacity to support a green roof. See Section 4.6.4 Green Roof Design Criteria for more information on structural design considerations.

Hurricane-Prone Areas

As South Carolina is subject to hurricanes, some may be concerned about the durability of green roofs in high winds. Having good vegetative cover and root growth in the growing media is the most effective way to reduce wind erosion of the media during high winds. New green roofs where the plants have not yet deeply rooted are the most susceptible to plant damage and media blow-off in a hurricane. Therefore, it is best to install a green roof three or more months prior to hurricane season, to allow enough time for the plants to be established.

Roof Pitch

Green roof storage volume is maximized on relatively flat roofs (a pitch of 1% to 2%). Some pitch is needed to promote positive drainage and prevent ponding and/or saturation of the growing media. Green roofs can be installed on rooftops with slopes up to 30% if baffles, grids, or strips are used to prevent slippage of the media. These baffles must be designed to ensure the roof provides adequate storage for the design storm. Slopes greater than 30% would be considered a green wall, which is not specifically identified as a stormwater BMP. Green walls can be used to receive cistern discharge (calculations are necessary to determine demand).

Roof Access
Adequate, permanent access to the roof must be available to deliver construction materials and perform routine maintenance. A temporary ladder is not sufficient for access to the roof. Roof access can be achieved either by an interior stairway through a penthouse or by an alternating tread device with a roof hatch or trap door not less than 16 square feet in area and with a minimum dimension of 24 inches (NVRC, 2007). Designers should also consider how they will get construction materials up to the roof (e.g., by elevator or crane) and how the roof structure can accommodate material stockpiles and equipment loads. If material and equipment storage is required, rooftop storage areas must be identified and clearly marked based on structural load capacity of the roof.

Roof Type
Green roofs can be applied to most roof surfaces. Certain roof materials, such as exposed treated wood and uncoated galvanized metal, may not be appropriate for green rooftops due to pollutant leaching through the media (Clark et al., 2008).

Setbacks
Green roofs should not be located near rooftop electrical and HVAC systems. A 2-foot-wide vegetation-free zone is recommended along the perimeter of the roof with a 1-foot vegetation-free zone around all roof penetrations, to act as a firebreak. The 2-foot setback may be relaxed for small or low green roof applications where parapets have been properly designed.

Contributing Drainage Area
It is recommended that the contributing drainage area (CDA) to a green roof be limited to the green roof itself. In cases where there will be additional CDA, the designer must provide sufficient design detail showing distribution of this additional runoff throughout the green roof area to prevent erosion or overloading of the roof growing media with the use of level spreaders, splash pads, perforated piping, or other flow dissipation techniques. The absolute maximum CDA to a green roof shall be no more than 100% larger than the area of the green roof (e.g., a 1,000-square-foot green roof can have no more than 1,000 square feet of additional impervious cover draining to it).

Local Building Codes
The green roof design must comply with the local building codes with respect to roof drains and emergency overflow devices. Additionally, a structural engineer should certify that the design complies with structural building codes. For green roofs installed on historic buildings or in historic districts, consult local building codes and architectural review criteria to determine if any special requirements exist for green roof design or maintenance.

Additionally, a State of South Carolina registered structural engineer must certify that the design complies with State building structural codes. This is true for new construction as well as retrofit projects.

Economic Considerations
Green roofs tend to be one of the most expensive BMPs on a per cubic foot captured basis. However, a green roof allows stormwater management to be achieved in otherwise unused space, a major benefit in space-constrained locations. Further, green roofs provide many other non-stormwater services with economic benefits, including increased insulation and roof life expectancy

4.6.2 Green Roof Conveyance Criteria

The green roof drainage layer (refer to Section 4.6.4 Green Roof Design Criteria) must convey flow from under the growing media directly to an outlet or overflow system such as a traditional rooftop downspout drainage system. The green roof drainage layer must be adequate to convey the volume of stormwater equal to the flow capacity of the overflow or downspout system without backing water up onto the rooftop or into the green roof media. Roof drains immediately adjacent to the growing media should be boxed and protected by flashing extending at least 3 inches above the growing media to prevent clogging. However, an adequate number of roof drains that are not immediately adjacent to the growing media must be provided so as to allow the roof to drain without 3 inches of ponding above the growing media.

4.6.3 Green Roof Pretreatment Criteria

Pretreatment is not necessary for green roofs.

4.6.4 Green Roof Design Criteria

Structural Capacity of the Roof

Green roofs can be limited by the additional weight of the fully saturated soil and plants, in terms of the physical capacity of the roof to bear structural loads. The designer shall consult with a licensed structural engineer to ensure that the building will be able to support the additional live and dead structural load and to determine the maximum depth of the green roof system and any needed structural reinforcement. Typically, the green roof manufacturer can provide specific background specifications and information on their product for planning and design.

In most cases, fully saturated extensive green roofs have loads of about 15 to 30 pounds per square foot, which is fairly similar to traditional new rooftops (12 to 15 pounds per square foot) that have a waterproofing layer anchored with stone ballast.

Functional Elements of a Green Roof System

A green roof is composed of up to nine different systems or layers that combine to protect the roof and maintain a vigorous cover (see Figure 4.21).

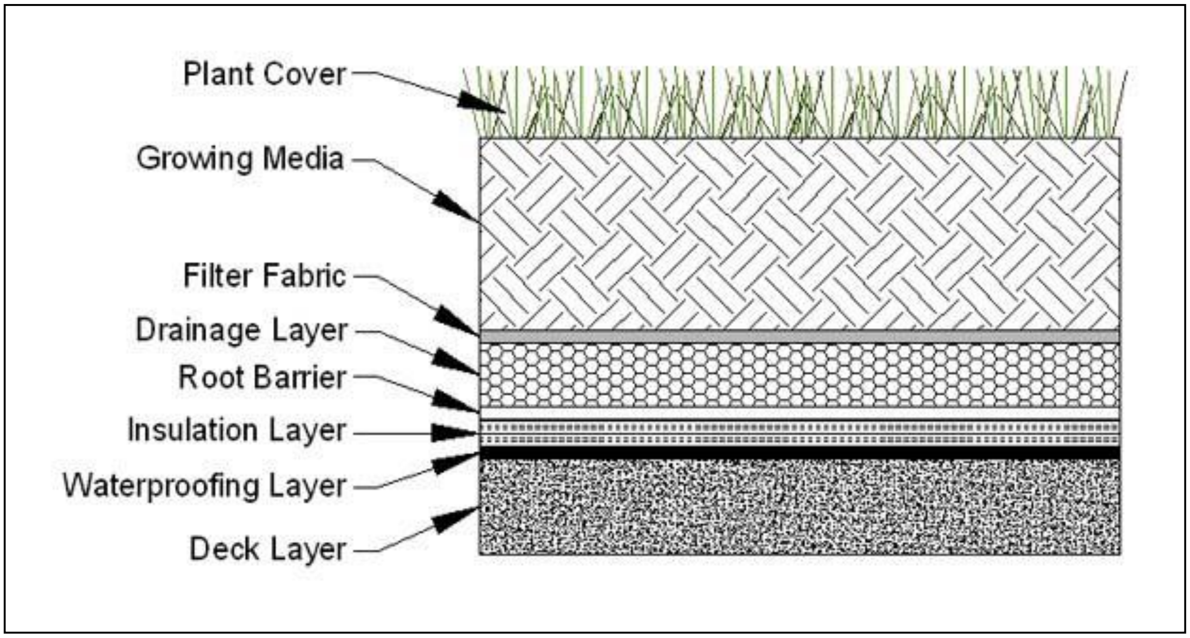


Figure 4.21. Green roof layers (note: the relative placement of various layers may vary depending on the type and design of the green roof system).

The design layers include the following:

1. **Deck Layer.** The roof deck layer is the foundation of a green roof. It may be composed of concrete, wood, metal, plastic, gypsum, or a composite material. The type of deck material determines the strength, load bearing capacity, longevity, and potential need for insulation in the green roof system.
2. **Leak Detection System (optional).** Leak detection systems are often installed above the deck layer to identify leaks, minimize leak damage through timely detection, and locate leak locations. Electric Field Vector Mapping (EFVM®) or other leak detection techniques are strongly recommended as part of the green roof installation process. In the case of EFVM, the deck material must be conductive. If it is not, an additional conductive medium may need to be added on top of the deck. Other leak detection systems may require additional materials between the deck layer and the waterproofing layer.
3. **Waterproofing Layer.** All green roof systems must include an effective and reliable waterproofing layer to prevent water damage through the deck layer. A wide range of waterproofing materials can be used, including hot applied rubberized asphalt, built up bitumen, modified bitumen, thermoplastic membranes, polyvinyl chloride (PVC), thermoplastic olefin membrane (TPO), and elastomeric membranes (EPDM) (see Weiler and Scholz-Barth, 2009, and Snodgrass and Snodgrass, 2006). The waterproofing layer must be 100% waterproof and have an expected life span as long as any other element of the green roof system. The waterproofing material may be loose laid or bonded (recommended). If loose laid, overlapping and additional construction techniques should be used to avoid water migration.
4. **Insulation Layer.** Many green rooftops contain an insulation layer, usually located above, but sometimes below, the waterproofing layer. The insulation increases the energy efficiency of the building and/or protects the roof deck (particularly for metal roofs). According to Snodgrass and Snodgrass (2006), the trend is to install insulation on the outside of the building, in part to avoid

mildew problems. The designer should consider the use of open or closed cell insulation depending on whether the insulation layer is above or below the waterproofing layer (and thus exposed to wetness), with closed cell insulation recommended for use above the waterproofing layer.

5. **Root Barrier.** Another layer of a green roof system, which can be either above or below the insulation layer depending on the system, is a root barrier that protects the waterproofing membrane from root penetration. Chemical root barriers or physical root barriers that have been impregnated with pesticides, metals, or other chemicals that could leach into stormwater runoff must be avoided in systems where the root barrier layer will come in contact with water or allow water to pass through the barrier.

6. **Drainage Layer and Drainage System.** A drainage layer is placed between the root barrier and the growing media to quickly remove excess water from the vegetation root zone. The selection and thickness of the drainage layer type is an important design decision that is governed by the desired stormwater storage capacity, the required conveyance capacity, and the structural capacity of the rooftop. The effective depth of the drainage layer is generally 0.25–1.5 inches thick for extensive green roof system and increases for intensive designs. The drainage layer should consist of synthetic or inorganic materials (e.g., 1–2-inch layer of clean, washed granular material (ASTM D448 size No. 8 stone or lightweight granular mix), high density polyethylene (HDPE)) that are capable of retaining water and providing efficient drainage (ASTM, 2017). A wide range of prefabricated water cups or plastic modules can be used, as well as a traditional system of protected roof drains, conductors, and roof leaders. ASTM E2396 and E2398 can be used to evaluate alternative material specifications (ASTM E2396, 2015 and ASTM E2398, 2015).

7. **Root-Permeable Filter Fabric.** A semi-permeable needled polypropylene filter fabric is normally placed between the drainage layer and the growing media to prevent the media from migrating into the drainage layer and clogging it. The filter fabric must not impede the downward migration of water into the drainage layer.

8. **Growing Media.** The next layer in an extensive green roof is the growing media, which is typically 3–8 inches deep. The recommended growing media for extensive green roofs is typically composed of approximately 70%–80% lightweight inorganic materials, such as expanded slates, shales or clays; pumice; scoria; or other similar materials. The media must contain no more than 30% organic matter, normally well-aged compost (see Appendix C Soil Compost Amendment Requirements). The percentage of organic matter should be limited, since it can leach nutrients into the runoff from the roof and clog the permeable filter fabric. It is advisable to mix the media in a batch facility prior to delivery to the roof. Manufacturer's specifications should be followed for all proprietary roof systems.

   The composition of growing media for intensive green roofs may be different (although the organic material limit still applies), and it is often much greater in depth (e.g., 8–48 inches). If trees are included in the green roof planting plan, the growing media must be sufficient to provide enough soil volume for the root structure of mature trees.

9. **Plant Cover.** The top layer of an extensive green roof typically consists of plants that are slow-growing, shallow-rooted, perennial, and succulent. These plants are chosen for their ability to withstand harsh conditions at the roof surface. Guidance on selecting the appropriate green roof plants can often be provided by green roof manufacturers and can also be found in Snodgrass and Snodgrass (2006). A mix of base ground covers (usually *Sedum* species) and accent plants can be used to enhance the visual amenity value of a green roof. See Section 4.6.4 Green Roof Design Criteria for additional plant information. The design must provide for temporary, manual, and/or

permanent irrigation or watering systems, depending on the green roof system and types of plants. For most applications, some type of watering system should be accessible for initial establishment or drought periods. The use of water efficient designs and/or use of non-potable sources are strongly encouraged.

Material Specifications

Standard specifications for North American green roofs continue to evolve, and no universal material specifications exist that cover the wide range of roof types and system components currently available. The ASTM has recently issued several overarching green roof standards, which are described and referenced in Table 4.22 below.

Designers and reviewers should also fully understand manufacturer specifications for each system component, particularly if they choose to install proprietary "complete" green roof systems or modules.

Table 4.22. Extensive Green Roof Material Specifications

Material	Specification
Roof	Structural capacity must conform to ASTM E2397, *Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems*. In addition, use standard test methods ASTM E2398, *Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetated (Green) Roof Systems* and ASTM E2399, *Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems*.
Leak Detection System	Optional system to detect and locate leaks in the waterproof membrane.
Waterproof Membrane	See Chapter 6 of Weiler and Scholz-Barth (2009) for waterproofing options that are designed to convey water horizontally across the roof surface to drains or gutter. This layer may sometimes act as a root barrier.
Root Barrier	Impermeable liner that impedes root penetration of the membrane.
Drainage Layer	Depth of the drainage layer is generally 0.25–1.5 inches thick for extensive designs. The drainage layer should consist of synthetic or inorganic materials (e.g., gravel, HDPE, etc.) that are capable of retaining water and providing efficient drainage. A wide range of prefabricated water cups or plastic modules can be used, as well as a traditional system of protected roof drains, conductors, and roof leaders. Designers should consult the material specifications as outlined in ASTM E2396 and E2398. Roof drains and emergency overflow must be designed in accordance with the local construction codes.

Material	Specification
Filter Fabric	Generally, needle-punched, non-woven, polypropylene geotextile, with the following qualities: ▪ Strong enough and adequate puncture resistance to withstand stresses of installing other layers of the green roof. Density as per ASTM D3776 ≥ 8 oz/yd^2. Puncture resistance as per ASTM D4833 ≥ 130 lb. These values can be reduced with submission of a Product Data Sheet and other documentation that demonstrates applicability for the intended use. ▪ Adequate tensile strength and tear resistance for long-term performance. ▪ Allows a good flow of water to the drainage layer. Apparent Opening Size, as per ASTM D4751, of ≥ 0.06mm ≤ 0.2mm, with other values based on Product Data Sheet and other documentation as noted above. ▪ Allows at least fine roots to penetrate. ▪ Adequate resistance to soil borne chemicals or microbial growth both during construction and after completion since the fabric will be in contact with moisture and possibly fertilizer compounds.
Growth Media	70%–80% lightweight inorganic materials and a maximum of 30% organic matter (e.g., well-aged compost). Material makeup of the growing media must be provided. Media must provide sufficient nutrient and water holding capacity to support the proposed plant materials. Determine acceptable saturated water permeability using ASTM E2396. An acceptable emerging industry practice combines the drainage layer with the growing media layer.
Plant Materials	*Sedum*, herbaceous plants, and perennial grasses that are shallow-rooted, low maintenance, and tolerant of full and direct sunlight, drought, wind, and frost. See ASTM E2400, *Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems*.

Solar Panels and Other Structures

Occasionally, structures such as solar panels or HVAC systems must be installed above a green roof. These structures can be incorporated into a green roof design with no adverse effects to the retention credit assigned to the green roof if specific design requirements for runoff disbursement, maintenance access, and sun/wind exposure are incorporated, including the following:

- **Structures above the green roof must be no more than 6.5 feet wide.**
- **Structures must have a minimum 3-foot separation between them.**
- **The lower edge of the structure must be at least 1 foot above the top of the green roof, and the upper edge must be at least 2.5 feet above the top of the green roof. This allows for at least a 15-degree tilt. For flatter installations, the lower edge would need to be raised to ensure that the 2.5-foot minimum for the upper edge is met.**

These design requirements are illustrated in Figure 4.22**.**

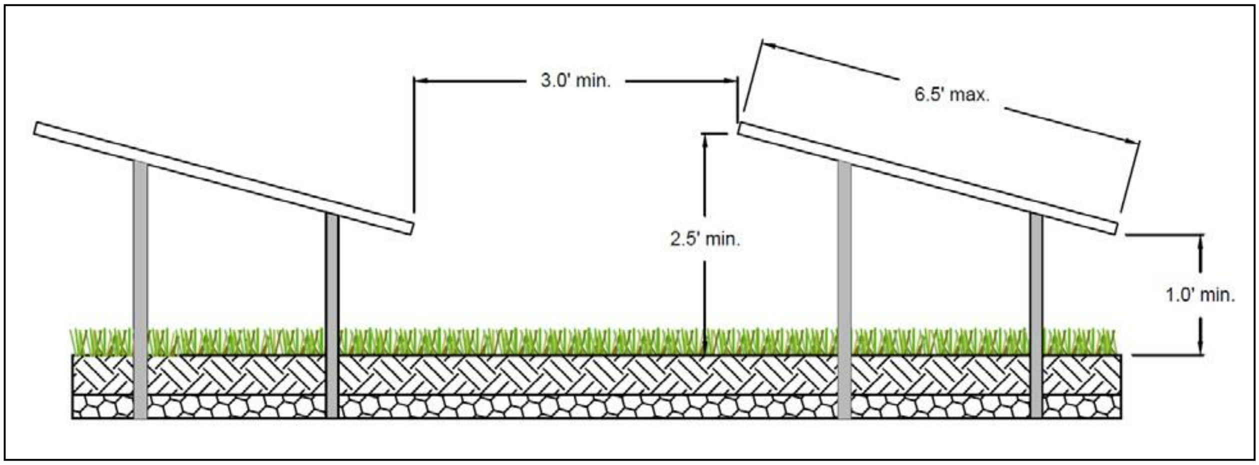


Figure 4.22. Design requirements for structures constructed above green roofs.

Green Roof Sizing

Green roof areas can be designed to capture the entire Stormwater Retention Volume (SWRv). In some cases, they could be designed to capture larger design storm volumes as well. The required size of a green roof will depend on several factors, including maximum water retention of the growing media and the underlying drainage and storage layer materials, if present (e.g., prefabricated water cups or plastic modules). As maximum water retention can vary significantly between green roof products, verification of this value must be included with the Stormwater Management Plan (SWMP). Verification shall be provided by an ASTM-certified lab using the methods described by ASTM tests E2396, E2397, E2398, or E2399, as appropriate. In the absence of laboratory test results, the baseline default values must be used. Equation 4.12 below shall be used to determine the storage volume retained by a green roof.

Equation 4.12. Storage Volume for Green Roofs

$$\mathrm{Sv} = \frac{\mathrm{SA} \times [(\mathrm{d} \times \mathrm{MWR}_1) + (\mathrm{DL} \times \mathrm{MWR}_2)]}{12} \times \mathrm{IF}$$

Where:

Sv	=	green roof storage volume (ft^3)
SA	=	green roof area (ft^2)
d	=	media depth (in.) (minimum 3 in.)
MWR_1	=	verified media maximum water retention (use 0.10 as a baseline default in the absence of verification data)
DL	=	drainage layer depth (in.) (if the drainage layer is combined with the media layer, then this value is 0)
MWR_2	=	verified drainage layer maximum water retention (use 0.0 as a baseline default in the absence of verification data)
IF	=	irrigation factor (0.5 for irrigated green roofs, 1.0 for unirrigated green roofs)

The appropriate Sv can then be compared to the required SWRv for the entire rooftop area (including all conventional roof areas) to determine the portion of the design storm captured.

Green roofs can have dramatic rate attenuation effects on larger storm events and may be used, in part, to manage a portion of the 2- to 25-year events. Designers can model various approaches by factoring in storage within the drainage layer. Routing calculations can also be used to provide a more accurate solution of the peak discharge and required storage volume.

4.6.5 Green Roof Landscaping Criteria

Plant selection, landscaping, and maintenance are critical to the performance and function of green roofs. Therefore, a landscaping plan shall be provided for green roofs.

A planting plan must be prepared for a green roof by a landscape architect, botanist, or other professional experienced with green roofs and submitted with the SWMP.

Plant selection for green roofs is an integral design consideration, which is governed by local climate and design objectives. The primary ground cover for most green roof installations is a hardy, low-growing succulent, such as *Sedum*, *Delosperma*, *Talinum*, *Semperivum*, or *Hieracium* that is matched to the local climate conditions and can tolerate the difficult growing conditions found on building rooftops (Snodgrass and Snodgrass, 2006).

A list of some common green roof plant species that work well in the can South Lowcountry region be found in Table 4.23 below.

Table 4.23. Ground Covers Appropriate for Green Roofs in the State of South Carolina

Plant	Light	Moisture Requirement	Notes
Delosperma cooperii	Full Sun	Dry	Pink flowers; grows rapidly
Delosperma 'Kelaidis'	Full Sun	Dry	Salmon flowers; grows rapidly
Delosperma nubigenum 'Basutoland'	Full Sun	Moist-Dry	Yellow flowers; very hardy
Sedum album	Full Sun	Dry	White flowers; hardy
Sedum lanceolatum	Full Sun	Dry	Yellow flowers; native to U.S.
Sedum oreganum	Part Shade	Moist	Yellow flowers; native to U.S.
Sedum stoloniferum	Sun	Moist	Pink flowers; drought tolerant
Sedum telephiodes	Sun	Dry	Blue green foliage; native to region
Sedum ternatum	Part Shade	Dry-Moist	White flowers; grows in shade
Talinum calycinum	Sun	Dry	Pink flowers; self-sows

Note: Designers should choose species based on shade tolerance, ability to sow or not, foliage height, and spreading rate. See Snodgrass and Snodgrass (2006) for a definitive list of green roof plants, including accent plants.

- Plant choices can be much more diverse for deeper intensive green roof systems. Herbs, forbs, grasses, shrubs, and even trees can be used, but designers should understand they may have higher watering, weeding, and landscape maintenance requirements.
- The species and layout of the planting plan must reflect the location of the building, in terms of its height, exposure to wind, heat stress, orientation to the sun, and impacts from surrounding buildings. Wind scour and solar burning have been observed on green roof installations that failed to adequately account for neighboring building heights and surrounding window reflectivity. In addition, plants must be selected that are fire resistant and able to withstand heat, cold, and high winds.
- Designers should also match species to the expected rooting depth of the growing media, which can also provide enough lateral growth to stabilize the growing media surface. The planting plan should usually include several accent plants to provide diversity and seasonal color. For a comprehensive resource on green roof plant selection, consult Snodgrass and Snodgrass (2006).
- It is also important to note that most green roof plant species will not be native to the Chesapeake Bay watershed (which contrasts with native plant recommendations for other stormwater practices, such as bioretention and constructed wetlands).
- Given the limited number of green roof plant nurseries in the region, it may be necessary for designers to order plants 6 to 12 months prior to the expected planting date. It is also advisable to have plant materials contract grown.
- Plants can be established using cuttings, plugs, mats, and, more rarely, containers. Several vendors also sell mats, rolls, or proprietary green roof planting modules. For the pros and cons of each method, see Snodgrass and Snodgrass (2006). To achieve 50% coverage after 1 year and 80% coverage after 2 years, the recommended minimum spacing for succulent plantings is 2 plugs per square foot and 10 pounds per 100 square feet.
- When planting cuttings, plugs, and mats, the planting window extends from the spring to early fall; although, it is important to allow plants to root thoroughly before the first killing frost. Green roof manufacturers and plant suppliers may provide guidance on planting windows as well as winter care. Proper planting and care may also be required for plant warranty eligibility.
- When appropriate species are selected, most green roofs will not require supplemental irrigation, except for temporary irrigation during drought or initial establishment. The use of water-efficient designs and/or use of non-potable sources is strongly encouraged. Permanent irrigation of extensive roof designs is prohibited. For intensive roofs, permanent irrigation may be included. However, permanent irrigation can adversely impact the rainfall retention capacity of the green roof. For this reason, soil moisture monitors are a required part of the irrigation system for all irrigated green roofs, and the calculated storage volume for green roofs with permanent irrigation must be reduced by 50%.
- The goal for green roof systems designed for stormwater management is to establish a full and vigorous cover of low-maintenance vegetation that is self-sustaining (not requiring fertilizer inputs) and requires minimal mowing, trimming, and weeding.

The green roof design should include non-vegetated walkways (e.g., paver blocks) to allow for easy access to the roof for weeding and making spot repairs (see Section 4.6.4 Green Roof Design Criteria).

4.6.6 Green Roof Construction Sequence <u>Green Roof Installation</u>

Given the diversity of extensive vegetated roof designs, there is no typical step-by-step construction sequence for proper installation. The following general construction considerations are noted:

- Construct the roof deck with the appropriate slope and material.
- Install the waterproofing method, according to manufacturer's specifications.
- Conduct electric field vector mapping (EVFM®) or flood testing to ensure the system is watertight. Where possible, EVFM® is strongly recommended over the flood test, but not all impermeable membranes and deck systems are compatible with this method. Problems have been noted with the use of EFVM on black ethylene propylene diene terpolymer (EPDM) and with aluminized protective coatings commonly used in conjunction with modified bituminous membranes. If EVFM® or other leak detection systems are not possible, a flood test should be performed instead. The flood test is done by placing at least 2 inches of water over the membrane for 48 hours to confirm the integrity of the waterproofing system.
- Add additional system components (e.g., insulation, root barrier, drainage layer and interior drainage system, and filter fabric) per the manufacturer's specifications, taking care not to damage the waterproofing. Any damage occurring must be reported immediately. Drain collars and protective flashing should be installed to ensure free flow of excess stormwater.
- The growing media should be mixed prior to delivery to the site. Media must be spread evenly over the filter fabric surface as required by the manufacturer. If a delay between the installation of the growing media and the plants is required, adequate efforts must be taken to secure the growing media from erosion and the seeding of weeds. The growing media must be covered and anchored in place until planting. Sheets of exterior grade plywood can also be laid over the growing media to accommodate foot or wheelbarrow traffic. Foot traffic and equipment traffic should be limited over the growing media to reduce compaction beyond manufacturer's recommendations.
- The growing media should be moistened prior to planting, and then planted with the ground cover and other plant materials, per the planting plan or in accordance with ASTM E2400 (2015). Plants should be watered immediately after installation and routinely during establishment.
- It generally takes 2 to 3 growing seasons to fully establish the vegetated roof. The growing medium should contain enough organic matter to support plants for the first growing season, so initial fertilization is not required. Extensive green roofs may require supplemental irrigation during the first few months of establishment. Hand weeding is also critical in the first 2 years (see Table 10.1 of Weiler & Scholz-Barth (2009) for a photo guide of common rooftop weeds).
- Most construction contracts should contain a care and replacement warranty that specifies at least 50% coverage after 1 year and 80% coverage after 2 years for plugs and cuttings, and 90% coverage after 1 year for *Sedum* carpet/tile.

<u>Construction Supervision</u>

Supervision during construction is recommended to ensure that the vegetated roof is built in accordance with these specifications. Inspection checklists should be used that include sign-offs by qualified individuals at critical stages of construction and confirm that the contractor's interpretation of the plan is consistent with the intent of the designer and/or manufacturer.

An experienced installer should be retained to construct the vegetated roof system. The vegetated roof should be constructed in sections for easier inspection and maintenance access to the membrane and roof drains. Careful construction supervision/inspection is needed throughout the installation of a vegetated roof, as follows:

- During placement of the waterproofing layer, to ensure that it is properly installed and watertight.
- During placement of the drainage layer and drainage system.
- During placement of the growing media, to confirm that it meets the specifications and is applied to the correct depth (certification for vendor or source should be provided).
- Upon installation of plants, to ensure they conform to the planting plan (certification from vendor or source should be provided).
- Before issuing use and occupancy approvals.
- At the end of the first or second growing season to ensure desired surface cover specified in the Care and Replacement Warranty has been achieved.

Construction phase inspection checklist for green roof practices can be found in Appendix E Construction Inspection Checklists.

4.6.7 Green Roof Maintenance Criteria

Maintenance Inspections

A green roof should be inspected by a qualified professional twice a year during the growing season to assess vegetative cover and to look for leaks, drainage problems, and any rooftop structural concerns (see Table 4.24). In addition, the green roof should be hand weeded to remove invasive or volunteer plants, and plants and/or media should be added to repair bare areas (refer to ASTM E2400; ASTM, 2015).

If a roof leak is suspected, it is advisable to perform an electric leak survey (e.g., EVFM®), if applicable, to pinpoint the exact location, make localized repairs, and then reestablish system components and ground cover.

The use of herbicides, insecticides, and fungicides should be avoided, since their presence could hasten degradation of some waterproofing membranes. Check with the membrane manufacturer for approval and warranty information. Also, power washing and other exterior maintenance operations should be avoided so that cleaning agents and other chemicals do not harm the green roof plant communities.

Fertilization is generally not recommended due to the potential for leaching of nutrients from the green roof. Supplemental fertilization may be required following the first growing season, but only if plants show signs of nutrient deficiencies and a media test indicates a specific deficiency. Addressing this issue with the holder of the vegetation warranty is recommended. If fertilizer is to be applied, it must be a slow-release type, rather than liquid or gaseous form.

Maintenance inspection checklist for green roofs and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Table 4.24. Typical Maintenance Activities Associated with Green Roofs

Schedule (following construction)	**Activity**
As needed or As required by manufacturer	▪ Water to promote plant growth and survival. ▪ Inspect the green roof and replace any dead or dying vegetation.
Semi-annually	▪ Inspect the waterproof membrane for leaks and cracks. ▪ Weed to remove invasive plants and tree seedlings (do not dig or use pointed tools where there is potential to harm the root barrier or waterproof membrane). ▪ Inspect roof drains, scuppers, and gutters to ensure they are not overgrown and have not accumulated organic matter deposits. Remove any accumulated organic matter or debris. ▪ Inspect the green roof for dead, dying, or invasive vegetation. Plant replacement vegetation as needed.

<u>Waste Material</u>

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.6.8 Green Roof Stormwater Compliance Calculations

Green roofs are credited with 100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (see Table 4.25).

Table 4.25. Retention and pollutant removal of green roofs.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

The practice must be designed using the guidance detailed in Section 4.6.4 Green Roof Design Criteria.

Green roofs also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) from the total runoff volume for the design storms. The resulting reduced runoff volumes can then be used to calculate a reduced Natural Resource Conservation Service (NRCS) curve number (CN) for the site or site drainage area (SDA). The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.7 Rainwater Harvesting

<table>
<tr><th colspan="6">Rainwater Harvesting</th></tr>
<tr><td colspan="6">Definition: Rainwater harvesting systems store rainfall and release it for future use. Rainwater that falls on a rooftop or other impervious surface is collected and conveyed into an above- or below-ground tank (also referred to as a cistern) or settling pond, where it is stored for non-potable uses.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>Varies*</td><td>Varies*</td><td>Varies*</td></tr>
<tr><th colspan="3">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Low to Moderate</td><td>Moderate</td><td colspan="3">Varies*</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">100% of Available Storage Volume</td></tr>
<tr><td>Quarterly</td><td>Every 3 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Reduces runoff rates and volume
▪ Can provide for/supplement irrigation needs</td><td colspan="3">▪ Stored water must be used on regular basis to maintain capacity
▪ Stagnant water can breed mosquitos</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Pretreatment
▪ Conveyance
▪ First flush diverter
▪ Cistern (storage tank)
▪ Overflow
▪ Low water cutoff</td><td colspan="3">▪ Plumbing codes (for indoor tanks)
▪ Size based on CDA, local rainfall patterns, and projected harvest rainwater demand
▪ Location and elevation of cistern
▪ Tank manufacturer's specifications
▪ Irrigation system and application rates</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Inspect/clean pretreatment devices and first flush diverts
▪ Clear gutter/downspouts</td><td colspan="3">▪ Inspect and clean storage tank
▪ Maintenance log required</td></tr>
</table>

[1]Credited pollutant load removal

**Varies according to rainwater harvesting storage capacity and demand*

Rainwater harvesting systems store rainfall for future, non-potable water uses and on-site stormwater disposal/infiltration. By providing a reliable and renewable source of water to end users, rainwater harvesting systems can also have environmental and economic benefits beyond stormwater management (e.g. increased water conservation, water supply during drought and mandatory municipal water supply restrictions, decreased demand on municipal or groundwater supply, decreased water costs for the end-user, potential for increased groundwater recharge, supply of water post storm/hurricane in case of failed municipal infrastructure etc.).

Definition

Rainwater harvesting systems store rainfall and release it for future use. Rainwater that falls on a rooftop or other impervious surface is collected and conveyed into an above- or below-ground tank (also referred to as a cistern) or settling pond where it is stored for non-potable uses or for on-site disposal or infiltration as stormwater. Cisterns can be sized for commercial as well as residential purposes (see Figure 4.23). Residential cisterns are commonly called rain barrels.

Figure 4.23. Example cistern application (photo: Marty Morganello).

The design includes the following:

R-1 Rainwater harvesting for non-potable uses

Non-potable uses of harvested rainwater may include the following:

- Landscape irrigation,
- Exterior washing (e.g., car washes, building facades, sidewalks, street sweepers, and fire trucks),
- Flushing of toilets and urinals,
- Fire suppression (e.g., sprinkler systems),
- Supply for cooling towers, evaporative coolers, fluid coolers, and chillers,
- Supplemental water for closed loop systems and steam boilers,
- Replenishment of water features and water fountains,
- Distribution to a green wall or living wall system, and
- Laundry.

Rainwater stored in a settling pond may only be used for landscape irrigation. Pond design criteria in Section 4.10 and landscaping criteria of Section 4.5.5 shall be followed.

The seven primary components of an enclosed rainwater harvesting system are discussed in detail in Section 4.5.4 Rainwater Harvesting Design Criteria. Some are depicted in Figure 4.25 . The components include the following:

- CDA surface,
- Collection and conveyance system (e.g., gutter and downspouts; number 1 in Figure 4.24)
- Pretreatment, including prescreening and first flush diverters (number 2 in Figure 4.24)
- Cistern (no number, but depicted in Figure 4.24)
- Water quality treatment (as required by Appendix J Rainwater Harvesting Treatment and Management Requirements)
- Distribution system
- Overflow, filter path, or secondary stormwater retention practice (number 8 in Figure 4.24)

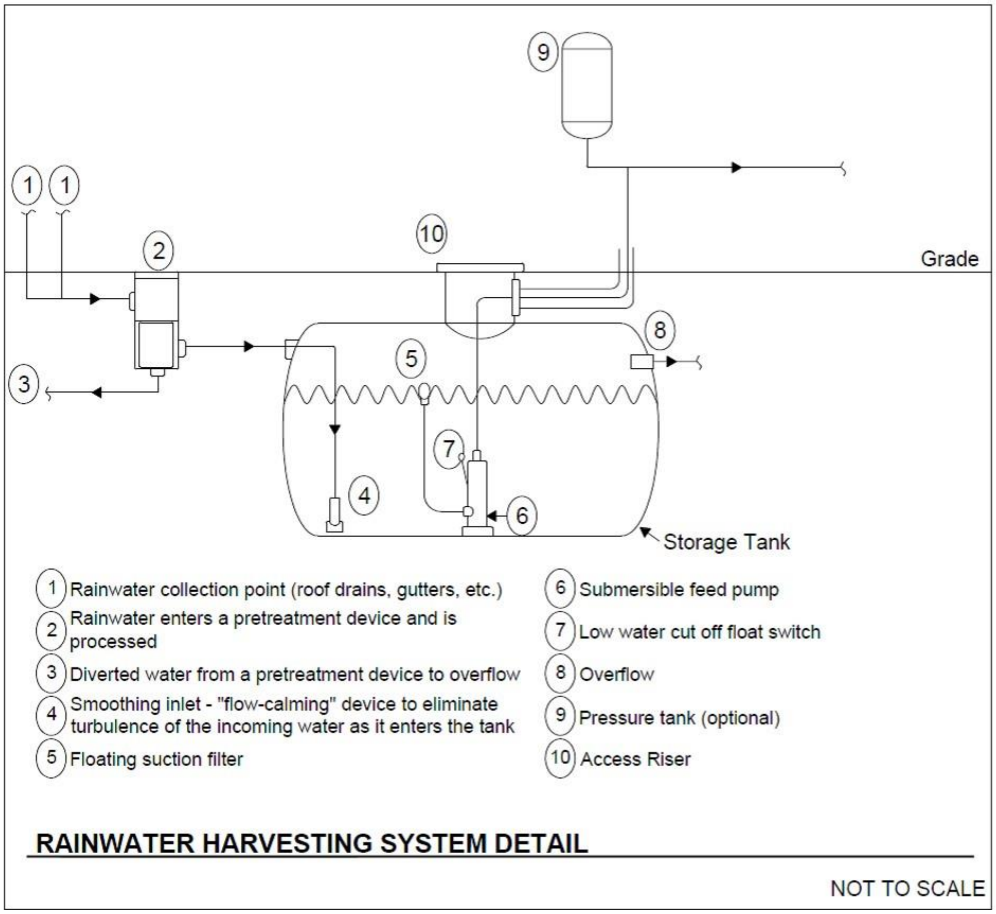


Figure 4.24. Example of a rainwater harvesting system detail.

4.7.1 Rainwater Harvesting Feasibility Criteria

Several site-specific features influence how rainwater harvesting systems are designed and/or utilized. The following are key considerations for rainwater harvesting feasibility. They are not comprehensive or conclusive; rather, they are recommendations to consider during the planning process to incorporate rainwater harvesting systems into the site design.

Plumbing Code

Designers and plan reviewers should consult with local construction codes to determine the allowable indoor uses and required treatment for harvested rainwater. This specification does not address indoor plumbing or disinfection issues. Designers and plan reviewers should refer to the 2012 Uniform Plumbing Code - Chapter 17 Non-potable Rainwater Catchment Systems, or local plumbing codes, as applicable.

Mechanical, Electrical, Plumbing

For systems that call for indoor use of harvested rainwater, the seal of a mechanical, electrical, and plumbing engineer is required.

Water Use

When rainwater harvesting will be used, the requirements in Appendix J Rainwater Harvesting Treatment and Management Requirements must be followed. This will outline the design assumptions and provide water quality end use standards.

Available Space
Adequate space is needed to house the cistern and any overflow. Space limitations are rarely a concern with rainwater harvesting systems if they are considered during the initial building design and site layout of a residential or commercial development. Cisterns can be placed underground, indoors, adjacent to buildings, and on rooftops that are structurally designed to support the added weight. Designers can work with architects and landscape architects to creatively site the cisterns. Underground utilities or other obstructions should always be identified prior to final determination of the cistern location.

Site Topography
Site topography and cistern location should be considered as they relate to every inlet and outlet invert elevation in the rainwater harvesting system.

The final invert of the cistern outlet pipe at the discharge point must match the invert of the receiving mechanism (e.g., natural channel, storm drain system) and be sufficiently sloped to adequately convey this overflow. The elevation drops associated with the various components of a rainwater harvesting system and the resulting invert elevations should be considered early in the design, to ensure that the rainwater harvesting system is feasible for the particular site.

Site topography and cistern location will also affect pumping requirements. Locating cisterns in low areas will make it easier to get water into the cisterns; however, it will increase the amount of pumping needed to distribute the harvested rainwater back into the building or to irrigated areas situated on higher ground. Conversely, placing cisterns at higher elevations may require larger diameter pipes with smaller slopes but will generally reduce the amount of pumping needed for distribution. It is often best to locate a cistern close to the building or SDA, to limit the amount of pipe needed.

Available Hydraulic Head
The required hydraulic head depends on the intended use of the water. For residential landscaping uses, the cistern may be sited up-gradient of the landscaping areas or on a raised stand. Pumps are commonly used to convey stored rainwater to the end use to provide the required head. When the water is being routed from the cistern to the inside of a building for non-potable use, often a pump is used to feed a much smaller pressure tank inside the building, which then serves the internal water demands. Cisterns can also use gravity to accomplish indoor residential uses (e.g., laundry) that do not require high water pressure.

Water Table
Underground storage tanks are most appropriate in areas where the tank can be buried above the water table. The tank should be located in a manner that does not subject it to flooding. In areas where the tank is to be buried partially below the water table, special design features must be employed, such as sufficiently securing the tank (to keep it from floating) and conducting buoyancy calculations when the tank is empty. The tank may need to be secured appropriately with fasteners or weighted to avoid uplift buoyancy. The combined weight of the tank and hold-down ballast must meet or exceed the buoyancy force of the cistern. The cistern must also be installed according to the cistern manufacturer's specifications.

Soils
Cisterns should only be placed on native soils or on fill in accordance with the manufacturer's guidelines. The bearing capacity of the soil upon which the cistern will be placed must be considered, as full cisterns can be very heavy. This is particularly important for above-ground cisterns, as significant settling could

cause the cistern to lean or in some cases to potentially topple. A sufficient aggregate, or concrete foundation, may be appropriate depending on the soils and cistern characteristics. Where the installation requires a foundation, the foundation must be designed to support the cistern's weight when the cistern is full, consistent with the bearing capacity of the soil and good engineering practice. The pH of the soil should also be considered in relation to its interaction with the cistern material.

Proximity of Underground Utilities

All underground utilities must be taken into consideration during the design of underground rainwater harvesting systems, treating all of the rainwater harvesting system components and storm drains as typical stormwater facilities and pipes. The underground utilities must be marked and avoided during the installation of underground cisterns and piping associated with the system.

Contributing Drainage Area

The CDA to the cistern is the area draining to the cistern. Rooftop surfaces are what typically make up the CDA, but paved areas can be used with appropriate treatment (oil/water separators and/or debris excluders).

Contributing Drainage Area Material

The quality of the harvested rainwater will vary according to the roof material or CDA over which it flows. Water harvested from certain types of rooftops and CDAs, such as asphalt sealcoats, tar and gravel, painted roofs, galvanized metal roofs, sheet metal, or any material that may contain asbestos may leach trace metals and other toxic compounds. In general, harvesting rainwater from such surfaces should be avoided. If harvesting from a sealed or painted roof surface is desired, it is recommended that the sealant or paint be certified for such purposes to the NSF International NSF Protocol P151 standard.

Water Quality of Rainwater

Designers should also note that the pH of rainfall in the State tends to be acidic (ranging from 4.5 to 5.0), which may result in leaching of metals from roof surfaces, cistern lining, or water laterals, to interior connections. Once rainfall leaves rooftop surfaces, pH levels tend to be slightly higher, ranging from 5.5 to 6.0. Limestone or other materials may be added in the cistern to buffer acidity, if desired.

Pollutant Hotspot Land Uses

Harvesting rainwater can be an effective method to prevent contamination of rooftop runoff that would result from its mixing with ground-level runoff from a stormwater hotspot operation.

Setbacks from Buildings

Cistern overflow devices must be designed to avoid causing ponding or soil saturation within 10 feet of building foundations. While most systems are generally sited underground and more than 10 feet laterally from the building foundation wall, some cisterns are incorporated into the basement of a building or underground parking areas. In any case, cisterns must be designed to be watertight to prevent water damage when placed near building foundations.

Vehicle Loading

Whenever possible, underground rainwater harvesting systems should be placed in areas without vehicle traffic or other heavy loading, such as deep earth fill. If site constraints dictate otherwise, systems must be designed to support the loads to which they will be subjected.

Feasibility
Rainwater harvesting systems are very well suited to the warm environment of South Carolina and may help to relieve some of the pressure on drinking water aquifers, if applied on a wide scale. In areas with a high-water table, above ground installations will often be more appropriate.

Economic Considerations
Rainwater harvesting systems can provide cost savings by replacing or augmenting municipal water supply needs.

4.7.2 Rainwater Harvesting Conveyance Criteria **Collection and Conveyance**
The collection and conveyance systems consist of the gutters, downspouts, and pipes that channel rainfall into cisterns. Gutters and downspouts should be designed as they would for a building without a rainwater harvesting system.

Pipes, which connect downspouts to the cistern, should be at a minimum slope of 1.5% and sized/designed to convey the intended design storm, as specified above. In some cases, a steeper slope and larger sizes may be recommended and/or necessary to convey the required runoff, depending on the design objective and design storm intensity. Gutters and downspouts should be kept clean and free of debris and rust.

Overflow
An overflow mechanism must be included in the rainwater harvesting system design in order to handle an individual storm event or multiple storms in succession that exceed the capacity of the cistern. The overflow pipe(s) must have a capacity greater than or equal to the inflow pipe(s) and have a diameter and slope sufficient to drain the cistern while maintaining an adequate freeboard height. The overflow pipe(s) must be screened to prevent access to the cistern by small mammals and birds and must include a backflow preventer if it connects directly to the combined sewer or storm sewer. All overflow from the system must be directed to an acceptable flow path that will not cause erosion during a 2-year storm event.

4.7.3 Rainwater Harvesting Pretreatment Criteria
Prefiltration is required to keep sediment, leaves, contaminants, and other debris from the system. Leaf screens and gutter guards meet the minimal requirement for prefiltration of small systems, although direct water filtration is preferred. The purpose of prefiltration is to significantly cut down on maintenance by preventing organic buildup in the cistern, thereby decreasing microbial food sources.

Various pretreatment devices are described below. In addition to the initial first flush diversion, filters have an associated efficiency curve that estimates the percentage of rooftop runoff that will be conveyed through the filter to the cistern. If filters are not sized properly, a large portion of the rooftop runoff may be diverted and not conveyed to the cistern at all. A design intensity of 1 inch per hour (for design storm = SWRv) must be used for the purposes of sizing pre-cistern conveyance and filter components. This design intensity captures a significant portion of the total rainfall during a large majority of rainfall events (NOAA, 2004). If the system will be used for channel and flood protection, the 2- to 25-year storm intensities must be used for the design of the conveyance and pretreatment portion of the system. The Appendix K Rainwater Harvesting Storage Volume Calculator, discussed in Section 4.7.4 Rainwater Harvesting Design Criteria, allows for input of variable filter efficiency rates for the design storm. To meet the requirements to manage the 2- to 25-year storms, a minimum filter efficiency of 90% must be met.

- **First Flush Diverters.** First flush diverters (see Figure 4.25) direct the initial pulse of rainfall away from the cistern. While leaf screens effectively remove larger debris such as leaves, twigs, and blooms from harvested rainwater, first flush diverters can be used to remove smaller contaminants such as dust, pollen, and bird and rodent feces.
- **Leaf Screens.** Leaf screens are mesh screens installed over either the gutter or downspout to separate leaves and other large debris from rooftop runoff. Leaf screens must be regularly cleaned to be effective; if not maintained, they can become clogged and prevent rainwater from flowing into the cisterns. Built-up debris can also harbor bacterial growth within gutters or downspouts (Texas Water Development Board, 2005).
- **Roof Washers.** Roof washers are placed just ahead of cisterns and are used to filter small debris from harvested rainwater (see Figure 4.26). Roof washers consist of a cistern, usually between 25 and 50 gallons in size, with leaf strainers and a filter with openings as small as 30 microns. The filter functions to remove very small particulate matter from harvested rainwater. All roof washers must be cleaned on a regular basis.
- **Hydrodynamic Separator.** For large-scale applications, hydrodynamic separators and other devices can be used to filter rainwater from larger CDAs.

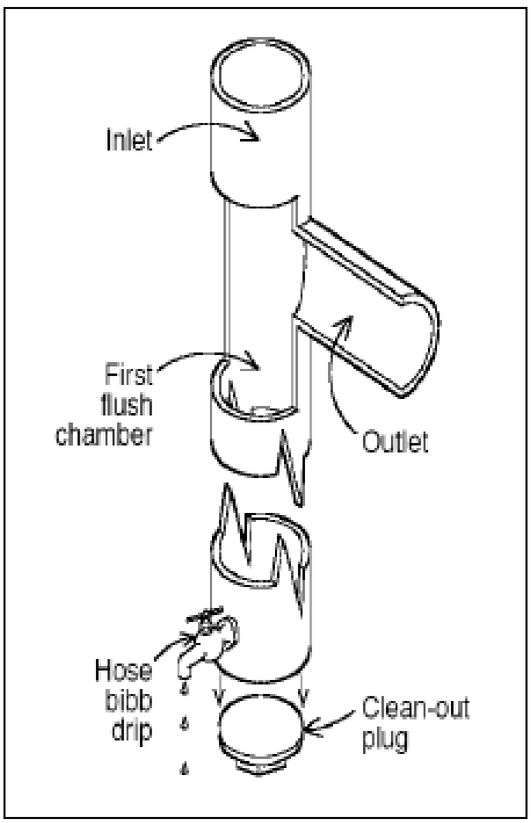


Figure 4.25. Diagram of a first flush diverter (photo: Texas Water Development Board, 2005).

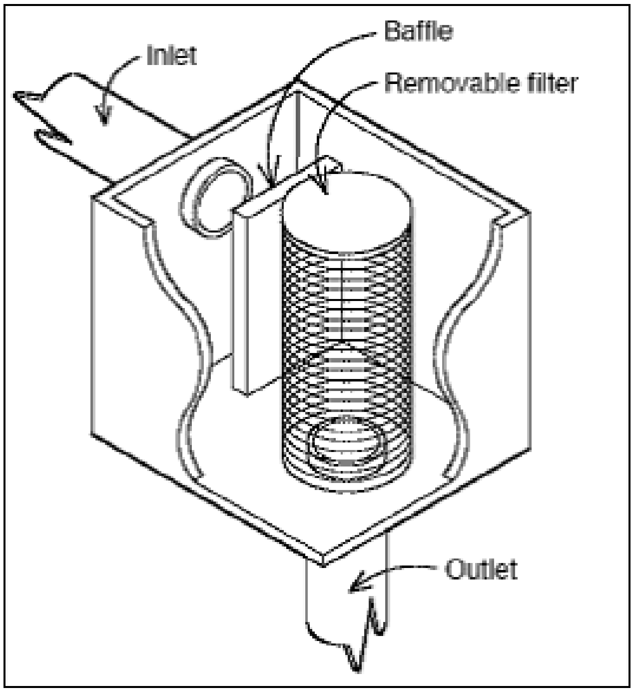


Figure 4.26. Diagram of a roof washer (photo: Texas Water Development Board, 2005).

4.7.4 Rainwater Harvesting Design Criteria

System Components: Seven primary components of a rainwater harvesting system require special considerations:

- CDA or CDA surface
- Collection and conveyance system (i.e., gutter and downspouts)
- Cisterns (Storage Tank)
- Pretreatment, including prescreening and first flush diverters
- Water quality treatment (as described in Appendix J Rainwater Harvesting Treatment and Management Requirements)
- Distribution systems
- Overflow, filter path, or secondary stormwater retention practice

The system components are discussed below:

CDA Surface

When considering CDA surfaces, smooth, non-porous materials will drain more efficiently. Slow drainage of the CDA leads to poor rinsing and a prolonged first flush, which can decrease water quality.

Rainwater can also be harvested from other impervious surfaces, such as parking lots and driveways; however, this practice requires more extensive pretreatment and treatment prior to use.

Collection and Conveyance System
See Section 1544.7.2 Rainwater Harvesting Conveyance Criteria.

Pretreatment
See Section 4.7.3 Rainwater Harvesting Pretreatment Criteria.

Cisterns (Storage Tank)
Also known as the storage tank, the cistern is the most important and typically the most expensive component of a rainwater harvesting system. Cistern capacities generally range from 250 to 30,000 gallons, but they can be as large as 100,000 gallons or more for larger projects. Multiple cisterns can be placed adjacent to each other and connected with pipes to balance water levels and to tailor the storage volume needed. Typical rainwater harvesting system capacities for residential use range from 1,500 to 5,000 gallons. Cistern volumes are calculated to meet the water demand and stormwater storage volume retention objectives, as described further below in this specification.

While many of the graphics and photos in this specification depict cisterns with a cylindrical shape, the cisterns can be made of many materials and configured in various shapes, depending on the type used and the site conditions where the cisterns will be installed. For example, configurations can be rectangular, L-shaped, or step vertically to match the topography of a site. The following factors should be considered when designing a rainwater harvesting system and selecting a cistern:

- Aboveground cisterns should be ultraviolet and impact resistant.
- Underground cisterns must be designed to support the overlying sediment and any other anticipated loads (e.g., vehicles, pedestrian traffic).
- Underground rainwater harvesting systems must have a standard size manhole or equivalent opening to allow access for cleaning, inspection, and maintenance purposes. The access opening must be installed in such a way as to prevent surface- or groundwater from entering through the top of any fittings, and it must be secured/locked to prevent unwanted entry. Confined space safety precautions/requirements should be observed during cleaning, inspection, and maintenance.
- All rainwater harvesting systems must be sealed using a water-safe, non-toxic substance.
- Rainwater harvesting systems may be ordered from a manufacturer or can be constructed on site from a variety of materials. Table 4. 26 compares the advantages and disadvantages of different cistern materials.
- Cisterns must be opaque or otherwise protected from direct sunlight to inhibit growth of algae, and they must be screened to discourage mosquito breeding.
- Dead storage below the outlet to the distribution system and an air gap at the top of the cistern must be included in the total cistern volume. For gravity-fed systems, a minimum of 6 inches of dead storage must be provided. For systems using a pump, the dead storage depth will be based on the pump specifications.
- Any hookup to a municipal backup water supply must have a backflow prevention device to keep municipal water separate from stored rainwater; this may include incorporating an air gap to separate the two supplies.

Table 4. 26. Advantages and Disadvantages of Typical Cistern Materials

Cistern Material	Advantages	Disadvantages
Fiberglass	Commercially available, alterable and moveable; durable with little maintenance; light weight; integral fittings (no leaks); broad application	Must be installed on smooth, solid, level footing; pressure proof for below-ground installation; expensive in smaller sizes
Polyethylene	Commercially available, alterable, moveable, affordable; available in wide range of sizes; can install above or below ground; little maintenance; broad application	Can be UV-degradable; must be painted or tinted for above-ground installations; pressure-proof for below-ground installation
Modular Storage	Can modify to topography; can alter footprint and create various shapes to fit site; relatively inexpensive	Longevity may be less than other materials; higher risk of puncturing of watertight membrane during construction
Plastic Barrels	Commercially available; inexpensive	Low storage capacity (20–50 gallons); limited application
Galvanized Steel	Commercially available, alterable, and moveable; available in a range of sizes; film develops inside to prevent corrosion	Possible external corrosion and rust; must be lined for potable use; can only install above ground; soil pH may limit underground applications
Steel Drums	Commercially available, alterable, and moveable	Small storage capacity; prone to corrosion, and rust can lead to leaching of metals; verify prior to reuse for toxics; water pH and soil pH may also limit applications
FerroConcrete	Durable and immoveable; suitable for above or below ground installations; neutralizes acid rain	Potential to crack and leak; expensive
Cast-in-Place Concrete	Durable, immoveable, and versatile; suitable for above or below ground installations; neutralizes acid rain	Potential to crack and leak; permanent; will need to provide adequate platform and design for placement in clay soils
Stone or Concrete Block	Durable and immoveable; keeps water cool in summer months	Difficult to maintain; expensive to build

Source: Cabell Brand Center, 2007; Cabell Brand Center, 2009

- **Water Quality Treatment**
  Depending upon the collection surface, method of dispersal, and proposed use for the harvested rainwater, a water quality treatment device may be required. Treatment requirements are described in Appendix J Rainwater Harvesting Treatment and Management Requirements.

- **Distribution Systems**
  Most distribution systems require a pump to convey harvested rainwater from the cistern to its final destination, whether inside the building, an automated irrigation system, or gradually discharged to a secondary stormwater treatment practice. The rainwater harvesting system should be equipped with an appropriately sized pump that produces sufficient pressure for all end-uses.

The typical pump and pressure tank arrangement consists of a multi-stage, centrifugal pump, which draws water out of the cistern and sends it into the pressure tank, where it is stored for distribution. Some systems will not require this two-tank arrangement (e.g., low-pressure and gravel systems). When water is drawn out of the pressure tank, the pump activates to supply additional water to the distribution system. The backflow preventer is required to separate harvested rainwater from the main potable water distribution lines.

A drain plug or cleanout sump must be installed to allow the system to be completely emptied, if needed. Above-ground outdoor pipes must be insulated or heat-wrapped to prevent freezing and ensure uninterrupted operation during winter if winter use is planned.

- **Overflow**
  See Section 4.7.2 Rainwater Harvesting Conveyance Criteria.

Rainwater Harvesting Material Specifications
The basic material specifications for rainwater harvesting systems are presented in Table 4.27. Designers should consult with experienced rainwater harvesting system and irrigation installers on the choice of recommended manufacturers of prefabricated cisterns and other system components.

Table 4.27. Design Specifications for Rainwater Harvesting Systems

Item	Specification
Gutters and Downspouts	Materials commonly used for gutters and downspouts include polyvinylchloride (PVC) pipe, vinyl, aluminum, and galvanized steel. Lead must not be used as gutter and downspout solder, since rainwater can dissolve the lead and contaminate the water supply. ▪ The length of gutters and downspouts is determined by the size and layout of the catchment and the location of the cisterns. ▪ Include needed bends and tees.
Pretreatment	At least one of the following (all rainwater to pass through pretreatment): ▪ First flush diverter ▪ Hydrodynamic separator ▪ Roof washer ▪ Leaf and mosquito screen (1 mm mesh size)
Cisterns	▪ Materials used to construct cisterns must be structurally sound. ▪ Cisterns should be constructed in areas of the site where soils can support the load associated with stored water. ▪ Cisterns must be watertight and sealed using a water-safe, non-toxic substance. ▪ Cisterns must be opaque or otherwise shielded to prevent the growth of algae. ▪ The size of the rainwater harvesting system(s) is determined through design calculations.

Note: This table does not address indoor systems or pumps.

Design Objectives and System Configuration

Rainwater harvesting systems can have many design variations that meet user demand and stormwater objectives. This specification provides a design framework to achieve the SWRv objectives that are required to comply with the regulations, and it adheres to the following concepts:

- Give preference to use of rainwater as a resource to meet on-site demand or in conjunction with other stormwater retention practices.
- Reduce peak flow by achieving volume reduction and temporary storage of runoff.

Based on these concepts, this specification focuses on system design configurations that harvest rainwater for internal building uses, seasonal irrigation, and other activities, such as cooling tower use and vehicle washing. While harvested rainwater will be in year-round demand for many internal building uses, some other uses will have varied demand depending on the time of year (e.g., cooling towers and seasonal irrigation). Thus, a lower retention volume is assigned to a type of use that has reduced demand.

Design Objectives & Cistern Design Set-Ups

Prefabricated rainwater harvesting cisterns typically range in size from 250 to over 30,000 gallons. Three basic cistern designs meet the various rainwater harvesting system configurations in this section.

Cistern Design 1. The first cistern set-up (Figure 4.27) maximizes the available storage volume to meet the desired level of stormwater retention. This layout also maximizes the storage that can be used to meet a demand. An emergency overflow exists near the top of the cistern as the only gravity release outlet device (not including the pump, manway, or inlets). It should be noted that it is possible to address 2- to 25-year storm volumes with this cistern configuration, but the primary purpose is to address the smaller SWRv design storm.

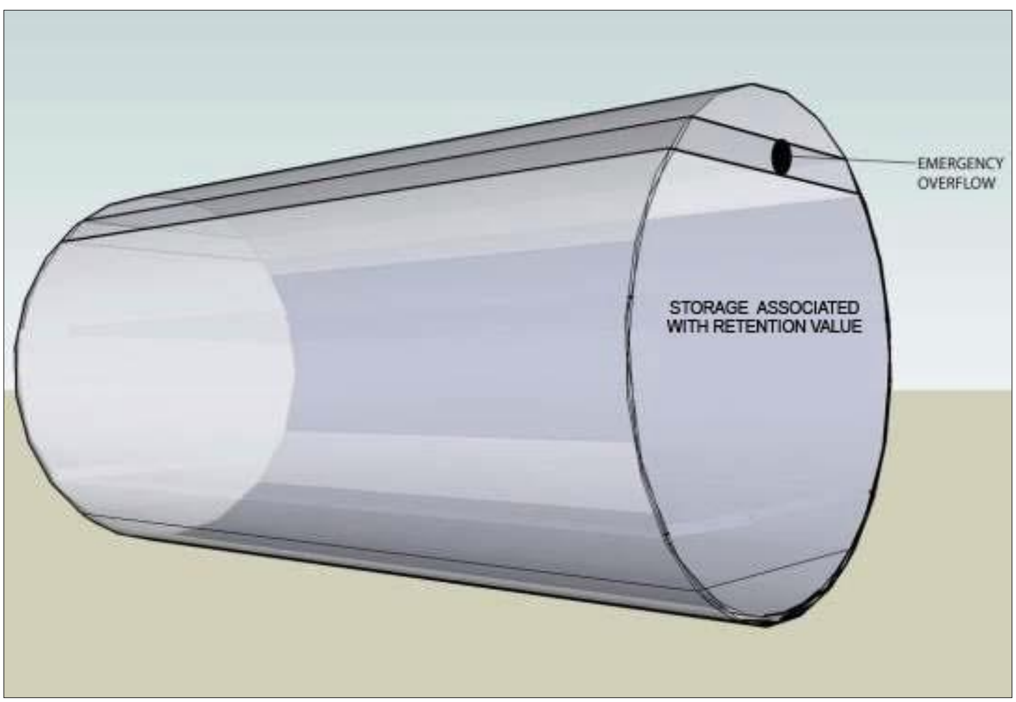


Figure 4.27. Cistern Design 1: Storage associated with the design storm volume only.

Cistern Design 2. The second cistern set-up (Figure 4.28) uses cistern storage to meet the SWRv retention objectives and also uses additional detention volume to meet some or all of the 2- to 25-year storm volume requirements. An orifice outlet is provided at the top of the design storage for the SWRv level, and an emergency overflow is located at the top of the detention volume level.

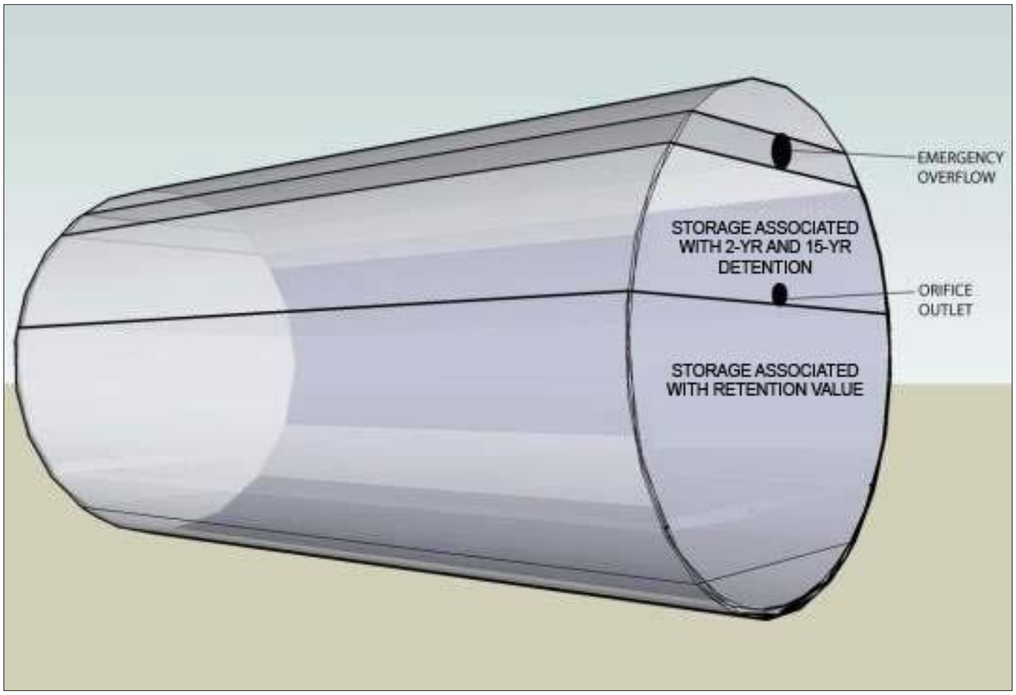


Figure 4.28. Cistern Design 2: Storage associated with design storm, channel protection, and flood volume.

Cistern Design 3. The third cistern set-up (Figure 4.29) creates a constant drawdown within the system. The small orifice at the bottom of the cistern needs to be routed to an appropriately designed secondary practice (i.e., bioretention, stormwater infiltration) that will allow the rainwater to be treated and allow for groundwater recharge over time. The release must not be discharged to a receiving channel or storm drain without treatment, and maximum specified drawdown rates from this constant drawdown should be adhered to, since the primary function of the system is not intended to be detention.

While a small orifice is shown at the bottom of the cistern in Figure 4.29, the orifice could be replaced with a pump that would serve the same purpose, conveying a limited amount of water to a secondary practice on a routine basis.

For this design, the secondary practice must be considered a component of the rainwater harvesting system with regard to the storage volume calculated in the General Retention Compliance Calculator in Appendix H. In other words, the storage volume associated with the secondary practice must not be included as a separate BMP because the secondary practice is an integral part of a rainwater harvesting system with a constant drawdown.

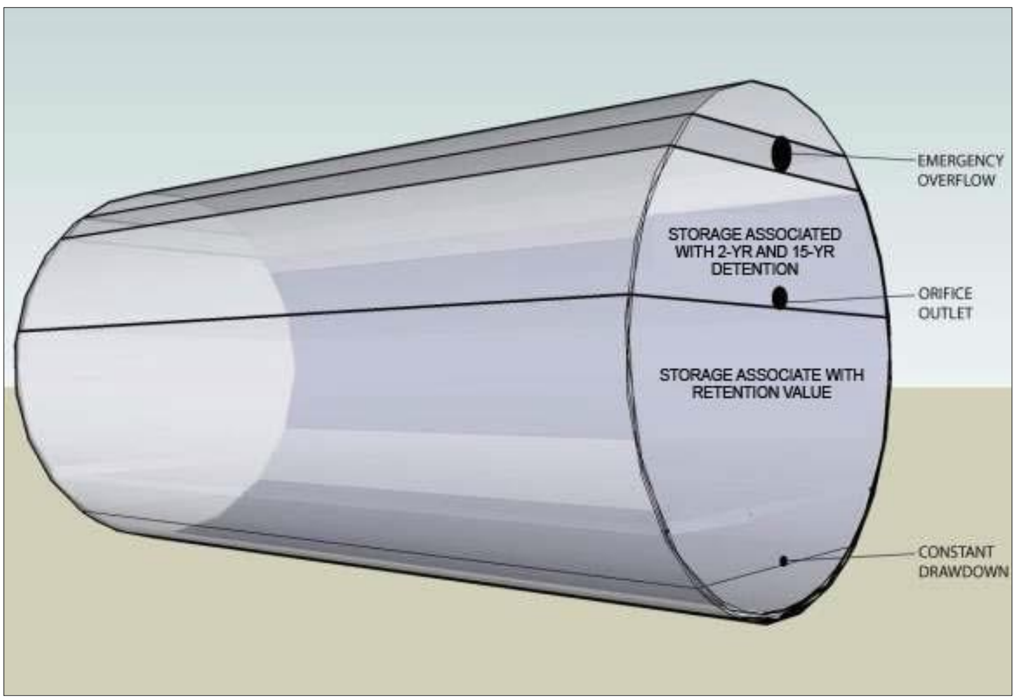


Figure 4.29. Cistern Design 3: Constant drawdown version where storage is associated with design storm, channel protection, and flood volume.

Sizing of Rainwater Harvesting Systems

The rainwater harvesting cistern sizing criteria presented in this section were developed using a spreadsheet model that used best estimates of indoor and outdoor water demand, long-term rainfall data, and CDA capture area data (Forasté 2011). The Rainwater Harvesting Storage Volume Calculator in Appendix J1 is used for cistern sizing guidance and to quantify the available storage volume achieved. This storage volume value is required for input into the General Retention Compliance Calculator and is part of the submission of a SWMP using rainwater harvesting systems for compliance. A secondary objective of the spreadsheet is to increase the beneficial uses of the stored stormwater, treating it as a valuable natural resource.

Rainwater Harvesting Storage Volume Calculator

The design specification provided in this section is follows the Rainwater Harvesting Storage Volume Calculator Appendix J1. The spreadsheet uses daily rainfall data from January 1, 2007 to December 31, 2019 to model performance parameters of the cistern under varying CDAs, demands on the system and cistern size.

The size of ponds used for irrigation, their irrigation area and characteristics of soil and land use can be entered in the calculator to determine stormwater volume retained. The runoff that reaches the cistern each day is added to the water level that existed in the cistern the previous day, with all of the total demands subtracted on a daily basis. If any overflow is realized, the volume is quantified and recorded. If the cistern runs dry (reaches the cut-off volume level), then the volume in the cistern is fixed at the low level. A summary of the water balance for the system is provided below.

Incremental Design Volumes within Cistern

Rainwater cistern sizing is determined by accounting for varying precipitation levels, captured CDA runoff, first flush diversion (through filters) and filter efficiency, low water cut-off volume, dynamic water levels at the beginning of various storms, storage needed for the design storm (permanent storage), storage needed for 2- to 25-year volume (temporary detention storage), seasonal and year-round demand use and objectives, overflow volume, and freeboard volumes above high water levels during very large storms. See Figure 4. 30 for a graphical representation of these various incremental design volumes.

The design specification described in this section does not provide guidance for sizing larger storms, but rather provides guidance on sizing for the 85th and 95th percentile design storms.

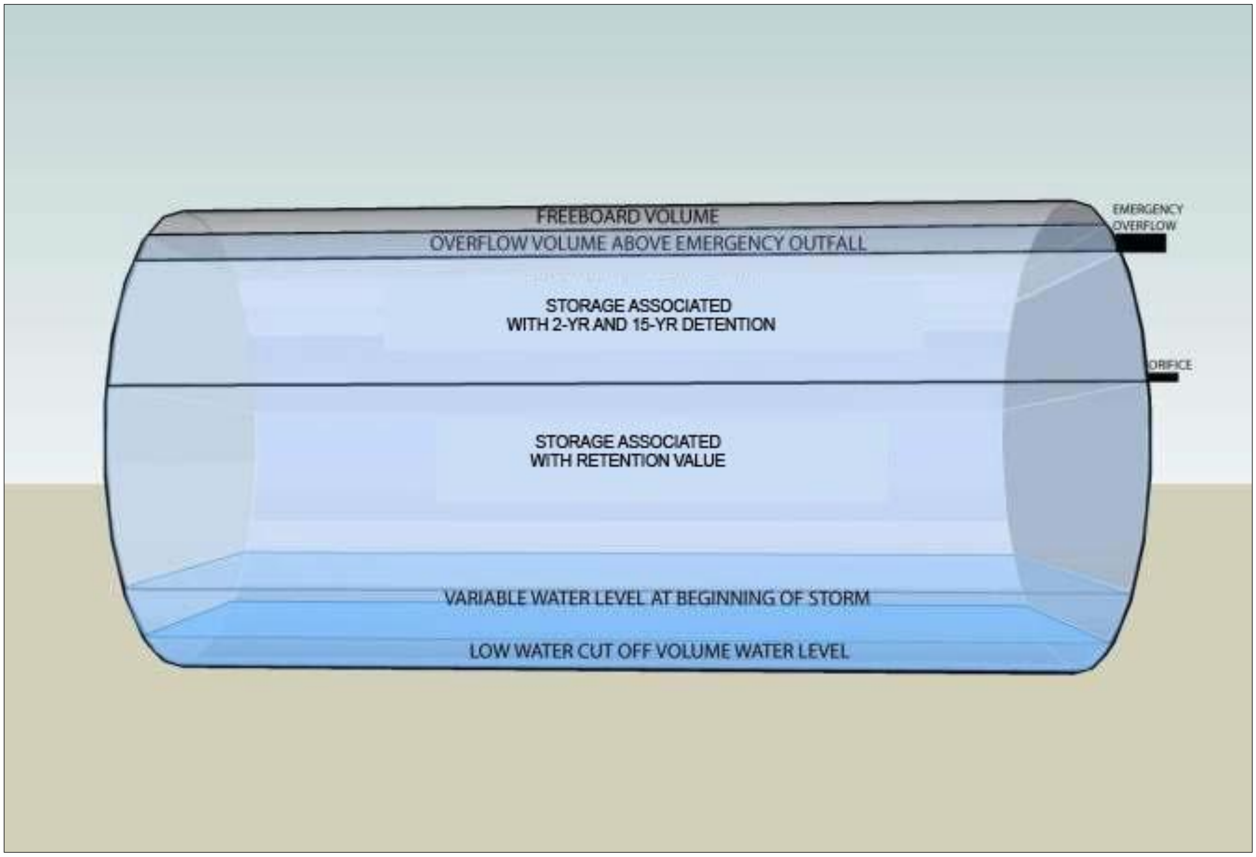


Figure 4.30. Incremental design volumes associated with cistern sizing.

The “Average Available Storage Volume” is the average storage within the cistern that is modeled and available to retain rainfall. While the SWRv will remain the same for a specific CDA, the “Average Available Storage Volume” is dependent on demand and cistern volume. It is the available space in the cistern between the average level at the beginning of a storm and the orifice outflow.

Water Contribution

- **Precipitation**
  The volume of water contributing to the rainwater harvesting system is a function of the rainfall and CDA, as defined by the designer.
- **Municipal Backup (optional)**
  In some cases, the designer may choose to install a municipal backup water supply to supplement cistern levels. Note that municipal backups may also be connected post-cistern (i.e., a connection is made to the non-potable water line that is used for pumping water from the cistern for reuse), thereby not contributing any additional volume to the cistern. Municipal backup designs that supply water directly to the cistern are not accounted for in the Rainwater Harvesting Storage Volume Calculator.

Water Losses

- **Contributing Drainage Area Runoff Coefficient**
  The CDA is assumed to convey 95% of the rainfall that lands on its surface (i.e., $RRRR = 0.95$).
- **First Flush Diversion**
  The first 0.02 to 0.06 inches of rainfall that is directed to filters is diverted from the system in order to prevent clogging it with debris. This value is assumed to be contained within the filter efficiency rate.
- **Filter Efficiency**
  It is assumed that, after the first flush diversion and loss of water due to filter inefficiencies, the remainder of the design storm will be captured successfully. For the 85^{th} or 95^{th} percentile storms, a minimum of 95% of the runoff should be conveyed into the cistern. The minimum values are included as the filter efficiencies in the Rainwater Harvesting Storage Volume Calculator, although they can be altered (increased) if appropriate. The Rainwater Harvesting Storage Volume Calculator applies these filter efficiencies, or interpolated values, to the daily rainfall record to determine the volume of runoff that reaches the cistern. For the purposes of selecting an appropriately sized filter, a rainfall intensity of 1 inch per hour shall be used when the design storm is the SWRv. The appropriate rainfall intensity values for the 2- to 25-year storms shall be used when designing for larger storm events.
- **Drawdown (Storage Volume)**
  This is the stored water within the cistern that is reused or directed to a secondary stormwater practice. It is the volume of runoff that is reduced from the CDA. This is the water loss that translates into the achievable storage volume retention.

Overflow

For the purposes of addressing the SWRv (not for addressing larger storm volumes), orifice outlets for both detention and emergency overflows are treated the same. This is the volume of water that may be lost during large storm events or successive precipitation events.

Storage Volume Results

The Rainwater Harvesting Storage Volume Calculator determines the average daily volume of water in the cistern for a range of cistern sizes. From this value, the available storage volume for the 85th and 95th percentile storm can be calculated; it is simply the difference between the cistern size and the average daily volume. The available storage volume for the selected cistern size should be used as an input to the General Retention Compliance Calculator. Similarly, the pond used for irrigation stormwater volume is entered in the General Retention Compliance Calculator in the rainwater harvesting row rather than the stormwater pond row to produce runoff reduction and pollutant removal credit with the other BMPs for the stormwater plan.

- **Available Storage Volume (Sv)**
  The volume available for storage of the 85th and 95th percentile storm is calculated for multiple sizes of cisterns. A trade-off curve plots these results, which allows for a comparison of the retention achieved versus cistern size. While larger cisterns yield more retention, they are more expensive. The curve helps the user to choose the appropriate cistern size, based on the design objectives and site needs.

- **Overflow Volume**
  The volume of the overflows resulting from the 85th or 95th percentile precipitation event is also reported in this sheet. The overflow volume is also plotted to illustrate the effects of cistern size on overflow volume. An example chart is shown in Figure 4.31. The effect of diminishing returns is clear. Beyond a cistern size of 9,000 gallons, the overflow volume drops to zero. So, while the available storage continues to increase, the 85th or95th percentile storm is entirely retained, and no additional retention will be possible.

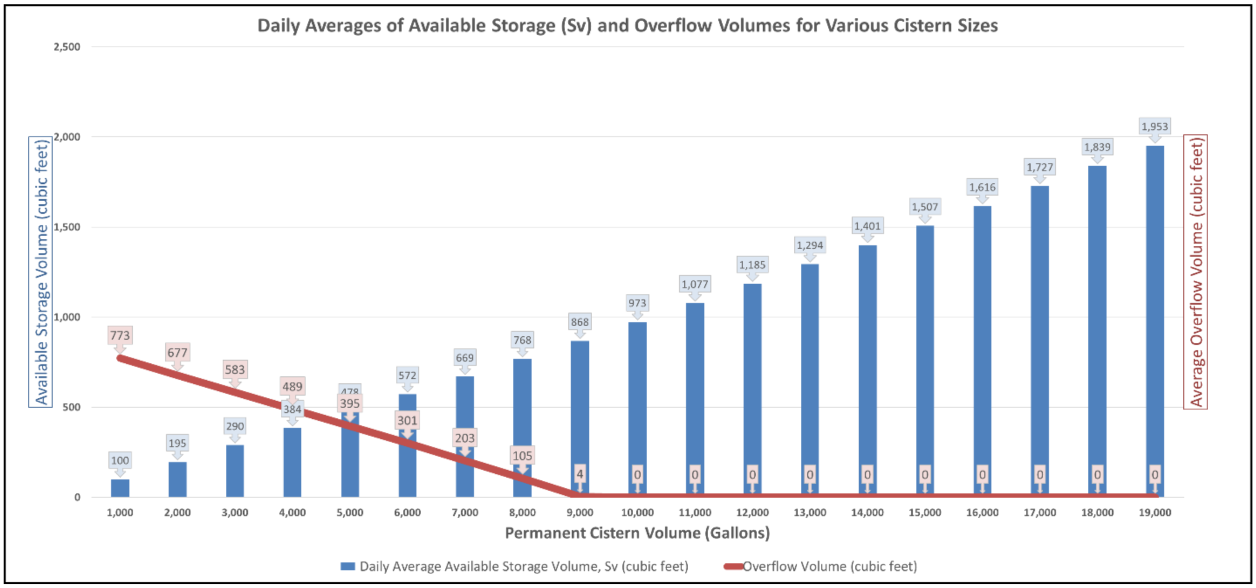


Figure 4.31. Example of graph showing Average Available Storage Volume and Overflow Volume for an example cistern design.

Results from the Rainwater Harvesting Storage Volume Calculator to be Transferred to the Compliance Calculator

There are two results from the Rainwater Harvesting Storage Volume Calculator that are to be transferred to the Compliance Calculator as follows:

- **Contributing Drainage Area**
  Enter the CDA that was used in the Rainwater Harvesting Storage Volume Calculator into the appropriate columns in the "Rainwater Harvesting" row of the Compliance Calculator BMP sheet.

- **Available Storage Volume**
  Once a cistern has been selected, enter the Available Storage Volume (ft^3) associated with that cistern into the Compliance Calculator column called "Storage Volume Provided by BMP" in the "Rainwater Harvesting" row of the BMP sheet.

Completing the Sizing Design of the Cistern

The total size of the cistern is the sum of the following four volume components:

- **Low Water Cutoff Volume (Included)**
  A dead storage area must be included so the pump will not run the cistern dry. This volume is included in the Rainwater Harvesting Storage Volume Calculator's modeled volume.

- **Cistern Storage Associated with Design Volume (Included)**
  This is the cistern design volume from the Rainwater Harvesting Storage Volume Calculator.

- **Adding Channel Protection and Flood Volumes (Optional)**
  Additional detention volume may be added above and beyond the cistern storage associated with the design storm volumes for the 2- to 25-year events. Typical routing software programs may be used to design for this additional volume.

- **Adding Overflow and Freeboard Volumes (Required)**
  An additional volume above the emergency overflow must be provided in order for the cistern to allow very large storms to pass. Above this overflow water level, there will be an associated freeboard volume that should account for at least 5% of the overall cistern size. Sufficient freeboard must be verified for large storms, and these volumes must be included in the overall size of the cistern.

4.7.5 Rainwater Harvesting Landscaping Criteria

If the harvested water is to be used for irrigation, the design plan elements must include the proposed delineation of planting areas to be irrigated, the planting plan, and quantification of the expected water demand. The default water demand for irrigation is 1.0 inches per week over the area to be irrigated during the months of May through October only. Justification must be provided if larger volumes are to be used.

4.7.6 Rainwater Harvesting Construction Sequence <u>Installation</u>

It is advisable to have a single contractor to install the rainwater harvesting system, outdoor irrigation system, and secondary retention practices. The contractor should be familiar with rainwater harvesting system sizing, installation, and placement. A licensed plumber is required to install the rainwater harvesting system components to the plumbing system.

A standard construction sequence for proper rainwater harvesting system installation is provided below. This can be modified to reflect different rainwater harvesting system applications or expected site conditions.

1. Choose the cistern location on the site.
2. Route all downspouts or pipes to prescreening devices and first flush diverters.
3. Properly install the cistern.
4. Install the pump (if needed) and piping to end uses (indoor, outdoor irrigation, or cistern dewatering release).
5. Route all pipes to the cistern.
6. Stormwater must not be diverted to the rainwater harvesting system until the overflow filter path has been stabilized with vegetation.

<u>Construction Supervision</u>

The following items should be inspected by a qualified professional in the mechanical, electrical, or plumbing fields prior to final sign-off and acceptance of a rainwater harvesting system:

- Rooftop area matches plans

- Diversion system is properly sized and installed
- Pretreatment system is installed
- Mosquito screens are installed on all openings
- Overflow device is directed as shown on plans
- Rainwater harvesting system foundation is constructed as shown on plans
- Catchment area and overflow area are stabilized
- Secondary stormwater treatment practice(s) is installed as shown on plans
- System commissioning

Construction phase inspection checklist for rainwater harvesting practices and the Stormwater Facility Leak Test form can be found in Appendix E Construction Inspection Checklists.

4.7.7 Rainwater Harvesting Maintenance Criteria **Maintenance Inspections**

Periodic inspections and maintenance shall be conducted for each system by a qualified professional.

Maintenance inspection checklists for rainwater harvesting systems and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Maintenance Schedule

Maintenance requirements for rainwater harvesting systems vary according to use. Systems that are used to provide supplemental irrigation water have relatively low maintenance requirements, while systems designed for indoor uses have much higher maintenance requirements. Table 4.28 describes routine maintenance tasks necessary to keep rainwater harvesting systems in working condition. It is recommended that maintenance tasks be performed by an "Inspector Specialist," certified by the American Rainwater Catchment Association. Maintenance tasks must be documented and substantially comply with the maintenance responsibilities outlined in the maintenance agreement.

Table 4.28. Typical Maintenance Tasks for Rainwater Harvesting Systems

Responsible Person	Frequency	Activity
Owner	Four times a year	Inspect and clean prescreening devices and first flush diverters
	Twice a year	Keep gutters and downspouts free of leaves and other debris
	Once a year	▪ Inspect and clean storage cistern lids, paying special attention to vents and screens on inflow and outflow spigots. Check mosquito screens and patch holes or gaps immediately ▪ Inspect condition of overflow pipes, overflow filter path, and/or secondary stormwater treatment practices
	Every third year	Clear overhanging vegetation and trees over roof surface
Qualified	According to Manufacturer	Inspect water quality devices

Responsible Person	Frequency	Activity
Third-Party Inspector	As indicated in Appendix J Rainwater Harvesting Treatment and Management Requirements	Field verification and data logs must be available at all times and annual reports should be sent to the Public Works Department.
	Every third year	▪ Inspect cistern for sediment buildup ▪ Check integrity of backflow preventer ▪ Inspect structural integrity of cistern, pump, pipe and electrical system ▪ Replace damaged or defective system components

Mosquitoes

In some situations, poorly designed rainwater harvesting systems can create habitat suitable for mosquito breeding. Designers must provide screens on above- and below-ground cisterns to prevent mosquitoes and other insects from entering the cisterns. If screening is not sufficient in deterring mosquitoes, dunks or pellets containing larvicide can be added to cisterns when water is intended for landscaping use.

Waste Material

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.7.8 Rainwater Harvesting Stormwater Compliance Calculations

Rainwater harvesting practices are credited with 100% retention for the average available storage volume (Sv) available in the cistern as well as 100% TSS, TN, and bacteria removal (see Table 4.29). This average available storage volume is determined by using the Rainwater Harvesting Storage Volume Calculator, as described in Section 4.5.4 Rainwater Harvesting Design Criteria.

Table 4.29. Rainwater Harvesting Retention and Pollutant Removal

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

Rainwater harvesting practices also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume from the total runoff volume for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.8 Impervious Surface Disconnection

<table>
<tr><th colspan="5">Impervious Surface Disconnection</th></tr>
<tr><td colspan="5">Definition: This strategy involves managing runoff close to its source by directing it from rooftops and other impervious surfaces to pervious areas.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80%</td><td>40%</td><td>40%</td></tr>
<tr><th colspan="3">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Low</td><td>Low</td><td colspan="3">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">40%</td></tr>
<tr><td>At least annually</td><td>As needed</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Low cost construction and maintenance
▪ Reduces runoff volume
▪ Helps restore pre-development hydrologic conditions</td><td colspan="3">▪ Only applicable to small drainage areas
▪ Difficult to apply to treatment trains
▪ Requires pervious receiving area</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Receiving area
▪ Vegetation
▪ Receiving soils</td><td colspan="3">▪ Maximum CDA of 1,000 ft^2 per disconnection
▪ Disconnection area should be at least 35 feet long and 10 feet wide.
▪ Slope of receiving area should be < 2% (with turf reinforcement, <5%)
▪ Building setback for areas with < 1% slope</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Typical lawn/landscaping maintenance</td><td colspan="3">▪ Ensure receiving area remains uncompacted and pervious</td></tr>
</table>

[1]*Credited pollutant load removal*

In this practice, runoff from a rooftop or other small impervious surface is directed to a pervious surface or small practice to provide infiltration, filtering, or reuse (Figure 4.32**)**


Figure 4.32. Rooftop disconnection (photo: Center for Watershed Protection, Inc.)

Definition
This strategy involves managing runoff close to its source by directing it from rooftops and other impervious surfaces to pervious areas. Disconnection practices can be used to reduce the volume of runoff that enters the combined or separate sewer systems. Applicable practices include the following:

D-1 Disconnection to pervious areas with the compacted cover designation

D-2 Disconnection to conservation areas

Disconnection practices reduce a portion of the SWRv. In order to fully meet retention requirements, , disconnection practices must be combined with additional practices.

4.8.1 Impervious Surface Disconnection Feasibility Criteria
Impervious surface disconnections are ideal for use on commercial, institutional, municipal, multi-family residential, and single-family residential buildings. Key constraints with impervious surface disconnections include available space, soil permeability, and soil compaction. These and other feasibility criteria are described below and summarized in Table 4. 30.

- **Contributing Drainage Area.** For rooftop impervious areas, the maximum impervious area treated cannot exceed 1,000 square feet per disconnection. For impervious areas other than rooftop, the longest contributing impervious area flow path cannot exceed 75 feet.
- **Sizing.** The available disconnection area must be at least 10 feet wide and 35 feet long. For sheet flow from impervious areas, the disconnection area must be as wide as the area draining to it.
- **Site Topography.** Disconnection is best applied when the grade of the receiving pervious area is less than 2%, or less than 5% with turf reinforcement. The slope of the receiving areas must be graded away from any building foundations. Turf reinforcement may include erosion control matting or other appropriate reinforcing materials that are confirmed by the designer to be erosion resistant for the specific characteristics and flow rates anticipated at each individual application, and acceptable to the plan-approving authority.

- **Soils.** Impervious surface disconnection can be used on any post-construction hydrologic soil group (HSG). The disconnection area must be kept well-vegetated with minimal bare spots—at least 95% soil cover.
- **Building Setbacks.** If the grade of the receiving area is less than 1%, downspouts must be extended 5 feet away from building.

Discharge Across Property Lines. Disconnection areas must be designed such that runoff is not directed across property lines toward other sites.

Economic Considerations. Disconnection is one of the least expensive BMPs available.

Table 4.30. Feasibility Criteria for Disconnection

Design Factor	Disconnection Design
Contributing Drainage Area	1,000 square feet per rooftop disconnection. For impervious areas other than rooftop, the longest contributing impervious area flow path cannot exceed 75 feet.
Sizing	The available disconnection area must be at least 10 feet wide and 35 feet long. For sheet flow from impervious areas, the disconnection area must be as wide as the area draining to it.
Site Topography	Grade of the receiving pervious area is less than 2%, or less than 5% with turf reinforcement. The slope of the receiving areas must be graded away from any building foundations.
Soils	Impervious surface disconnection can be used on any post-construction HSG. The disconnection area must be kept well-vegetated with minimal bare spots.
Building Setbacks	5 feet away from building if the grade of the receiving area is less than 1%.

4.8.2 Impervious Surface Disconnection Conveyance Criteria

Receiving areas in disconnection practices (D-1, D-2, and D-3) require a design that safely conveys the 2- to 25-year storm events over the receiving area without causing erosion. In some applications, erosion control matting or other appropriate reinforcing materials may be needed to control flow rates anticipated for these larger design storms.

4.8.3 Impervious Surface Disconnection Pretreatment Criteria

Pretreatment is not needed for impervious surface disconnection.

4.8.4 Impervious Surface Disconnection Design Criteria

If the feasibility criteria presented in Section 4.6.1 are met for a disconnection area, the storage volume is equal to the SWRv for the impervious area draining to it. The disconnection area itself should be considered Compacted Cover or Open Space rather than BMP area and should not be considered as part of the contributing drainage area to the impervious surface disconnection.

The following additional design criteria apply to Disconnection to Conservation Areas:

- **(D-2) Disconnection to a Conservation Area.** Disconnection area cannot include regulated wetlands and buffer areas.

- Inflow must be conveyed via sheet flow or via a level spreader.
- If inflow is conveyed via a level spreader, the maximum flow path is 150 feet, and the level spreader must be designed with an appropriate width as specified below.

Level Spreaders. A level spreader can be used to disperse or “spread” concentrated flow thinly over a vegetated or forested area to promote greater runoff infiltration in the receiving area. A level spreader consists of a permanent linear structure constructed at a 0% grade that transects the slope. The influent concentrated runoff must be spread over an area wide enough area so that erosion of the receiving area does not result. Detailed information on the design and function of level spreaders can be found in Hathaway and Hunt (2006) and NCDWQ (2010).

The minimum required width of the level spreader is

- 13 linear feet per each 1 cubic foot/second of inflow if the receiving conservation area has a minimum 90% ground cover
- 40 linear feet per 1 cubic foot/second of inflow if the receiving conservation area is forested

4.8.5 Impervious Surface Disconnection Landscaping Criteria

All receiving disconnection areas must be stabilized to prevent erosion or transport of sediment to receiving practices or drainage systems according to the Erosion and Sediment Control seeding and vegetation requirements. Designers must ensure that the maximum flow velocities do not exceed the acceptable values for the selected grass species and the specific site slope.

4.8.6 Impervious Surface Disconnection Construction Sequence

Construction Sequence for Disconnection to Pervious Areas. For disconnection to a pervious area, the pervious area can be within the limits of disturbance (LOD) during construction. The following procedures should be followed during construction:

- Before site work begins, the receiving pervious disconnection area boundaries should be clearly marked.
- Construction traffic in the disconnection area should be limited to avoid compaction. The material stockpile area shall not be located in the disconnection area.
- Construction runoff should be directed away from the proposed disconnection area, using perimeter silt fence, or, preferably, a diversion dike.
- If existing topsoil is stripped during grading, it shall be stockpiled for later use.
- The disconnection area may require light grading to achieve desired elevations and slopes. This should be done with tracked vehicles to prevent compaction.
- Topsoil and or compost amendments should be incorporated evenly across the disconnection area, stabilized with seed, and protected by biodegradable erosion control matting or blankets.
- Stormwater must not be diverted into any topsoil or compost amended areas until the area is stabilized (establishment of 95% or greater groundcover).

Construction Sequence for Disconnection to Conservation Areas. For disconnection to a conservation area, the conservation area must be fully protected during the construction stage of development and kept outside the LOD on the soil erosion and sediment control plan.

- No staging, parking, clearing, grading, or heavy equipment access is allowed in the conservation area except temporary disturbances associated with incidental utility construction, restoration operations, or management of nuisance vegetation. Incidental utility construction includes protecting existing utilities, removing abandoned utilities, rearranging service lines, temporarily rearranging utilities, and adjusting utility appurtenances.
- Any conservation areas shall be protected by super silt fence, chain link fence, orange safety fence, or other measures to prevent sediment discharge consistent with soil erosion and sediment control standards and specifications.
- The LOD must be clearly shown on all construction drawings and identified and protected in the field by acceptable signage, silt fence or other protective barrier.
- If a level spreader is to be used in the design, construction of the level spreader shall not commence until the CDA has been stabilized and perimeter soil erosion and sediment control measures have been removed and cleaned out. Stormwater must not be diverted into the disconnection area until the level spreader is installed and stabilized.

Construction Supervision. Construction supervision is recommended to ensure compliance with design standards. A qualified professional should evaluate the performance of the disconnection after the first significant rainfall event to look for evidence of gullies, outflanking, undercutting, or sparse vegetative cover. Spot repairs should be made as needed.

Construction phase inspection checklist for impervious cover disconnection can be found in Appendix E Construction Inspection Checklists.

4.8.7 Impervious Surface Disconnection Maintenance Criteria
Maintenance of disconnected downspouts usually involves regular lawn or landscaping maintenance in the filter path from the roof to the street. In some cases, runoff from a disconnection may be directed to a more natural, undisturbed setting (i.e., where lot grading and clearing is “fingerprinted” and the proposed filter path is protected). Typical maintenance activities include erosion control of the receiving area and ensuring the receiving area remains uncompacted and pervious.

Maintenance inspection checklists for disconnection can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.8.8 Impervious Surface Disconnection Stormwater Compliance Calculations Disconnection practices are credited with 40% retention for the SWRv as well as 80% TSS, 40% TN, and 40% bacteria removal (see Table 4.31).

Table 4.31. Disconnection Retention and Pollutant Removal

Retention	= 40%
TSS Removal	= 80%

TN Removal	= 40%
Bacteria Removal	= 40%

Impervious surface disconnection also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume from the total runoff volume for the 2- to 25-year, and 100-year storms. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.9 Open Channel Systems

<table>
<tr><th colspan="7">Open Channel Systems</th></tr>
<tr><td colspan="7">Definition: Vegetated open channels that are designed to capture and treat or convey the design storm volume (SWRv).</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="5">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><td colspan="5">WQ Improvement: Moderate to High</td></tr>
<tr><td rowspan="3">▪ Suburban
▪ Rural</td><td rowspan="3">Moderate</td><th colspan="2">TSS[1]</th><th colspan="2">Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td colspan="2">50-80%</td><td colspan="2">25-70%</td><td>30-80%</td></tr>
<tr><th colspan="5">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="5">Volume</th></tr>
<tr><td>Low</td><td>Low</td><td colspan="5">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="5">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><th>O-1a</th><th>O-1b</th><th>O-2</th><th>O-3</th><th>O-4</th></tr>
<tr><td>Quarterly</td><td>Every 10-15 years</td><td>10%</td><td>20%</td><td>60%</td><td>0%</td><td>0%</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="5">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Less expensive than curb and gutter
▪ Relatively low maintenance requirements
▪ Provides pretreatment if used as part of runoff conveyance system
▪ Provides partial infiltration of runoff in some soils
▪ Good for small drainage areas</td><td colspan="5">▪ Must be carefully designed to achieve low flow rates in the channel (< 1.0 ft/s)
▪ May re-suspend sediment
▪ May not be acceptable for some areas because of standing water in channel</td></tr>
<tr><th colspan="2">Components</th><th colspan="5">Design considerations</th></tr>
<tr><td colspan="2">▪ Channel geometry
▪ Dense vegetation
▪ Check dams, as needed)</td><td colspan="5">▪ Maximum drainage area of 2.5 acres
▪ Slopes (<4% unless using O-4)
▪ Runoff velocities must be non-erosive
▪ Vegetation must withstand both relatively high velocity flows and wet/dry periods.</td></tr>
<tr><th colspan="7">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Mow grass to 3 or 4 inches high
▪ Inspect for, and correct, formation of rills and gullies</td><td colspan="5">▪ Clean out sediment accumulation in channel
▪ Ensure that vegetation remains well established</td></tr>
</table>

[1]*Credited pollutant load removal*

Often found along roadsides, parking lots, and property boundaries, open channels can provide stormwater conveyance, capture and/or treatment (Figure 4.33**). One of the most visible stormwater BMPs, they are often part of stormwater conveyance systems.**

Figure 4.33. Open channel (photo: Center for Watershed Protection, Inc.)

Definition. Vegetated open channels that are designed to capture and treat or convey the design storm volume (SWRv). Design variants include the following:

O-1 Grass channels

O-2 Dry swales/bioswales

O-3 Wet swales

O-4 Regenerative stormwater conveyance (RSC)

Open channel systems shall not be designed to provide stormwater detention except under extremely unusual conditions. Open channel systems must generally be combined with a separate facility to meet detention requirements.

Grass channels (O-1) can provide a modest amount of runoff filtering and volume attenuation within the stormwater conveyance system resulting in the delivery of less runoff and pollutants than a traditional system of curb and gutter, storm drain inlets, and pipes (see Figure 4.34). The performance of grass channels will vary depending on the underlying soil permeability. Grass channels, however, are not capable of providing the same stormwater functions as dry swales as they lack the storage volume associated with the engineered filter media. Their retention performance can be boosted when compost amendments are added to the bottom of the swale (see Appendix C Soil Compost Amendment Requirements). Grass channels are a preferable alternative to both curb and gutter and storm drains as a stormwater conveyance system, where development density, topography, and soils permit.

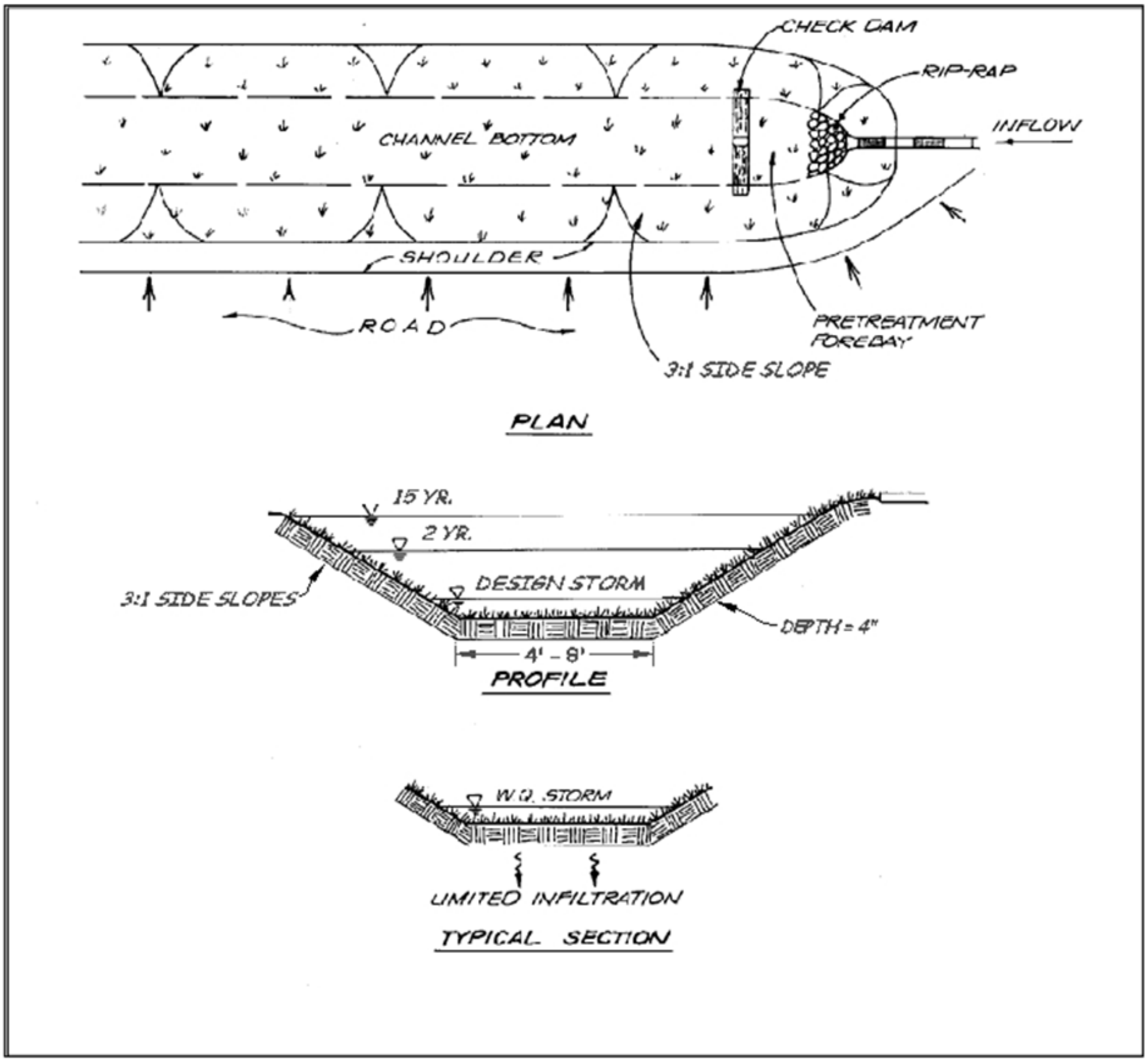


Figure 4.34. Grass channel typical plan, profile, and section views (O-1).

Dry swales (O-2), also known as bioswales, are essentially bioretention cells that are shallower, configured as linear channels, and covered with turf or other surface material (other than mulch and ornamental plants). The dry swale is a soil filter system that temporarily stores and then filters the desired design storm volume. Dry swales rely on a premixed filter media below the channel that is identical to that used for bioretention. In most cases, the runoff treated by the filter media flows into an underdrain, which conveys treated runoff back to the conveyance system further downstream. The underdrain system consists of a perforated pipe within a gravel layer on the bottom of the swale, beneath the filter media. However, if soils are permeable, runoff infiltrates into underlying soils and the dry swale can be designed without an underdrain as if it were an enhanced bioretention. In either case, check dams should be constructed to encourage ponding (see Site Topography). Dry swales may appear as simple grass channels with the same shape and turf cover, while others may have more elaborate landscaping. Swales can be planted with turf grass, tall meadow grasses, decorative herbaceous cover, or trees.

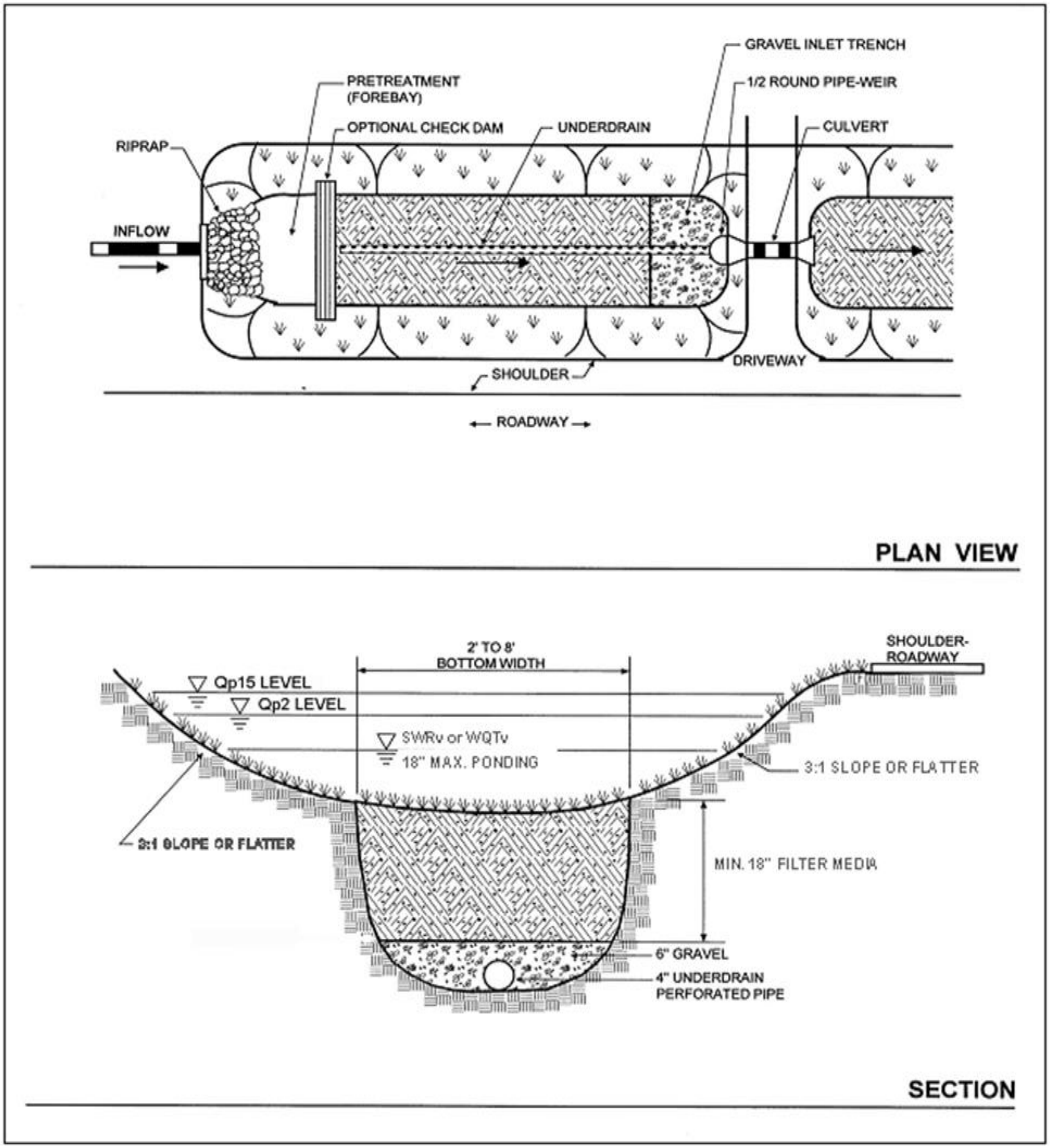


Figure 4.35. Example of a dry swale/bioswale (O-2).

Wet swales (O-3) can provide a modest amount of runoff filtering within the conveyance (see Figure 4.36). These linear wetland cells often intercept shallow groundwater to maintain a wetland plant community. The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity. On-line or off-line cells are formed within the channel to create saturated soil or shallow standing water conditions (typically less than 6 inches deep).

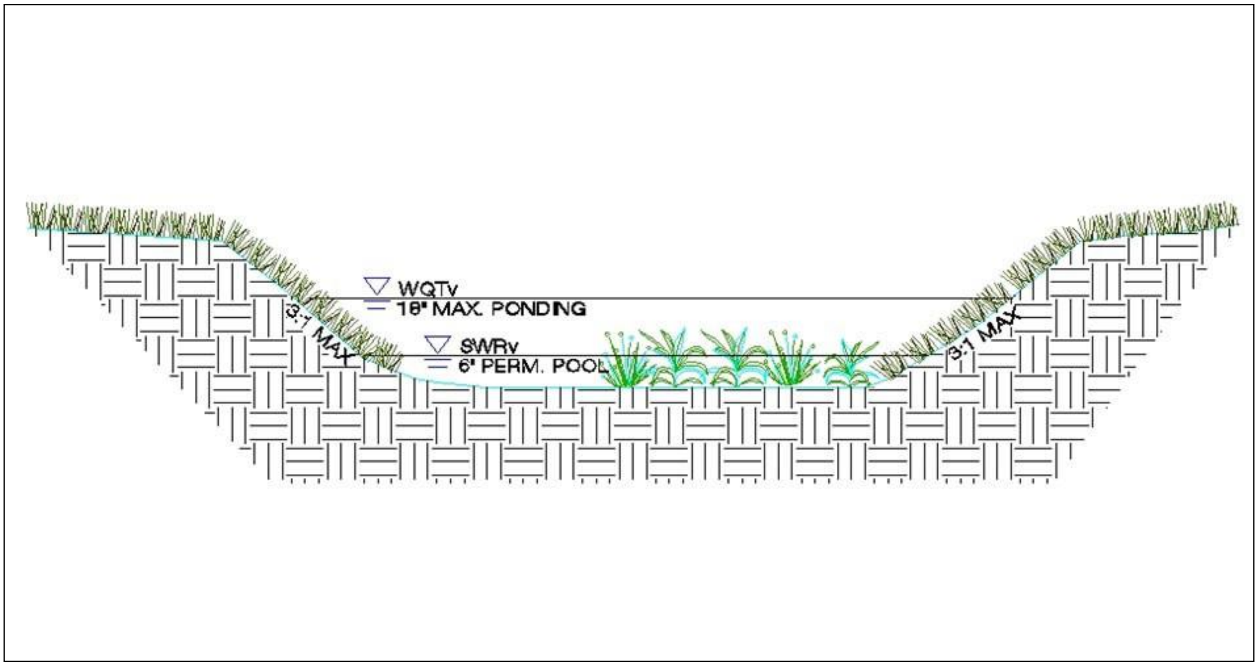


Figure 4.36. Example of a wet swale (O-3).

Regenerative Stormwater Conveyance (O-4). RSC is a unique conveyance practice that can be used in locations where other conveyance practices are infeasible, or as a restoration practice for eroded or degraded outfalls and drainage channels (Figure 4.37). RSC utilizes a series of shallow aquatic pools, riffle weir grade controls, native vegetation and underlying sand and woodchip beds to treat, detain, and convey storm flow. It can be used in places where grades make traditional stormwater practices difficult to implement. Because of the regional topography and waters of the state limitations, RSC Systems will have limited application in the Southern Lowcountry. RSC Systems combine features and treatment benefits of Swales, Infiltration, Filtering and Wetland practices. In addition, they are designed to convey flows associated with larger storm events in a non-erosive manner, which results in a reduction of channel erosion impacts commonly encountered at conventional stormwater outfalls and headwater stream channels.

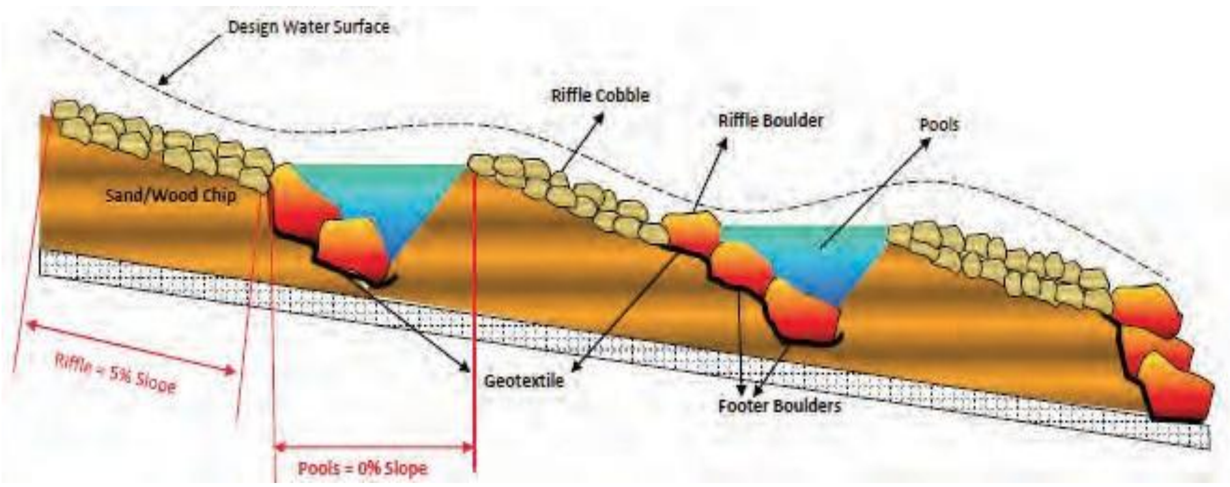


Figure 4.37. Example of Regenerative Stormwater Conveyance (O-4).

4.9.1 Open Channel Feasibility Criteria

Open channel systems are primarily applicable for land uses, such as roads, highways, and residential development. Some key feasibility issues for open channels include the following:

Contributing Drainage Area. The maximum CDA to an open channel should be 2.5 acres, preferably less. When open channels treat and convey runoff from CDAs greater than 2.5 acres, the velocity and flow depth through the channel often becomes too great to treat runoff or prevent erosion in the channel. The design criteria for maximum channel velocity and depth are applied along the entire length (see Section 4.9.4 Open Channel Design Criteria). Dry Swales should be approximately 3%–10% of the size of the CDA, depending on the amount of impervious cover. Wet swale footprints usually cover about 5%–15% of their CDA.

Available Space. Open channel footprints can fit into relatively narrow corridors between utilities, roads, parking areas, or other site constraints. Grass channels can be incorporated into linear development applications (e.g., roadways) by utilizing the footprint typically required for an open section drainage feature. The footprint required will likely be greater than that of a typical conveyance channel. However, the benefit of the retention may reduce the footprint requirements for stormwater management elsewhere on the development site.

Site Topography. Grass channels and wet swales should be used on sites with longitudinal slopes of less than 4%. Check dams can be used to reduce the effective slope of the channel and lengthen the contact time to enhance filtering and/or infiltration. Longitudinal slopes of less than 2% are ideal and may eliminate the need for check dams. However, channels designed with longitudinal slopes of less than 1% should be monitored carefully during construction to ensure a continuous grade so as to avoid flat areas with pockets of standing water.

For dry swales, check dams will be necessary regardless of the longitudinal slope to create the necessary ponding volume.

Land Uses. Open channels can be used in residential, commercial, or institutional development settings.

When open channels are used for both conveyance and water quality treatment, they should be applied only in linear configurations parallel to the contributing impervious cover, such as roads and small parking areas. The linear nature of open channels makes them well-suited to treat highway or low- and medium-density residential road runoff, if there is adequate right-of-way width and distance between driveways. Typical applications of open channels include the following, as long as CDA limitations and design criteria can be met:

- Within a roadway or bicycle path right-of-way;
- Along the margins of small parking lots;
- Oriented from the roof (downspout discharge) to the street;
- Disconnecting small impervious areas; and
- Used to treat the managed turf areas of parkland, sports fields, golf courses, and other turf-intensive land uses, or to treat CDAs with both impervious and managed turf cover (such as residential streets and yards).

Open channels are not recommended when residential density exceeds more than four (4) dwelling units per acre, due to a lack of available land and the frequency of driveway crossings along the channel.

Open channels can also provide pretreatment for other stormwater treatment practices.

Available Hydraulic Head. A minimum amount of hydraulic head is needed to implement open channels in order to ensure positive drainage and conveyance through the channel. The hydraulic head for wet swales and grass channels is measured as the elevation difference between the channel inflow and outflow point. The hydraulic head for dry swales is measured as the elevation difference between the inflow point and the storm drain invert (unless an infiltration-based design will be used). Dry swales typically require 3 to 5 feet of hydraulic head since they have both a filter bed and underdrain.

Hydraulic Capacity. Open channels are typically designed as on-line practices that must be designed with enough capacity to (1) convey runoff from the 25-year design storm at non-erosive velocities, and (2) contain the 25-year flow within the banks of the swale. This means that the swale’s surface dimensions are more often determined by the need to pass the 25-year storm events, which can be a constraint in the siting of open channels within existing rights-of-way (e.g., constrained by sidewalks).

Depth to Water Table. The bottom of dry swales and grass channels must be at least 0.5 feet above the seasonally high groundwater table, to ensure that groundwater does not intersect the filter bed, since this could lead to groundwater contamination or practice failure. It is permissible for wet swales to intersect the water table.

Soils. Soil conditions do not constrain the use of open channels, although they do dictate some design considerations:

- Dry swales in soils with low infiltration rates may need an underdrain. Designers must verify site-specific soil permeability at the proposed location using the methods for on-site soil investigation presented in Appendix B Geotechnical Information Requirements for Underground BMPs to eliminate the requirements for a dry swale underdrain.
- Grass channels situated on low-permeability soils may incorporate compost amendments to improve performance (see Appendix C Soil Compost Amendment Requirements).
- Wet swales work best on the more impermeable HSG C or D soils.
- At infill soil locations, geotechnical investigations are required to determine if the use of an impermeable liner and underdrain are necessary for open channel designs.

Utilities. Typically, utilities can cross linear channels if they are specially protected (e.g., double-casing). Interference with underground utilities should be avoided, if possible. When large site development is undertaken, the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the PROW. Where conflicts cannot be avoided, these guidelines shall be followed:

- Consult with each utility company on recommended offsets that will allow utility maintenance work with minimal disturbance to the BMP.
- Whenever possible, coordinate with utility companies to allow them to replace or relocate their aging infrastructure while BMPs are being implemented.
- BMP and utility conflicts will be a common occurrence in PROW projects. However, the standard solution to utility conflict should be the acceptance of conflict provided sufficient soil coverage over the utility can be assured.
- Additionally, when accepting utility conflict into the BMP design, it is understood that the BMP will be temporarily impacted during utility maintenance but restored to its original condition.

Avoidance of Irrigation or Baseflow. Open channels should be located so as to avoid inputs of springs, irrigation systems, chlorinated wash-water, or other dry weather flows.

Setbacks. To avoid the risk of seepage, stormwater cannot flow from the open channel reservoir layer or via baseflow to the traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties Open channels should be set back at least 10 feet down-gradient from building foundations and property lines, 50 feet from septic system fields and 150 feet from public or private drinking water wells. The 10-foot building setback may be relaxed if an impermeable building liner is installed.

Pollutant Hotspot Land Use. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil- water separator or filtering device must be provided. These pretreatment facilities should be monitored and maintained frequently to avoid negative impacts to the channel and subsequent water bodies.

Runoff from hotspot land uses must not be treated with infiltrating dry swales due to the potential interaction with the water table and the risk that hydrocarbons, trace metals, and other toxic pollutants could migrate into the groundwater. An impermeable liner must be used for filtration of hotspot runoff for dry swales.

Grass channels can typically be used to convey runoff from stormwater hotspots, but they do not qualify as a hotspot treatment mechanism. Wet swales are not recommended to treat stormwater hotspots, due to the potential interaction with the water table and the risk that hydrocarbons, trace metals, and other toxic pollutants could migrate into the groundwater.

On sites with existing contaminated soils, infiltration is not allowed; dry and wet swales on these hotspots must include an impermeable liner.

Feasibility. Open channels are ideally suited to the Southern Lowcountry environment, since open channel drainage is often the norm due to the flat topography. Depending on underlying soil and other characteristics, however, a specific open channel option may be the most appropriate. For example, the wet swale design option is most suited to areas with elevated groundwater tables, while dry swales and grassed channels are best suited for sandy soils of the coastal plain.

Economic Considerations. While most open channel designs provide relatively small water quality credits when compared with other stormwater practices, they nevertheless provide greater quality benefits than traditional conveyance designs, such as curb and gutter.

4.9.2 Open Channel Conveyance Criteria

The bottom width and slope of a grass channel must be designed such that the velocity of flow from the design storm provides a minimum hydraulic residence time (average travel time for a particle of water through a waterbody) of 9 minutes for the peak flows from the SWRv or design storm. Check dams may be used to achieve the needed retention volume, as well as to reduce the flow velocity. Check dams must be spaced based on channel slope and ponding requirements, consistent with the criteria in Section 4.9.4 Open Channel Design Criteria.

Open channels must also convey the 25-year storm at non-erosive velocities (generally less than 6 feet per second) for the soil and vegetative cover provided. The final designed channel shall provide 6 inches minimum freeboard above the designated water surface profile of the channel. The analysis must evaluate the flow profile through the channel at normal depth, as well as the flow depth over top of the check dams.

RSC systems are typically designed to convey larger storm events, up to and including the 100- year storm event.

4.9.3 Open Channel Pretreatment Criteria

Pretreatment is required for open channels to dissipate energy, trap sediments, and slow down the runoff velocity.

The selection of a pretreatment method depends on whether the channel will experience sheet flow or concentrated flow. Several options are as follows:

- **Check Dams (channel flow).** These energy dissipation devices are acceptable as pretreatment on small open channels with CDAs of less than 1 acre. The most common form is the use of wooden or stone check dams. The pretreatment volume stored must be 15% of the design volume.
- **Tree Check Dams (channel flow).** These are street tree mounds that are placed within the bottom of grass channels up to an elevation of 9 to 12 inches above the channel invert. One side has a gravel or river stone bypass to allow runoff to percolate through (Cappiella et al, 2006). The pretreatment volume stored must be 15% of the design volume.
- **Grass Filter Strip (sheet flow).** Grass filter strips extend from the edge of the pavement to the bottom of the open channel at a slope of 5H:1V or flatter. Alternatively, provide a combined 5 feet of grass filter strip at a maximum 5% (20H:1V) cross slope and 3H:1V or flatter side slopes on the open channel.
- **Gravel or Stone Diaphragm (sheet flow).** The gravel diaphragm is located at the edge of the pavement or the edge of the roadway shoulder and extends the length of the channel to pretreat lateral runoff. This requires a 2- to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The stone must be sized according to the expected rate of discharge.
- **Gravel or Stone Flow Spreaders (concentrated flow).** The gravel flow spreader is located at curb cuts, downspouts, or other concentrated inflow points, and should have a 2- to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The gravel should extend the entire width of the opening and create a level stone weir at the bottom or treatment elevation of the channel.
- **Initial Sediment Forebay (channel flow).** This grassed cell is located at the upper end of the open channel segment with a recommended 2:1 length to width ratio and a storage volume equivalent to at least 15% of the total design storm volume. If the volume of the forebay will be included as part of the dry swale storage volume, the forebay must de-water between storm events. It cannot have a permanent ponded volume.

4.9.4 Open Channel Design Criteria

Channel Geometry. Design guidance regarding the geometry and layout of open channels is provided below:

- Open channels should generally be aligned adjacent to and the same length as the CDA identified for treatment.
- Open channels should be designed with a trapezoidal or parabolic cross section. A parabolic shape is preferred for aesthetic, maintenance, and hydraulic reasons.
- The bottom width of the channel should be between 4 to 8 feet wide to ensure that an adequate surface area exists along the bottom of the swale for filtering. If a channel will be wider than 8 feet, the designer must incorporate benches, check dams, level spreaders, or multi-level cross sections to prevent braiding and erosion along the channel bottom.
- Open-channel side slopes should be no steeper than 3H:1V for ease of mowing and routine maintenance. Flatter slopes are encouraged, where adequate space is available, to enhance pretreatment of sheet flows entering the channel.
- RSC has several specific geometry requirements, which are outlined in RSC Sizing below.

Check dams. Check dams may be used for pretreatment, to break up slopes, and to increase the hydraulic residence time in the channel. Design requirements for check dams are as follows:

- Check dams should be spaced based on the channel slope, as needed to increase residence time, provide design storm storage volume, or any additional volume attenuation requirements. In typical spacing, the ponded water at a downhill check dam should not touch the toe of the upstream check dam. More frequent spacing may be desirable in dry swales to increase the ponding volume.
- The maximum desired check dam height is 12 inches, for maintenance purposes. However, for some sites, a maximum of 18 inches can be allowed, with additional design elements to ensure the stability of the check dam and the adjacent and underlying soils.
- Armoring may be needed at the downstream toe of the check dam to prevent erosion.
- Check dams must be firmly anchored into the side-slopes to prevent outflanking; check dams must also be anchored into the channel bottom so as to prevent hydrostatic head from pushing out the underlying soils.
- Check dams must be designed with a center weir sized to pass the channel design storm peak flow (25-year storm event for man-made channels).
- For grass channels, each check dam must have a weep hole, or similar drainage feature, so it can dewater after storms. This is not appropriate for dry swales.
- Check dams should be composed of wood, concrete, stone, compacted soil, or other non-erodible material, or should be configured with elevated driveway culverts.
- Individual channel segments formed by check dams or driveways should generally be at least 25 to 40 feet in length.

Check dams for grass channels must be spaced to reduce the effective slope to less than 2%, as indicated in Table 4.32.

Table 4.32. Typical Check Dam Spacing to Achieve Effective Channel Slope

Channel Longitudinal Slope (%)	Check Dam Spacing to Achieve Effective Slope [a, b, c]	
	Effective Slope of 2% (ft)	Effective Slope of 0%–1% (ft)
0.5	–	
1.0	–	
1.5	–	67–200
2.0	–	50–100
2.5	200	40–67
3.0	100	33–50
3.5	67	30–40
4.0	50	25–33

4.5[d]	40	20–30
5.0[d]	40	20–30

[a] All check dams require a stone energy dissipator at the downstream toe.
[b] Check dams require weep holes at the channel invert. Swales with slopes less than 2% will require multiple weep holes (at least 3) in each check dam.
[c] Assumed check dam height is 12 inches. The spacing dimension is half of the above distances if a 6-inch check dam is used.
[d] Open channels with slopes greater than 4% require special design considerations, such as drop structures to accommodate greater than 12-inch high check dams (and therefore a flatter effective slope), in order to ensure non-erosive flows.

Ponding Depth. Check dams must be used in dry swales to create ponding cells along the length of the channel. The maximum ponding depth in a dry swale must not exceed 18 inches. Minimum surface ponding depth is 3 inches (averaged over the surface area of the open channel). In order to increase the ponding depth, it may be necessary or desirable to space check dams more frequently than is shown in Table 4.32.

Dry Swale Filter Media. Dry swales require replacement of native soils with a prepared filter media. The filter media provides adequate drainage, supports plant growth, and facilitates pollutant removal within the dry swale. At least 18 inches of filter media must be added above the choker stone layer (and no more than 6 feet) to create an acceptable filter. The recipe for the filter media is identical to that used for bioretention and is provided in Section 4.1 Bioretention. The batch receipt confirming the source of the filter media should be submitted to the Beaufort County Public Works Department inspector. One acceptable design adaptation is to use 100% sand for the first 18 inches of the filter and add a combination of topsoil and compost, as specified in Appendix C Soil Compost Amendment Requirements, for the top 4 inches, where turf cover will be maintained.

Dry Swale Drawdown. Dry swales must be designed so that the desired design storm volume is completely filtered within 72 hours, using the equations specified in Section 4.9.6 Open Channel Construction Sequence.

Dry Swale Underdrain. Some dry swale designs will not use an underdrain (where soil infiltration rates meet minimum standards). See Section 4.9.1 Open Channel Feasibility Criteria for more details. When underdrains are necessary, they should have a minimum diameter of 4 to 6 inches and be encased in a 12-inch deep gravel bed. Two layers of stone should be used. A choker stone layer, consisting of No. 8 or No. 89 stone at least 3 inches deep, must be installed immediately below the filter media. Below the choker stone layer, the underdrain must be encased (a minimum of 2 inches above and below the underdrain) in a layer of clean, double-washed ASTM D448 No.57 or smaller (No. 68, 8, or 89) stone. The maximum depth of the underdrain stone layer combined with the choking layer is 12 inches, and it cannot extend beyond the surface dimensions of the dry swale filter media.

Impermeable Liner. An impermeable liner is not typically required, although it may be utilized in fill applications where deemed necessary by a geotechnical investigation, on sites with contaminated soils, or on the sides of the practice to protect adjacent structures from seepage. Use a PVC geomembrane liner or an equivalent of an appropriate thickness (follow manufacturer's instructions for installation). Field seams must be sealed according to the liner manufacturer's specifications. A minimum 6-inch overlap of material is required at all seams.

Dry Swale Observation Well. A dry swale must include well-anchored, 4- to 6-inch diameter PVC pipe observation wells along the length of the swale. For a dry swale with an underdrain, the wells should be tied into any Ts or Ys in the underdrain system and must extend upward above the surface of the ponding. These observation wells may double as clean outs. For an infiltrating dry swale, the observation well should be perforated in the gravel layer only.

Grass Channel Material Specifications. The basic material specifications for grass channels are outlined in Table 4.33.

Table 4.33. Grass Channel Material Specifications

Component	Specification
Grass	A dense cover of water-tolerant, erosion-resistant grass. The selection of an appropriate species or mixture of species is based on several factors including climate, soil type, topography, and sun or shade tolerance. Grass species should have the following characteristics: ▪ A deep root system to resist scouring; ▪ A high stem density with well-branched top growth; ▪ Water-tolerance; ▪ Resistance to being flattened by runoff; ▪ An ability to recover growth following inundation; and
Check Dams	Check dams should be constructed of a non-erodible material such as wood, gabions, riprap, or concrete. Wood used for check dams should consist of pressure-treated logs or timbers or water-resistant tree species such as cedar, hemlock, swamp oak, or locust. Computation of check dam material is necessary, based on the surface area and depth used in the design computations.
Diaphragm	Pea gravel used to construct pretreatment diaphragms must consist of washed, open-graded, course aggregate between 3 and 10 mm in diameter.
Erosion Control Fabric	Where flow velocities dictate, biodegradable erosion control netting or mats that are durable enough to last at least two growing seasons must be used.

Dry Swale Material Specifications. For additional material specifications pertaining to dry swales, designers should consult Section 4.1.4 Bioretention Design Criteria and Table 4.34.

Table 4.34. Dry Swale Material Specifications

Material	Specification	Notes
Filter Media Composition	Filter Media to contain: � 80%–90% sand � 10%–20% soil fines � Maximum 10% clay	To account for settling/compaction, it is recommended that 110% of the plan volume be utilized.

Material	Specification	Notes
	▯ 3%–5% organic matter	
Filter Media Testing	P content = 5 to 15 mg/kg (Mehlich I) or 18 to 40 mg/kg (Mehlich III) CEC > 5 milliequivalents per 100 grams	See Section 4.3.4 Bioretention, for additional filter media information.
Geotextile	Geotextile fabric meeting the following specifications: ▯ AASHTO M-288 Class 2, latest edition ▯ Has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability. ▯ Apply along sides of the filter media only and do not apply along the swale bottom.	
Choking Layer	A 2- to 4-inch layer of choker stone (typically No. 8 or No. 89 washed gravel) laid above the underdrain stone.	
Underdrain Stone Layer	Stone must be double-washed and clean and free of all fines (ASTM D448 No. 57 or smaller stone).	
Underdrains and Cleanouts	4-inch or 6-inch rigid schedule 40 PVC pipe, with 3 or 4 rows of 3/8-inch perforations at 6 inches on center.	Install perforated pipe for the full length of the dry swale cell. Use non-perforated pipe, as needed, to connect with the storm drain system.
Observation Wells	4-inch or 6-inch rigid schedule 40 PVC pipe	For dry swales with underdrains, tie the non-perforated observation well to the underdrain via T or Y connection. This observation well can double as a cleanout. For dry swales without an underdrain, the pipe should only be perforated in the gravel layer. The observation wells should extend to the top of ponding.
Impermeable Liner	Where appropriate, use a PVC geomembrane liner or equivalent.	
Vegetation	Plant species as specified on the landscaping plan.	
Check Dams	Use non-erosive material, such as wood, gabions, riprap, or concrete. Wood used for check dams should consist of pressure-treated logs or timbers, or water-resistant tree species, such as cedar, hemlock, swamp oak, or locust.	
Erosion Control Fabric	Where flow velocities dictate, use woven biodegradable erosion control fabric or mats (EC2) that are durable enough to last at least 2 growing seasons.	

RSC Material Specifications. RSC has several design elements that are unique to this practice. The practice includes riffle and pool segments, underlain with a sand/ wood chip bed, and with a top dressing of compost and plant material. Table 4.35 outlines the materials needed for this practice.

Table 4.35. Regenerative Stormwater Conveyance System Material Specifications

Material	Specification
Footer Boulders	Should have a natural appearance and be equivalent in size to Class 3 Rip Rap (aver- age diameter 26.4 inches)
Cobble	Should have a natural appearance and a minimum diameter of 6”
Sand/ Woodchip Bed	The sand component of the sand/wood chip bed should meet the AASHTO- M-6 or ASTM-C-33, 0.02 inches to 0.04 inches in size. Sand shall be a silica-based coarse aggregate. Substitutions such as Diabase and Gray- stone (AASHTO) #10 are not acceptable. No calcium carbonate or dolomitic sand substitutions are acceptable. No “rock dust” can be used for sand. Locally-approved pulverized glass may be substituted if the local authority undertakes testing to verify compliance with the particle size specification. No art glass shall be used for a pulverized glass material. For woodchips, use aged, shredded hardwood chips/mulch. The woodchips should be added to the sand mix, approximately 20 percent by volume, to increase the organic content and promote plant growth and sustainability.
Choker Stone	The choker stone layer between the sand bed and the bank run gravel should be clean, washed #8 or #78 stone.
Bank Run Gravel	The bank run gravel layer that is placed beneath and above the sand bed/choker stone layers should be constructed using clean, washed # 5 or # 57 coarse aggregate.
Compost	The compost used as a top dressing over the RSC System should consist of a 100% organic compost, with a pH of between 6.0 and 7.0, a moisture content of between 30 and 55%, and a particle size of 0.25 inches or less. (See Appendix C for compost specifications)
Wood Chips	The wood chips used within the sand bed should consist of double-shredded or double-ground hardwood mulch that is free of dyes, chromated copper arsenate and other preservatives.
Plant Materials	Plants should be native species, appropriate to the planting/wetness zone where they are located.

Wet Swale Design Issues. The following criteria apply to the design of wet swales:

- The average normal pool depth (dry weather) throughout the swale must be 6 inches or less.
- The maximum temporary ponding depth in any single wet swale cell must not exceed 18 inches at the most downstream point (e.g., at a check dam or driveway culvert).
- Check dams should be spaced as needed to maintain the effective longitudinal slope.

- Individual wet swale segments formed by check dams or driveways should generally be at least 25 to 40 feet in length.
- Wet swale side slopes should be no steeper than 4H:1V to enable wetland plant growth. Flatter slopes are encouraged where adequate space is available, to enhance pretreatment of sheet flows entering the channel. Under no circumstances are side slopes to steeper than 3H:1V.

Grass Channel Enhancement using Compost Soil Amendments. Soil compost amendments serve to increase the retention capability of a grass channel. The following design criteria apply when compost amendments are used:

- The compost-amended strip must extend over the length and width of the channel bottom, and the compost must be incorporated to a depth as outlined in Appendix C Soil Compost Amendment Requirements.
- For grass channels on steep slopes, it may be necessary to install a protective biodegradable erosion control mat to protect the compost-amended soils. Care must be taken to consider the erosive characteristics of the amended soils when selecting an appropriate erosion control mat.

Grass Channel Sizing. Unlike other BMPs, grass channels are designed based on a peak rate of flow. Designers must demonstrate channel conveyance and treatment capacity in accordance with the following guidelines:

- Hydraulic capacity should be verified using Manning's Equation or an accepted equivalent method, such as erodibility factors and vegetal retardance.
- The flow depth for the peak flow generated by the SWRv must be maintained at 4 inches or less.
- Manning's "n" value for grass channels is 0.2 for flow depths up to 4 inches, decreasing to 0.03 at a depth of 12 inches and above, which would apply to the 2- to 25-year storms if an on-line application (Haan et. al, 1994).
- Peak flow rates for the 25-year frequency storm must be non-erosive, in accordance with Table 4. 37 (see Section 4.9.5 Open Channel Landscaping Criteria), or subject to a site-specific analysis of the channel lining material and vegetation; and the 25-year peak flow rate must be contained within the channel banks (with a minimum of 6 inches of freeboard).
- Calculations for peak flow depth and velocity must reflect any increase in flow along the length of the channel, as appropriate. If a single flow is used, the flow at the outlet must be used.
- The hydraulic residence time (e.g., the average travel time for a particle of water through a waterbody) must be a minimum of 9 minutes for the peak flows from the SWRv or design storm (Mar et al., 1982; Barrett et al., 1998; Washington State Department of Ecology, 2005). If flow enters the swale at several locations, a 9-minute minimum hydraulic residence time must be demonstrated for each entry point, using Equation 4.13 through Equation 4. 17.

The bottom width of the grass channel is therefore sized to maintain the appropriate flow geometry as follows:

Equation 4. 13 Manning's Equation

$$VV = (\frac{1.49}{DD}) \times DD^{2/3} \times SS^{1/2}$$

Where:

V	=	flow velocity (ft/s)
n	=	roughness coefficient (0.2, or as appropriate)
D	=	flow depth (ft) (Note: D approximates hydraulic radius for shallow flows)
S	=	channel slope (ft/ft)

Equation 4. 14 Continuity Equation

$$QQ = VV \times (WW + 3 \times DD) \times DD$$

where:

Q	=	design storm peak flow rate (cfs)
V	=	design storm flow velocity (ft/s)
W	=	channel bottom width (ft)
D	=	flow depth (ft)

(Note: Channel width (W) plus 3 times the depth (D) represents the average width of a trapezoidal channel with 3H:1V side slopes. Average width multiplied by depth equals the cross-sectional flow area.)

Combining Equation 4.13 and Equation 4.14, and rewriting them provides a solution for the minimum width (Equation 4.15):

Equation 4. 15 Minimum Width

$$WW = \frac{DD \times QQ}{1.49 \times DD^{5/3} \times SS^{1/2}} - (3 \times DD)$$

where:

W	=	channel bottom width (ft)
n	=	roughness coefficient (0.2, or as appropriate)
Q	=	design storm peak flow rate (cfs)
D	=	flow depth (ft)
S	=	channel slope (ft/ft)

Equation 4.16 provides the corresponding velocity:

Equation 4. 16 Corresponding Velocity

$$VV = \frac{QQ}{(WW + 3 \times DD) \times DD}$$

where:

V	=	design storm flow velocity (ft/s)
Q	=	design storm peak flow rate (cfs)
W	=	channel bottom width (ft)
D	=	flow depth (ft)

The width, slope, or Manning's "n" value can be adjusted to provide an appropriate channel design for the site conditions. However, if a higher density of grass is used to increase the Manning's "n" value and decrease the resulting channel width, it is important to provide material specifications and construction oversight to ensure that the denser vegetation is actually established. Equation 4.17 can then be used to ensure adequate hydraulic residence time.

Equation 4. 17 Grass Channel Length for Hydraulic Residence Time of 9 minutes (540 seconds)

$$LL = 540 \times VV$$

where:

L	=	minimum swale length (ft)
V	=	flow velocity (ft/s)

The storage volume (Sv) provided by the grass channel is equal to the total runoff from the design storm (typically SWRv) used to size the channel (conveyed at a depth of 4 inches or less), as shown in Equation 4.18.

Equation 4. 18 Grass Channel Storage Volume

$$SSRR = DDDDDDDDDDDDSSDDDDDDDD$$

where:

Sv	=	total storage volume of grass channel (ft^3)
DesignStorm	=	SWRv or other design storm volume (ft^3) (e.g., portion of the SWRv)

Dry Swale Sizing. Dry swales are typically sized to capture the SWRv or larger design storm volumes in the surface ponding area, filter media, and gravel reservoir layers of the dry swale.

Total storage volume of the BMP is calculated using Equation 4.19.

Equation 4. 19 Dry Swale Storage Volume

$$Sv = SA_{bottom} \times \left[(d_{media} \times \eta_{media}) + (d_{gravel} \times \eta_{gravel})\right] + (SA_{average} \times d_{ponding})$$

where:

Sv	=	total storage volume of dry swale (ft^3)
SA_{bottom}	=	bottom surface area of dry swale (ft^2)
d_{media}	=	depth of the filter media, including mulch layer (ft)
η_{media}	=	effective porosity of the filter media (typically 0.25)
d_{gravel}	=	depth of the underdrain and underground storage gravel layer, including choker stone (ft)
η_{gravel}	=	effective porosity of the gravel layer (typically 0.4)
$SA_{average}$	=	average surface area of the dry swale (ft^2) typically, where SA_{top} is the top surface area of dry swale, $SA_{average} = \frac{SA_{bottom} + SA_{top}}{2}$
$d_{ponding}$	=	the maximum ponding depth of the dry swale (ft)

Equation 4.19 can be modified if the storage depths of the filter media, gravel layer, or ponded water vary in the actual design or with the addition of any surface or subsurface storage components (e.g., additional area of surface ponding, subsurface storage chambers, etc.). The maximum depth of ponding in the dry swale must not exceed 18 inches. If storage practices will be provided off-line or in series with the dry swale, the storage practices should be sized using the guidance in Section 0 Storage Practices.

Dry swales can be designed to address, in whole or in part, the detention storage needed to comply with channel protection and/or flood control requirements. The Sv can be counted as part of the 2- to 25-year runoff volumes to satisfy stormwater quantity control requirements.

Note: To increase the storage volume of a dry swale, the ponding surface area may be increased beyond the filter media surface area. However, the top surface of the BMP (at the top of the ponding elevation) may not be more than twice the size of surface area of the filter media (SA_{bottom}).

Wet Swale Sizing. Wet swales can be designed to capture and treat the SWRv remaining from any upstream stormwater retention practices. The storage volume is made up of the temporary and permanent storage created within each wet swale cell. This includes the permanent pool volume and up to 12 inches of temporary storage created by check dams or other design features that has 24 hours extended detention.

The storage volume (Sv) of the practice is equal to the volume provided by the pond permanent pool plus the 24-hour extended detention (ED) volume provided by the practice (Equation 4.20). The total Sv cannot exceed the design SWRv.

Equation 4. 20 Wet Swale Storage Volume

$$Sv = \text{Pond permanent pool volume} + 24\ \text{hour ED volume}$$

RSC Sizing. RSC design is an iterative process in which the channel is sized to convey the 100-year storm event, using manning's equation for parabolic channels.

Some key RSC sizing considerations include the following:

- One control structure and pool (riffle-pool) combination is needed for each foot of elevation difference along the channel.
- The length of each grade control structure or pool is determined by Equation 4.21

Equation 4. 21 Riffle Pool Length

$$L_{pool} = \frac{L_{riffle}}{(Elevation\ Change) \times 2}$$

where:

L_{pool}	=	surface length of each pool (ft)
L_{riffle}	=	total length of riffle pool (ft)
Elevation Change	=	difference in elevation between pool and bottom pool (ft)

- In areas with steep slopes (10% or greater) the length of the pool or riffle may be small (<10’). In these locations, cascades may be needed as a part of the system design.
- The minimum width of grade control structures should be 8 ft and the width should be equal to 10 times the channel depth (Figure 4.38).
- The depth of flow in the riffle sections should be less than 4 inches.
- Cobbles in the riffle section should be sized so that the velocity of the 100-year storm is non-erosive (Table 4.36).

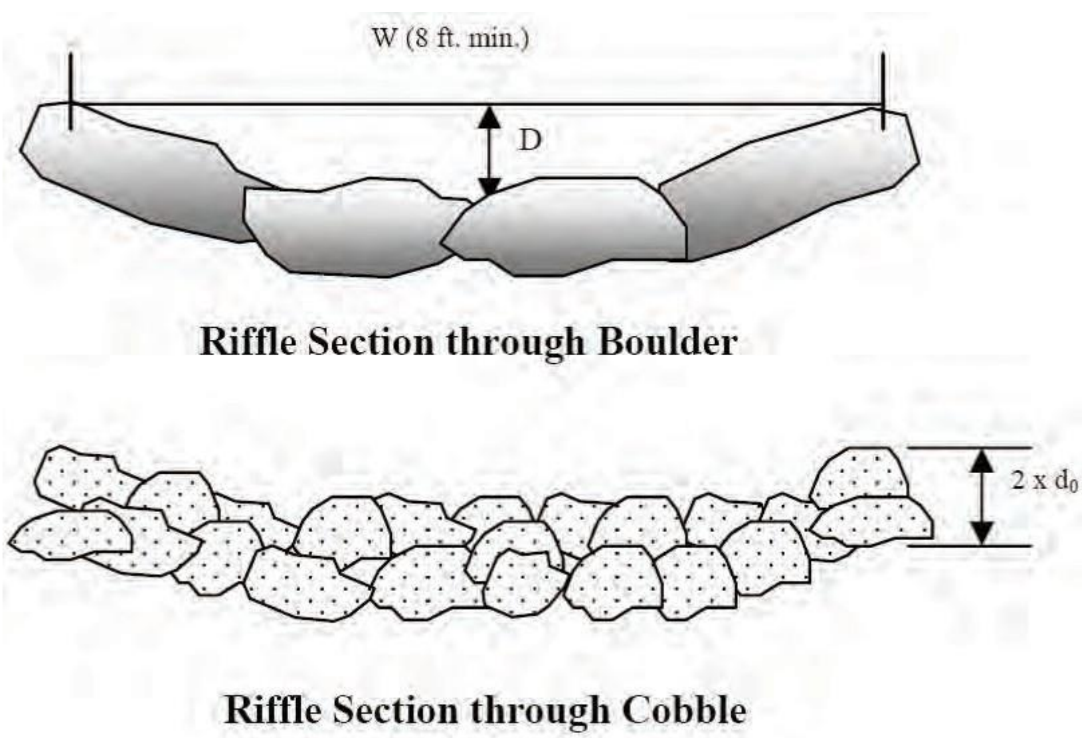


Figure 4.38. Typical Width and Depth of Riffle Sections (Anne Arundel County, 2011).

Table 4.36. Maximum Allowable Velocity

Cobble size (in)	Allowable velocity (ft/s)
4	5.8
5	6.4
6	6.9
7	7.4
8	7.9
9	8.4
10	8.8
11	9.2
12	9.6
15	10.4

- Pools should be between 1.5 and 3 feet deep, and equal to the width of the riffle sections.
- The RSC system is underlain with a sand bed with a 1–5 foot depth and a width between 4 and 14 feet.
- The downstream edge of the riffle should incorporate a series of boulders in a parabolic shape.
- Place a cobble apron below the riffle section to allow for a stable transition between the riffle section and the downstream pools when the pools are dry. The cobble apron should be approximately 5 feet wide and 3 feet long.

The total Sv in the RSC system (available for water quality treatment) is determined by Equation 4.22.

Equation 4.22 RSC Systems Storage Volume

$$SSRR = VV_{ppbbbbgg} + VV_{ssaappmmbbmmmm}$$

where:

Sv	=	total storage volume of RSC system (ft^3)
V_{pool}	=	volume in pools (ft^3)
$V_{sandbed}$	=	volume in sand bed (ft^3), use effective porosity of 0.25

4.9.5 Open Channel Landscaping Criteria

All open channels must be stabilized to prevent erosion or transport of sediment to receiving practices or drainage systems. There are several types of grasses appropriate for dry open channels (grass channels and dry swales). These are listed in Table 4.37. Designers should choose plant species that can withstand both wet and dry periods and relatively high velocity flows for planting within the channel. Designers should ensure that the maximum flow velocities do not exceed the values listed in the table for the selected grass species and the specific site slope. For more information on stabilization seeding, see the Charleston County Stabilization Specifications.

Table 4.37. Recommended Vegetation for Open Channels

Vegetation Type	Slope (%)	Maximum Velocity (ft/s)	
		Erosion Resistant Soil	Easily Eroded Soil
Bermuda Grass	0–5	8	6
	5–10	7	5
	>10	6	4
Kentucky Bluegrass	0–5	7	5
	5–10	6	4
	>10	5	3
Tall Fescue Grass Mixture	0–5	6	4
	5–10	4	3
Annual and Perennial Rye	0–5	4	3
Sod		4	3

Source: USDA, TP-61, 1954; Roanoke Virginia, Stormwater Design Manual, 2008

Wet swales should be planted with grass and wetland plant species that can withstand both wet and dry periods as well as relatively high velocity flows within the channel. For a list of wetland plant species suitable for use in wet swales, refer to the wetland panting guidance and plant lists provided in Section 0 Stormwater Wetlands.

Landscape design shall specify proper grass species based on site-specific soils and hydric conditions present along the channel.

Open channels should be seeded at such a density to achieve a 90% vegetated cover after the second growing season. Taller and denser grasses are preferable, although the species is less important than good stabilization and dense vegetative cover.

Grass channels should be seeded and not sodded. Seeding establishes deeper roots and sod may have muck soil that is not conducive to infiltration. Grass channels should be protected by a biodegradable erosion control fabric to provide immediate stabilization of the channel bed and banks.

4.9.6 Open Channel Construction Sequence

Design Notes. Channel invert and tops of banks are to be shown in plan and profile views. A cross sectional view of each configuration and completed limits of grading must be shown for proposed channels. For proposed channels, the transition at the entrance and outfall is to be clearly shown on plan and profile views.

Open Channel Installation. The following is a typical construction sequence to properly install open channels, although steps may be modified to reflect different site conditions or design variations. Grass channels should be installed at a time of year that is best to establish turf cover without irrigation. For more specific information on the installation of wet swales, designers should consult the construction criteria outlined in Section 0 Stormwater Wetlands.

1. **Protection During Site Construction.** Ideally, open channels should remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment. However, this is seldom practical, given that the channels are a key part of the drainage system at most sites. In these cases, temporary soil erosion and sediment controls such as dikes, silt fences, and other erosion control measures should be integrated into the swale design throughout the construction sequence. Specifically, barriers should be installed at key check dam locations, and erosion control fabric should be used to protect the channel. Dry swales that lack underdrains (and rely on infiltration) must be fully protected by silt fence or construction fencing to prevent compaction by heavy equipment during construction.

2. **Installation.** Installation may only begin after the entire CDA has been stabilized with vegetation. Any accumulation of sediments that does occur within the channel must be removed during the final stages of grading to achieve the design cross section. Soil erosion and sediment controls for construction of the channel must be installed as specified in the soil erosion and sediment control plan. Stormwater flows must not be permitted into the channel until the bottom and side slopes are fully stabilized.

3. **Grading.** Grade the grass channel to the final dimensions shown on the plan. Excavators or backhoes should work from the sides to grade and excavate the open channels to the appropriate design dimensions. Excavating equipment should have scoops with adequate reach so they do not have to sit inside the footprint of the open channel area. If constructing a dry swale, the bottom of the swale should be ripped, rototilled or otherwise scarified to promote greater infiltration.

4. **Placing Stone Layer (for dry swales).** If constructing a dry swale, place an acceptable geotextile fabric on the underground (excavated) sides of the dry swale with a minimum 6-inch overlap. Place the stone needed for storage layer over the filter bed. Add the perforated underdrain pipe. Add the remaining stone jacket, and then pack No. 57 stone (clean, double-washed) to 3 inches above the top of the underdrain, and then add 3 inches of pea gravel as a filter layer. Add the filter media in 12-inch lifts until the desired top elevation of the dry swale is achieved. Water thoroughly and add additional media as needed where settlement has occurred.

5. **Add Amendments (optional, for grass channels).** Add soil amendments as needed. Till the bottom of the grass channel to a depth of 1 foot and incorporate compost amendments according to Appendix C Soil Compost Amendment Requirements.

6. **Install Check Dams**. Install check dams, driveway culverts and internal pretreatment features as shown on the plan. Fill material used to construct check dams should be placed in 8- to 12-inch lifts and compacted to prevent settlement. The top of each check dam must be constructed level at the design elevation.

7. **Hydro-seed.** Hydro-seed the bottom and banks of the open channel, and peg in erosion control fabric or blanket where needed. After initial planting, a biodegradable erosion control fabric should be used, conforming the South Carolina BMP Handbook (SDHEC, 2005).

8. **Plant.** Plant landscaping materials as shown in the landscaping plan, and water them weekly during the first 2 months. The construction contract should include a care and replacement warranty to ensure that vegetation is properly established and survives during the first growing season following construction.

9. **Final Inspection.** A qualified professional should conduct the final construction inspection and develop a punch list for facility acceptance.

Open Channel Construction Supervision. Supervision during construction is recommended to ensure that the open channel is built in accordance with these specifications.

Construction phase inspection checklist is available in Appendix E Construction Inspection Checklists.

Some common pitfalls can be avoided by careful construction supervision that focuses on the following key aspects of dry swale installation:

- Make sure the desired coverage of turf or erosion control fabric has been achieved following construction, both on the channel beds and their contributing side-slopes.
- Inspect check dams and pretreatment structures to make sure they are at correct elevations, are properly installed, and are working effectively.
- For dry swale designs:
  - Check the filter media to confirm that it meets specifications and is installed to the correct depth.
  - Check elevations, such as the invert of the underdrain, inverts for the inflow and outflow points, and the ponding depth provided between the surface of the filter bed and the overflow structure.
  - Ensure that caps are placed on the upstream (but not the downstream) ends of the underdrains.
  - Check that outfall protection/energy dissipation measures at concentrated inflow and outflow points are stable.

The real test of an open channel occurs after its first big storm. The post-storm inspection should focus on whether the desired sheet flow, shallow concentrated flows or fully concentrated flows assumed in the plan actually occur in the field. Minor adjustments are normally needed as part of this post-storm inspection (e.g., spot reseeding, gully repair, added armoring at inlets, or realignment of outfalls and check dams). Also, a qualified professional should check that dry swale practices drain completely within the 72-hour drawdown period.

4.9.7 Open Channel Maintenance Criteria

Maintenance is a crucial and required element that ensures the long-term performance of open channels. Once established, grass channels have minimal maintenance needs outside of the spring cleanup, regular mowing, repair of check dams, and other measures to maintain the hydraulic efficiency of the channel and a dense, healthy grass cover. Dry swale designs may require regular pruning and management of trees and shrubs. The surface of dry swale filter beds can become clogged with fine sediment over time, but this can be alleviated through core aeration or deep tilling of the filter bed. Additional effort may be needed to repair check dams, stabilize inlet points, and remove deposited sediment from pretreatment cells. Table 4.38 provides a schedule of typical maintenance activities required for open channels.

Table 4.38.Typical Maintenance Activities and Schedule for Open Channels

Schedule	Maintenance Activity
As needed	▪ Mow grass channels and dry swales during the growing season to maintain grass heights in the 4- to 6-inch range.
Quarterly	▪ Ensure that the CDA, inlets, and facility surface are clear of debris. ▪ Ensure that the CDA is stabilized. Perform spot-reseeding if where needed. ▪ Remove accumulated sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, and overflow structures. ▪ Repair undercut and eroded areas at inflow and outflow structures.
Annual inspection	▪ Add reinforcement planting to maintain 90% turf cover. Reseed areas of dead vegetation. ▪ Remove any accumulated sand or sediment deposits behind check dams. ▪ Inspect upstream and downstream of check dams for evidence of undercutting or erosion. Remove and trash or blockages at weep holes. ▪ Examine channel bottom for evidence of erosion, braiding, excessive ponding, or dead grass. ▪ Check inflow points for clogging and remove any sediment. ▪ Inspect side slopes and grass filter strips for evidence of any rill or gully erosion and repair. ▪ Look for any bare soil or sediment sources in the CDA and stabilize immediately.

Maintenance Inspections. Annual inspections by a qualified professional are used to trigger maintenance operations, such as sediment removal, spot revegetation, and inlet stabilization. Maintenance inspection checklists for disconnection and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.9.8 Open Channel Stormwater Compliance Calculations

Grass channels are credited with 10% retention for the storage volume (Sv) provided by the practice as well as 50% TSS, 25% TN, and 30% bacteria removal (see Table 4.39).

Table 4.39. Grass Channel Retention and Pollutant Removal

Retention	= 10%
TSS Removal	= 50%
TN Removal	= 25%
Bacteria Removal	= 30%

Grass channels with amended soils are credited with 20% retention for the storage volume (Sv) provided by the practice as well as 50% TSS, 35% TN, and 30% bacteria removal (Table 4.40).

Table 4.40. Grass Channel on Amended Soils Retention and Pollutant Removal

Retention	= 20%
TSS Removal	= 50%
TN Removal	= 35%
Bacteria Removal	= 30%

Dry swales are credited with 60% retention for the storage volume (Sv) provided by the practice as well as 85% TSS, 70% TN, and 80% bacteria removal (Table 4.41).

Table 4.41. Dry Swale Retention and Pollutant Removal

Retention	= 60%
TSS Removal	= 85%
TN Removal	= 70%
Bacteria Removal	= 80%

Wet Swales are credited with 0% retention, but they do receive 80% TSS, 25% TN, and 60% bacteria removal for the storage volume (Sv) provided by the practice (Table 4.42).

Table 4.42. Wet Swale Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 25%
Bacteria Removal	= 60%

RSCs are credited with 0% retention, but they do receive 80% TSS, 40% TN, and 80% bacteria removal for the storage volume (Sv) provided by the practice (Table 4.43).

Table 4.43. RSC Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 40%
Bacteria Removal	= 80%

All practices must be sized using the guidance detailed in Section 4.9.4 Open Channel Design Criteria.

Open channels also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume from the total runoff volume for the 2-year through the 50-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.10 Filtering Systems

<table>
<tr><th colspan="6">Filtering Systems</th></tr>
<tr><td colspan="6">Definition: Practices that capture and temporarily store the design storm volume and pass it through a filter bed of sand media. Filtered runoff may be collected and returned to the conveyance system or allowed to partially infiltrate into the soil.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="4">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="4">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban</td><td rowspan="3">Small</td><th colspan="2">TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td colspan="2">80%</td><td>30%</td><td>80%</td></tr>
<tr><th colspan="4">Runoff Reductions</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="4">Volume</th></tr>
<tr><td>High</td><td>High</td><td colspan="4">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="4">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="4" rowspan="2">0%</td></tr>
<tr><td>At least annually</td><td>Every 5 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="4">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Applicable to small drainage areas
▪ Good for highly impervious areas
▪ Good for water quality retrofits to existing developments</td><td colspan="4">▪ High maintenance burden
▪ Not recommended for areas with high sediment content in stormwater or clay/silt runoff areas
▪ Relatively costly
▪ Possible odor problems, if not maintained
▪ Limited volume and rate control</td></tr>
<tr><th colspan="2">Components</th><th colspan="4">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Pretreatment
▪ Sand bed (or Filtration) chamber
▪ Spillway/outlet system(s)
▪ Liner, as needed</td><td colspan="4">▪ Typically requires 2 to 10 feet of head
▪ Maximum CDA of 2-5 acres
▪ Must drain within 40 hours
▪ In karst areas, watertight structure required
▪ Maintenance access</td></tr>
<tr><th colspan="6">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Inspect for clogging—rake first inch of sand
▪ Remove sediment from pretreatment areas</td><td colspan="4">▪ Replace filter media as needed
▪ Clean spillway/outlet system(s)</td></tr>
</table>

[1]*Credited pollutant load removal*

Stormwater filters are a useful practice to treat stormwater runoff from small, highly impervious sites. Stormwater filters capture, temporarily store, and treat stormwater runoff by passing it through an engineered filter media, collecting the filtered water in an underdrain, and then returning it back to the storm drainage system. Stormwater filters are a versatile option because they consume very little surface land and have few site restrictions. They provide moderate pollutant removal performance at small sites where space is limited.

Definition. Practices that capture and temporarily store the design storm volume and pass it through a filter bed of sand media. Filtered runoff may be collected and returned to the conveyance system or allowed to partially infiltrate into the soil. Design variants include the following:

F-1 Nonstructural sand filter

F-2 Surface sand filter

F-3 Three-chamber underground sand filter

F-4 Perimeter sand filter

Filters have no retention capability, so designers should consider using up-gradient retention practices, which have the effect of decreasing the design storm volume and size of the filtering practices. Filtering practices are also suitable to provide special treatment at designated stormwater hotspots.

Filtering systems are typically not designed to provide stormwater detention, but they may be in some circumstances. Filtering practices are generally combined with separate facilities to provide this type of control. However, the three-chamber underground sand filter can be modified by expanding the first (or settling) chamber, or by adding an extra chamber between the filter chamber and the clear well chamber to handle the detention volume, which is subsequently discharged at a predetermined rate through an orifice and weir combination.

A nonstructural or surface sand filter is depicted in Figure 4.39, while Figure 4.40 through Figure 4.45 depict three-chamber underground sand filters.

Perimeter sand filters (Figure 4.46) are enclosed stormwater management practices that are typically located just below grade in a trench along the perimeter of parking lot, driveway, or other impervious surface. Perimeter sand filters consist of a pretreatment forebay and a filter bed chamber. Stormwater runoff is conveyed into a perimeter sand filter through grate inlets located directly above the system

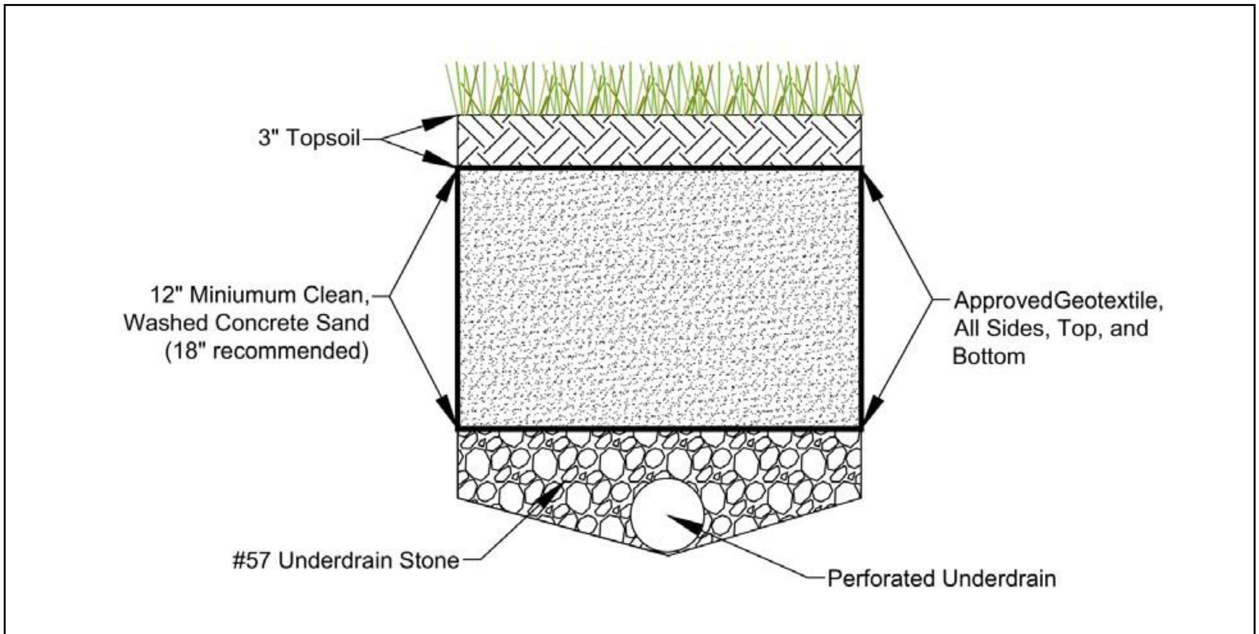


Figure 4.39. Typical schematic for a nonstructural or surface sand filter (note: material specifications are found in Table 4.44).

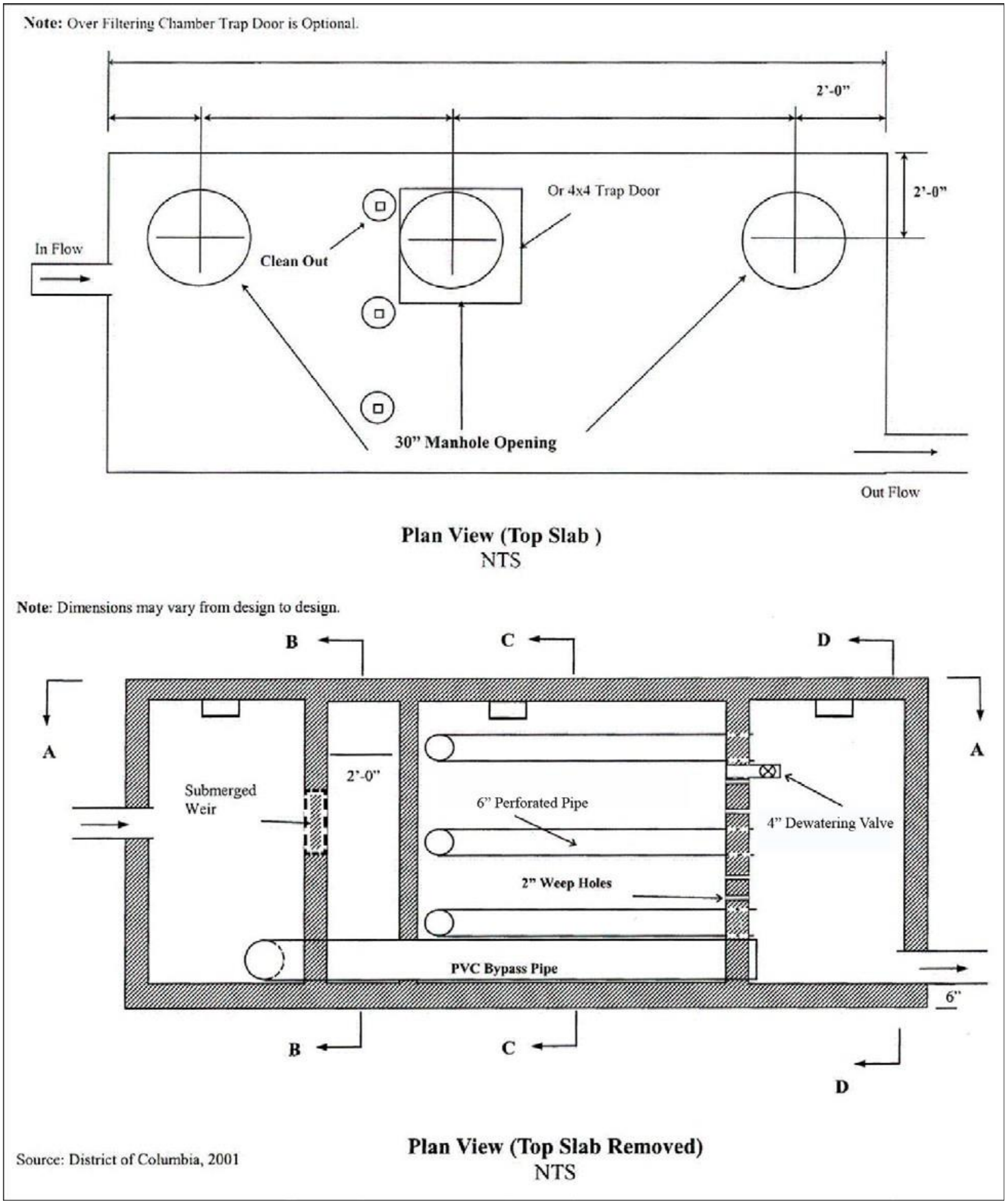


Figure 4.40. Example of a three-chamber underground sand filter (F-3) for separate sewer options. Part A. Note: material specifications are indicated in Table 4.44.

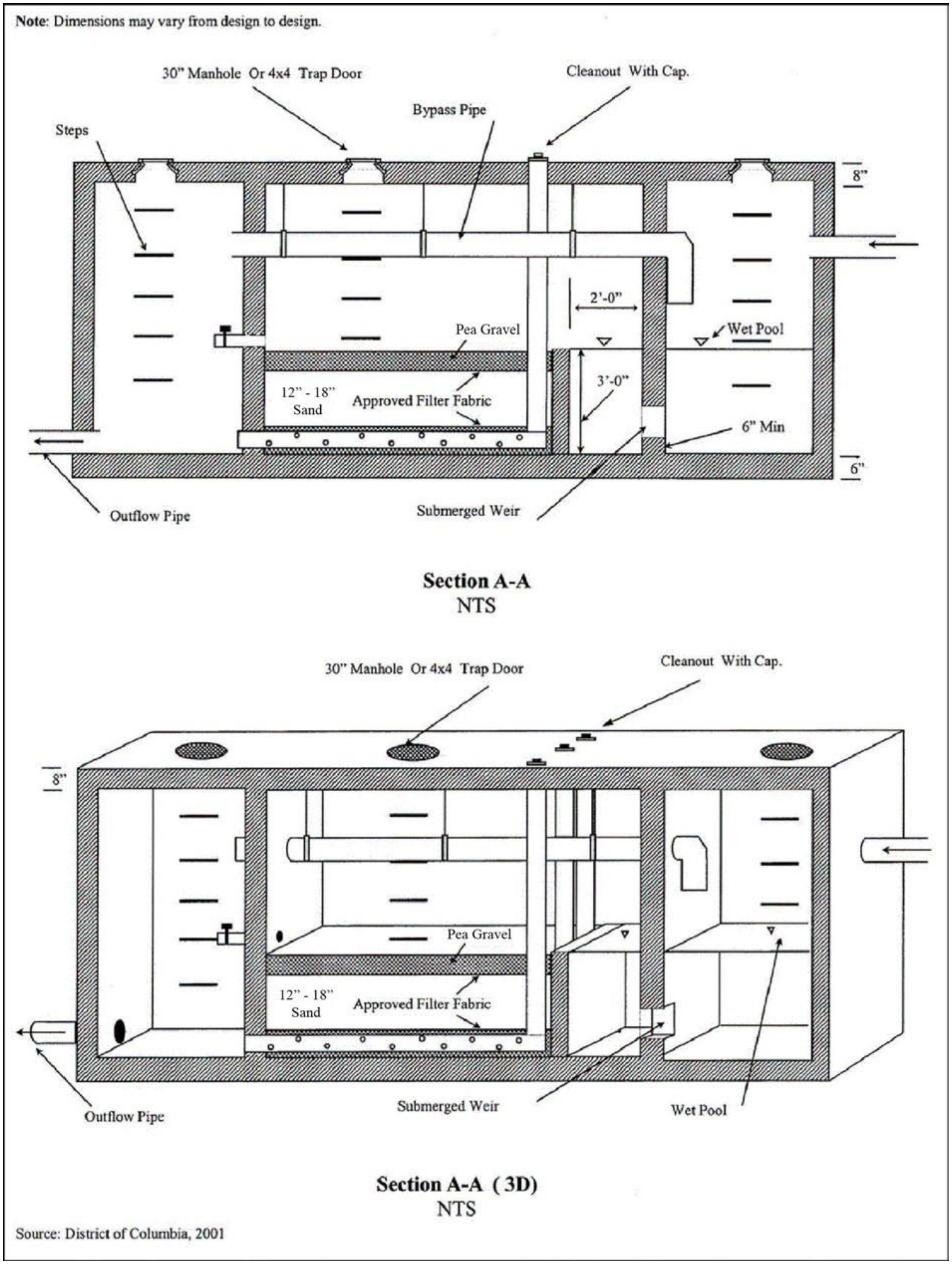


Figure 4.41. Example of a three-chamber underground sand filter (F-3) for separate sewer areas. Part B. Note: material specifications are indicated in Table 4.44.

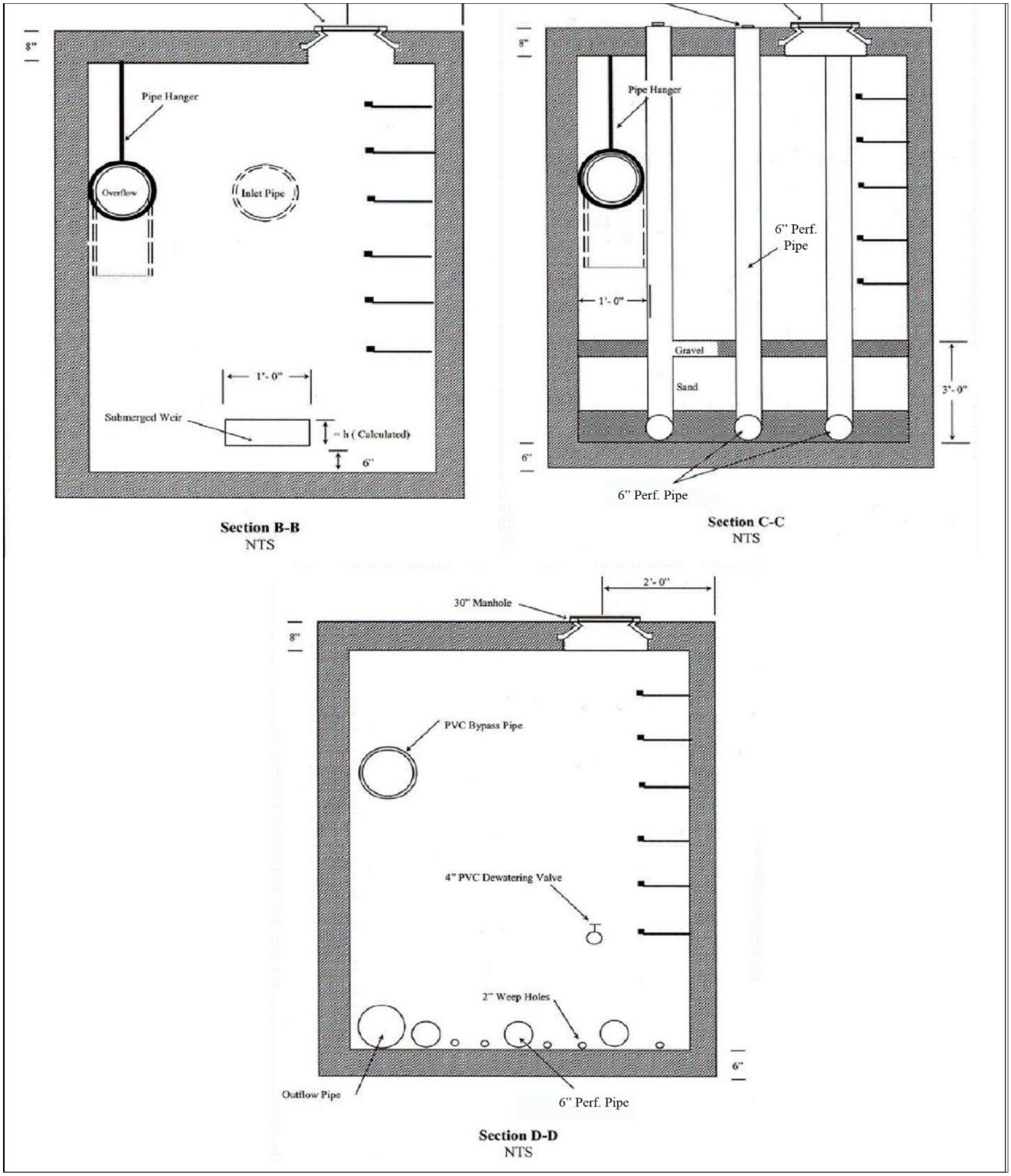


Figure 4. 42. Example of a three-chamber underground sand filter (F-3) for separate sewer areas. Part C. Note: material specifications are indicated in Table 4.44.

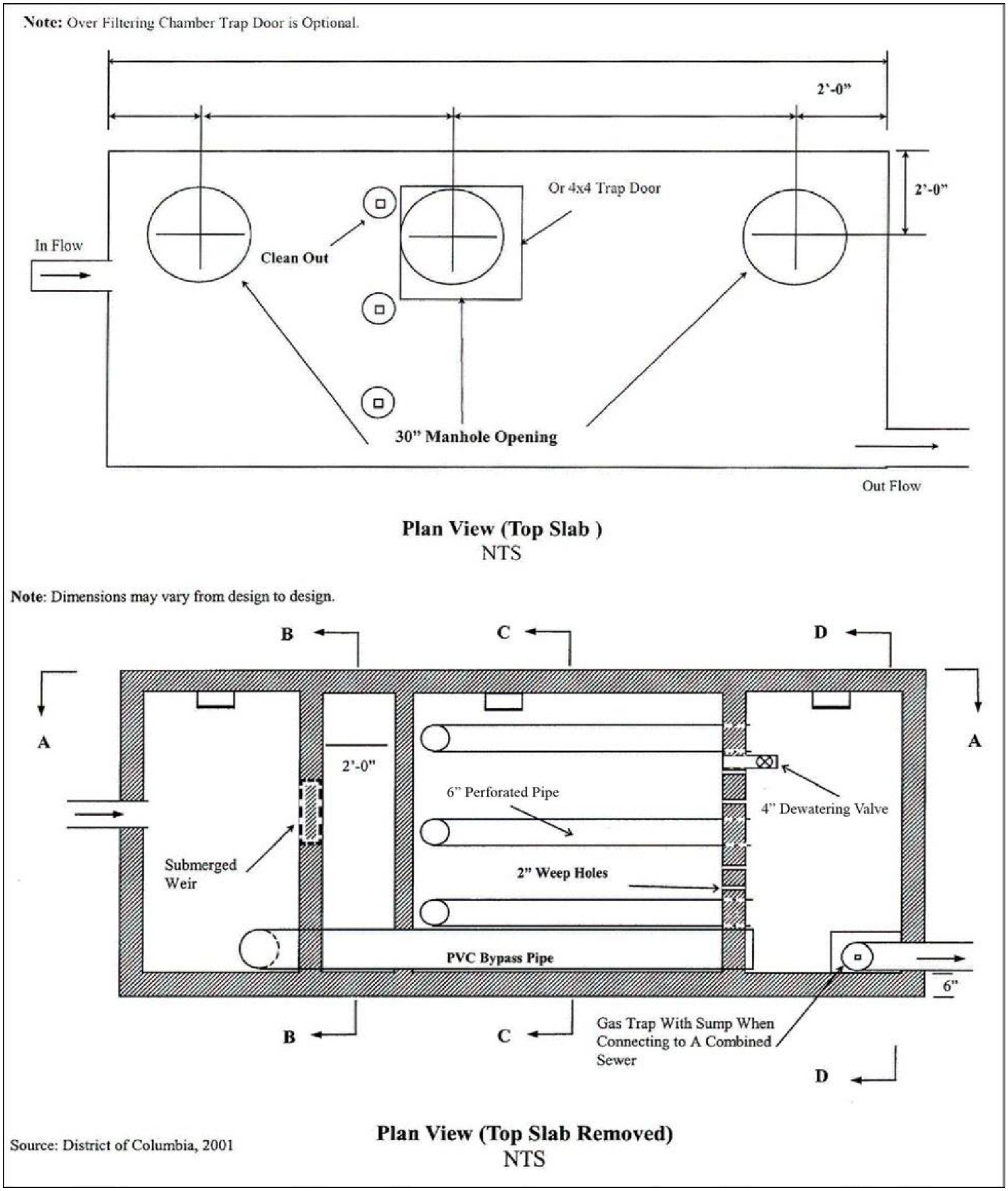


Figure 4.43. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part A. Note: Material specifications are indicated in Table 4.44.

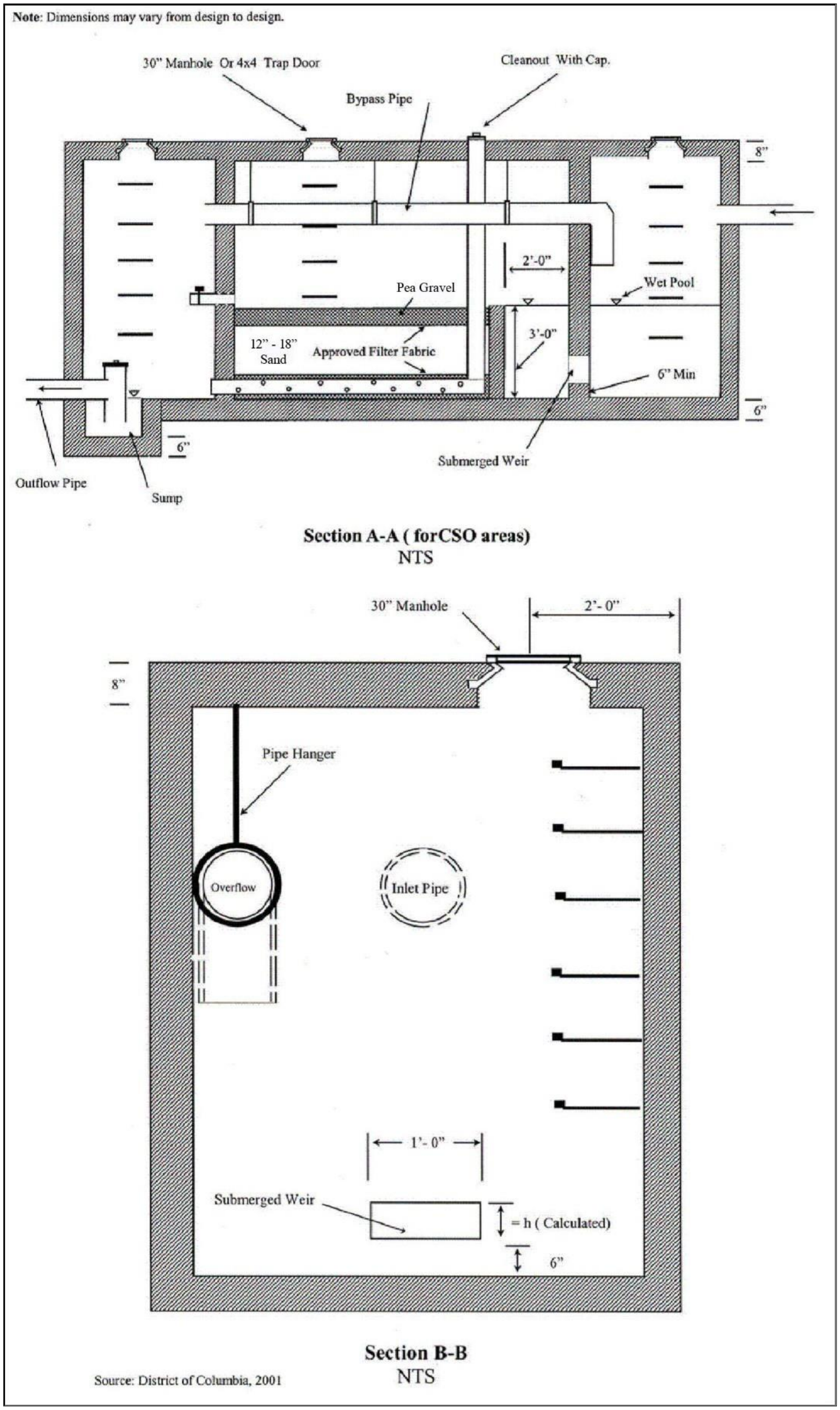


Figure 4. 44. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part B. Note: Material specifications are indicated in Table 4.44.

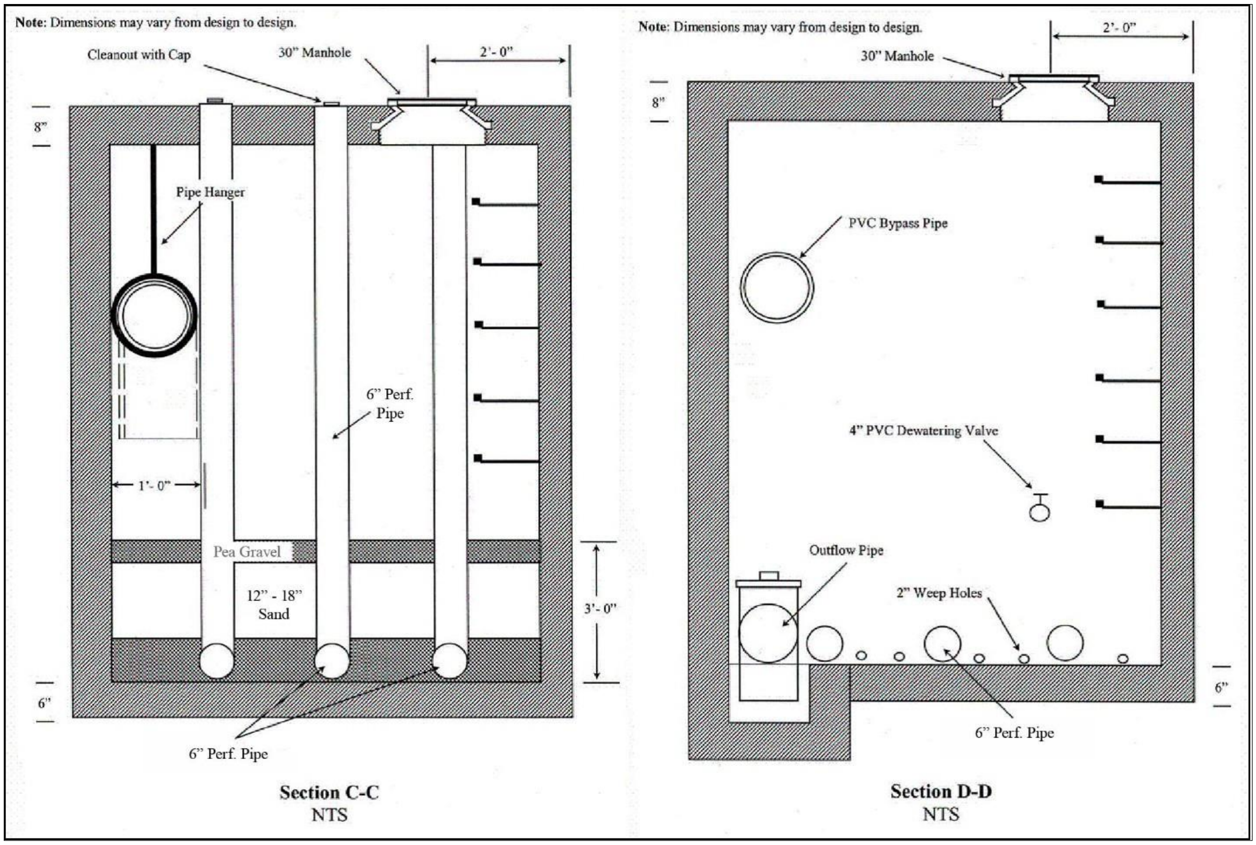


Figure 4.45. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part C. Note: Material specifications are indicated in Table 4.44.

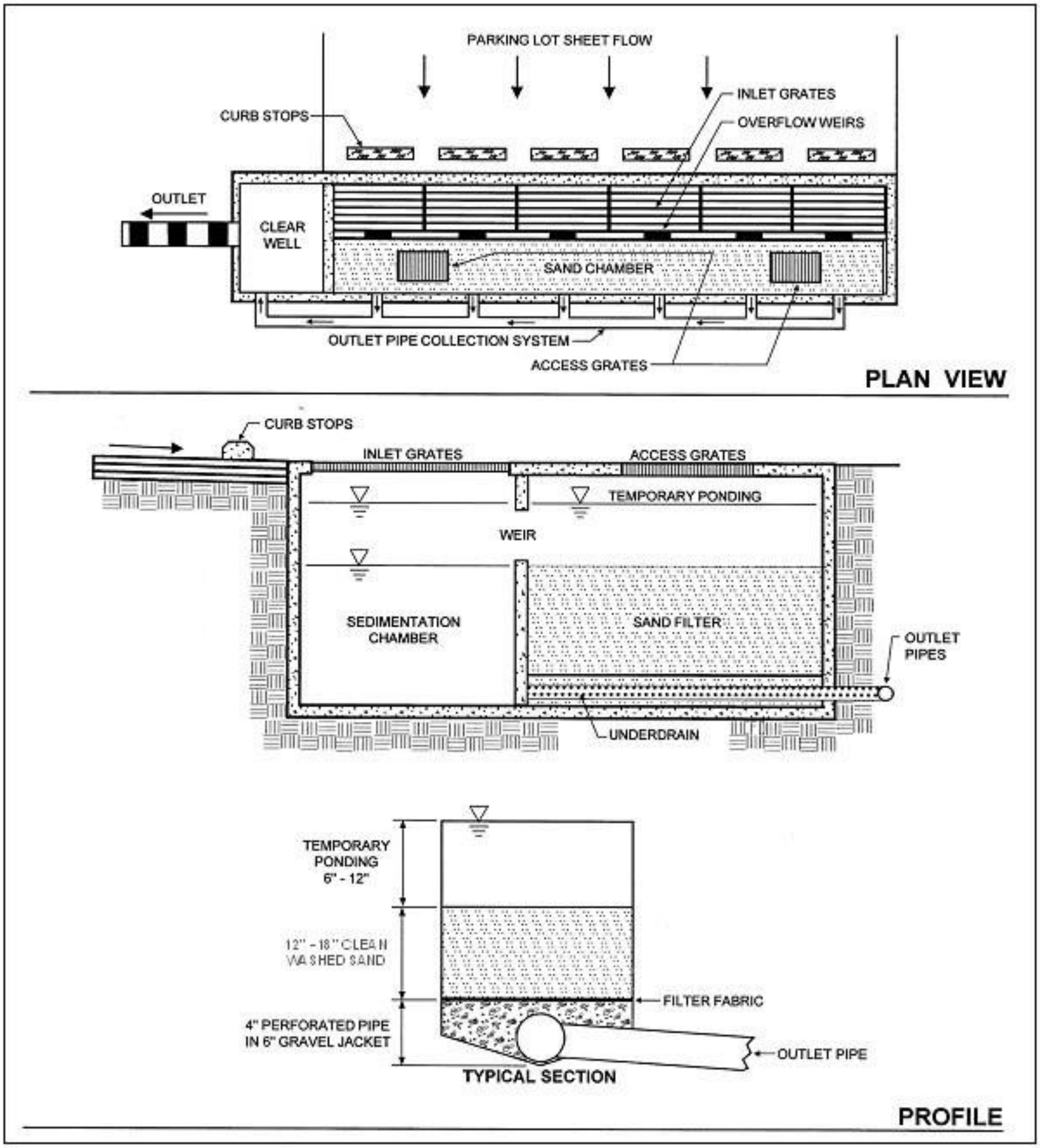


Figure 4.46. Example of a perimeter sand filter (F-4). Note: material specifications are indicated in Table 4.44.

4.10.1 Filtering System Feasibility Criteria

Stormwater filters can be applied to most types of urban land. They are not always cost-effective, given their high unit cost and small area served, but there are situations where they may clearly be the best option for stormwater treatment (e.g., hotspot runoff treatment, small parking lots, ultra-urban areas, etc.). The following criteria apply to filtering practices:

Available Hydraulic Head. The principal design constraint for stormwater filters is available hydraulic head, which is defined as the vertical distance between the top elevation of the filter and the bottom elevation of the existing storm drain system that receives its discharge. The head required for stormwater filters ranges from 2 to 10 feet, depending on the design variant. It is difficult to employ filters in extremely flat terrain, since they require gravity flow through the filter. The only exception is the perimeter sand filter, which can be applied at sites with as little as 2 feet of head.

Depth to Water Table. The designer must assure a standard separation distance of at least 0.5 feet between the groundwater table and the bottom invert of the filtering practice.

Contributing Drainage Area. Filters are best applied on small sites where the CDA is as close to 100% impervious as possible to reduce the risk that eroded sediment will clog the filter. If the CDA is pervious, then the vegetation must be dense and stable. Turf is acceptable (see Section 4.10.5 Filtering Landscaping Criteria). A maximum CDA of 5 acres is recommended for surface sand filters, and a maximum CDA of 2 acres is recommended for perimeter or underground filters. Filters have been used on larger CDAs in the past, but greater clogging problems have typically resulted.

Space Required. The amount of space required for a filter practice depends on the design variant selected. Surface sand filters typically consume about 2%–3% of the CDA, while perimeter sand filters typically consume less than 1%. Underground stormwater filters generally consume no surface area except their manholes.

Land Use. As noted above, filters are particularly well suited to treat runoff from stormwater hotspots and smaller parking lots. Other applications include redevelopment of commercial sites or when existing parking lots are renovated or expanded. Filters can work on most commercial, industrial, institutional, or municipal sites and can be located underground if surface area is not available.

Site Topography. Filters shall not be located on slopes greater than 6%.

Utilities. All utilities shall have a minimum 5-foot, horizontal clearance from the filtering practice.

Facility Access. All filtering systems shall be located in areas where they are accessible for inspection and for maintenance (by vacuum trucks).

Soils. Soil conditions do not constrain the use of filters. At least one soil boring must be taken at a low point within the footprint of the proposed filtering practice to establish the water table and evaluate soil suitability. A geotechnical investigation is required for all underground stormwater BMPs, including underground filtering systems. Geotechnical testing requirements are outlined in Appendix B Geotechnical Information Requirements for Underground BMPs.

Setbacks. Filters should be set back at least 10 feet from the property line, and the bottom of the practice should be separated from groundwater by at least 0.5 feet.

Economic Considerations. Perimeter sand filters are expensive relative to other treatment practices, but may be the only option to treat small hotspot drainage areas.

4.10.2 Filtering System Conveyance Criteria

Most filtering practices are designed as off-line systems so that all flows enter the filter storage chamber until it reaches capacity, at which point larger flows are then diverted or bypassed around the filter to an outlet chamber and are not treated. Runoff from larger storm events must be bypassed using an overflow structure or a flow splitter.

Some underground filters will be designed and constructed as on-line BMPs. In these cases, designers must indicate how the device will safely pass larger storm events (e.g., the 25-year event) to a stabilized water course without resuspending or flushing previously trapped material.

All stormwater filters must be designed to drain or dewater within 40 hours (1.67 days) after a storm event to reduce the potential for nuisance conditions.

4.10.3 Filtering System Pretreatment Criteria

Adequate pretreatment is needed to prevent premature filter clogging and ensure filter longevity. Dry or wet pretreatment shall be provided prior to filter media. Pretreatment devices are subject to the following criteria:

- Sedimentation chambers are typically used for pretreatment to capture coarse sediment particles before they reach the filter bed.
- Sedimentation chambers may be wet or dry but must be sized to accommodate at least 25% of the total design storm volume (inclusive).
- Sediment chambers should be designed as level spreaders such that inflows to the filter bed have near zero velocity and spread runoff evenly across the bed.
- Non-structural and surface sand filters may use alternative pretreatment measures, such as a grass filter strip, forebay, gravel diaphragm, check dam, level spreader, or a combination of these. The grass filter strip must be a minimum length of 15 feet and have a slope of 3% or less. The check dam may be wooden or concrete and must be installed so that it extends only 2 inches above the filter strip and has lateral slots to allow runoff to be evenly distributed across the filter surface. Alternative pretreatment measures must contain a non-erosive flow path that distributes the flow evenly over the filter surface. If a forebay is used, it must be designed to accommodate at least 25% of the total design storm volume (inclusive).

4.10.4 Filtering System Design Criteria

Detention time. All filter systems must be designed to drain the design storm volume from the filter chamber within 40 hours (1.67 days) after each rainfall event.

Structural Requirements. If a filter will be located underground or experience traffic loads, a licensed structural engineer must certify the structural integrity of the design.

Geometry. Filters are gravity flow systems that normally require 2 to 5 feet of driving head to push the water through the filter media through the entire maintenance cycle; therefore, sufficient vertical clearance between the inverts of the inflow and outflow pipes is required.

Type of Filter Media. The normal filter media consists of clean, washed AASHTO M-6/ASTM C-33 medium aggregate concrete sand with individual grains 0.02 to 0.04 inches in diameter.

Depth of Filter Media. The depth of the filter media plays a role in how quickly stormwater moves through the filter bed and how well it removes pollutants. The recommended filter bed depth is 18 inches. An absolute minimum filter bed depth of 12 inches above underdrains is required; although, designers should note that specifying the minimum depth of 12 inches will incur a more intensive maintenance schedule and possibly result in costlier maintenance.

Underdrain and Liner. Stormwater filters are normally designed with an impermeable liner and underdrain system that meet the criteria provided in Table 4. 44 below.

Underdrain Stone. The underdrain should be covered by a minimum 6-inch gravel layer consisting of clean, double washed No. 57 stone.

Type of Filter. There are several design variations of the basic filter that enable designers to use filters at challenging sites or to improve pollutant removal rates. The choice of which filter design to apply depends on available space, hydraulic head, and the level of pollutant removal desired. In ultra-urban situations where surface space is at a premium, underground sand filters are often the only design that can be used. Surface and perimeter filters are often a more economical choice when adequate surface area is available. The most common design variants include the following:

- **Non-Structural Sand Filter (F-1).** The non-structural sand filter is applied to sites less than 2 acres in size and is very similar to a bioretention practice (see Section 4.3 Bioretention), with the following exceptions:
  - The bottom is lined with an impermeable liner and always has an underdrain.
  - The surface cover is sand, turf, or pea gravel.
  - The filter media is 100% sand.
  - The filter surface is not planted with trees, shrubs, or herbaceous materials.
  - The filter has two cells, with a dry or wet sedimentation chamber preceding the sand filter bed.

  The non-structural sand filter is the least expensive filter option for treating hotspot runoff. The use of bioretention areas is generally preferred at most other sites.
- **Surface Sand Filter (F-2).** The surface sand filter is designed with both the filter bed and sediment chamber located at ground level. The most common filter media is sand; however, a peat/sand mixture may be used to increase the removal efficiency of the system. In most cases, the filter chambers are created using precast or cast-in-place concrete. Surface sand filters are normally designed to be off-line facilities, so that only the desired design volume is directed to the filter for treatment. However, in some cases they can be installed on the bottom of a dry pond (see Section 4.11 Storage Practices).
- **Underground Sand Filter.** The underground sand filter is modified to install the filtering components underground and is often designed with an internal flow splitter or overflow device that bypasses runoff from larger stormwater events around the filter. Underground sand filters are expensive to construct, but they consume very little space and are well suited to ultra-urban areas.
- **Three-Chamber Underground Sand Filter (F-3).** The three-chamber underground sand filter is a gravity flow system. The facility may be precast or cast-in-place. The first chamber acts as a pretreatment facility removing any floating organic material such as oil, grease, and tree leaves. It should have a submerged orifice leading to a second chamber, and it should be designed to minimize the energy of incoming stormwater before the flow enters the second chamber (i.e., filtering or processing chamber).

The second chamber is the filtering or processing chamber. It should contain the filter material consisting of gravel and sand and should be situated behind a weir. Along the bottom of the structure should be a subsurface drainage system consisting of a parallel perforated PVC pipe system in a stone bed. A dewatering valve should be installed at the top of the filter layer for safety release in cases of emergency. A bypass pipe crossing the second chamber to carry overflow from the first chamber to the third chamber is required.

The third chamber is the discharge chamber. It should also receive the overflow from the first chamber through the bypass pipe when the storage volume is exceeded.

Water enters the first chamber of the system by gravity or by pumping. This chamber removes most of the heavy solid particles, floatable trash, leaves, and hydrocarbons. Then the water flows to the second chamber and enters the filter layer by overtopping a weir. The filtered stormwater is then picked up by the subsurface drainage system that empties it into the third chamber.

Whenever there is insufficient hydraulic head for a three-chamber underground sand filter, a well pump may be used to discharge the effluent from the third chamber into the receiving storm or combined sewer. For three-chamber sand filters in combined-sewer areas, a water trap shall be provided in the third chamber to prevent the back flow of odorous gas.

- **Perimeter Sand Filter (F-4).** The perimeter sand filter also includes the basic design elements of a sediment chamber and a filter bed. The perimeter sand filter typically consists of two parallel trenches connected by a series of overflow weir notches at the top of the partitioning wall, which allows water to enter the second trench as sheet flow. The first trench is a pretreatment chamber removing heavy sediment particles and debris. The second trench consists of the sand filter layer. A subsurface drainage pipe must be installed at the bottom of the second chamber to facilitate the filtering process and convey filter water into a receiving system.

  In this design, flow enters the system through grates, usually at the edge of a parking lot. The perimeter sand filter is usually designed as an on-line practice (i.e., all flows enter the system), but larger events bypass treatment by entering an overflow chamber. One major advantage of the perimeter sand filter design is that it requires little hydraulic head and is therefore a good option for sites with low topographic relief.

Surface Cover. The surface cover for non-structural and surface sand filters should consist of a 3-inch layer of topsoil on top of the sand layer. The surface may also have pea gravel inlets in the topsoil layer to promote filtration. The pea gravel may be located where sheet flow enters the filter, around the margins of the filter bed, or at locations in the middle of the filter bed.

Underground sand filters should have a pea gravel or No. 57 stone layer on top of the sand layer. This gravel layer helps to prevent bio-fouling or blinding of the sand surface.

Maintenance Reduction Features. The following maintenance issues should be addressed during filter design to reduce future maintenance problems:

- **Observation Wells and Cleanouts.** Non-structural and surface sand filters must include an observation well consisting of a 6-inch diameter non-perforated PVC pipe fitted with a lockable cap. It should be installed flush with the ground surface to facilitate periodic inspection and maintenance. In most cases, a cleanout pipe will be tied into the end of all underdrain pipe runs. The portion of the cleanout pipe/observation well in the underdrain layer should be perforated. At least one cleanout pipe must be provided for every 2,000 square feet of filter surface area.

- **Access.** Good maintenance access is needed to allow crews to perform regular inspections and maintenance activities. "Sufficient access" is operationally defined as the ability to get a vacuum truck or similar equipment close enough to the sedimentation chamber and filter to enable cleanouts. Direct maintenance access shall be provided to the pretreatment area and the filter bed. For underground structures, sufficient headroom for maintenance should be provided. A minimum head space of 5 feet above the filter is recommended for maintenance of the structure. However, if 5 feet of headroom is not available, manhole access must be installed.
- **Manhole Access (for underground filters).** Access to the headbox and clearwell of Underground Filters must be provided by manholes at least 30 inches in diameter, along with steps to the areas where maintenance will occur.
- **Visibility.** Stormwater filters should be clearly visible at the site so inspectors and maintenance crews can easily find them. Adequate signs or markings must be provided at manhole access points for Underground Filters.
- **Confined Space Issues.** Underground filters are often classified as a confined space. Consequently, special OSHA rules apply, and training may be needed to protect the workers that access them. These procedures often involve training about confined space entry, venting, and the use of gas probes.

Filter Material Specifications. The basic material specifications for filtering practices that utilize sand as a filter media are outlined in Table 4.44.

Table 4.44. Filtering Practice Material Specifications

Material	Specification
Surface Cover	Non-structural and surface sand filters: 3-inch layer of topsoil on top of the sand layer. The surface may also have pea gravel inlets in the topsoil layer to promote filtration. Underground sand filters: Clean, double-washed pea gravel or No. 57 stone on top of the sand layer.
Sand	Clean AASHTO M-6/ASTM C-33 medium aggregate concrete sand with a particle size range of 0.02–0.04 inches in diameter.
Choker Stone and/or Geotextile/Filter Fabric	For choker stone, a 2- to 4-inch layer of choker stone (e.g., typically ASTM D448 No. 8 or No. 89 washed gravel) should be placed between the sand layer and the underdrain stone. Alternatively, if available head is limited, an appropriate geotextile fabric that meets AASHTO M-288 Class 2, latest edition, requirements may be used. The geotextile fabric must have a flow rate of > 125 gpm/ft^2 (ASTM D4491) and an Apparent Opening Size (AOS) equivalent to a US No. 70 or No. 80 sieve.
Underdrain/Perforated Pipe	4- or 6-inch perforated schedule 40 PVC pipe, with three or four rows of 3/8-inch perforations at 6 inches on center.
Underdrain Stone	Use No. 57 stone or the ASTM equivalent (1-inch maximum).
Impermeable Liner	Where appropriate, use a PVC Geomembrane liner or equivalent.

Filter Sizing. Filtering devices are sized to accommodate a specified design storm volume (typically SWRv). The volume to be treated by the device is a function of the storage depth above the filter and the surface area of the filter. The storage volume is the volume of ponding above the filter. For a given design volume, Equation 4.23 is used to determine the required filter surface area.

Equation 4.23 Minimum Filter Surface Area for Filtering Practices

$$SA_{filter} = \frac{DesignVolume \times d_f}{k \times (h_{avg} + d_f) \times t_d}$$

where:

SA_{filter}	=	area of the filter surface (ft^2)
$DesignVolume$	=	design storm volume, typically the SWRv (ft^2)
d_f	=	filter media depth (thickness) (ft), with a minimum of 1 ft
k	=	coefficient of permeability (ft/day) (3.5 ft/day for partially clogged sand)
h_f	=	height of water above the filter bed (ft), with a maximum of 5 ft
h_{avg}	=	average height of water above the filter bed (ft), one half of the filter height (h_f)
t_d	=	allowable drawdown time (1.67 days)

The coefficient of permeability (ft/day) is intended to reflect the worst-case situation (i.e., the condition of the sand media at the point in its operational life where it is in need of replacement or maintenance). Filtering practices are therefore sized to function within the desired constraints at the end of the media's operational life cycle.

The entire filter treatment system, including pretreatment, shall temporarily hold at least 50% of the design storm volume prior to filtration (see Equation 4.24). This reduced volume takes into account the varying filtration rate of the water through the media, as a function of a gradually declining hydraulic head.

Equation 4. 24 Required Ponding Volume for Filtering Practices

$$V_{ponding} = 0.50 \times DesignVolume$$

where:

$V_{ponding}$	=	storage volume required prior to filtration (ft^3)
$DesignVolume$	=	design storm volume, typically the SWRv (ft^2)

The total storage volume for the practice (Sv) can be determined using Equation 4. 25 below.

Equation 4.25 Storage Volume for Filtering Practices

$$SSRR = 2.0 \times W_{ppbbppmmmppgg}$$

where:

Sv	=	total storage volume for the practice (ft^3)
$V_{ponding}$	=	storage volume required prior to filtration (ft^3)

4.10.5 Filtering System Landscaping Criteria

A dense and vigorous vegetative cover shall be established over the contributing pervious drainage areas before runoff can be accepted into the facility. Filtering practices should be incorporated into site landscaping to increase their aesthetics and public appeal.

Surface filters (e.g., surface and non-structural sand filters) can have a grass cover to aid in pollutant adsorption. The grass should be capable of withstanding frequent periods of inundation and drought.

4.10.6 Filtering System Construction Sequence

Soil Erosion and Sediment Control. No runoff shall be allowed to enter the filter system prior to completion of all construction activities, including revegetation and final site stabilization. Construction runoff shall be treated in separate sedimentation basins and routed to bypass the filter system. Should construction runoff enter the filter system prior to final site stabilization, all contaminated materials must be removed and replaced with new clean filter materials before a regulatory inspector approves its completion. The approved soil erosion and sediment control plan shall include specific measures to provide for the protection of the filter system before the final stabilization of the site.

Filter Installation. The following is the typical construction sequence to properly install a structural sand filter. This sequence can be modified to reflect different filter designs, site conditions, and the size, complexity, and configuration of the proposed filtering application.

1. **Stabilize Contributing Drainage Area.** Filtering practices should only be constructed after the CDA to the facility is completely stabilized, so sediment from the CDA does not flow into and clog the filter. If the proposed filtering area is used as a sediment trap or basin during the construction phase, the construction notes should clearly specify that, after site construction is complete, the sediment control facility will be dewatered, dredged, and regraded to design dimensions for the post-construction filter.

2. **Install Soil Erosion and Sediment Control Measures for the Filtering Practice.** Stormwater should be diverted around filtering practices as they are being constructed. This is usually not difficult to accomplish for off-line filtering practices. It is extremely important to keep runoff and eroded sediment away from the filter throughout the construction process. Silt fence or other sediment controls should be installed around the perimeter of the filter, and erosion control fabric may be needed during construction on exposed side-slopes with gradients exceeding 4H:1V. Exposed soils in the vicinity of the filtering practice should be rapidly stabilized by hydro-seed, sod, mulch, or other method.

3. **Assemble Construction Materials on Site.** Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

4. **Clear and Strip.** Bring the project area to the desired subgrade.

5. **Excavate and Grade.** Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the filtering practice.

6. **Install Filter Structure. Install filter structure in design location** and check all design elevations (i.e., concrete vaults for surface, underground, and perimeter sand filters). Upon completion of the filter structure shell, inlets and outlets must be temporarily plugged and the structure filled with water to the brim to demonstrate water tightness. Maximum allowable leakage is 5% of the water volume in a 24-hour period. See Appendix E Construction Inspection Checklists for the Stormwater Facility Leak Test form. If the structure fails the test, repairs must be performed to make the structure watertight before any sand is placed into it.

7. **Install Base Material Components. Install the gravel, underdrains, and choker layers** of the filter.

8. **Install Top Sand Component. Spread sand across filter bed** in 1-foot lifts up to the design elevation. Backhoes or other equipment can deliver the sand from outside the filter structure. Sand should be manually raked. Clean water is then added until the sedimentation chamber and filter bed are completely full. The facility is then allowed to drain, hydraulically compacting the sand layers. After 48 hours of drying, refill the structure to the final top elevation of the filter bed.

9. **Install Surface Layer (Surface Sand Filters only).** Add a 3-inch topsoil layer and pea gravel inlets and immediately seed with the permanent grass species. The grass should be watered, and the facility should not be switched on-line until a vigorous grass cover has become established.

10. **Stabilize Surrounding Areas. Stabilize exposed soils** on the perimeter of the structure with temporary seed mixtures appropriate for a buffer. All areas above the normal pool should be permanently stabilized by hydroseed, sod, or seeding and mulch.

11. **Final Inspection. Conduct the final construction inspection.** Multiple construction inspections by a qualified professional are critical to ensure that stormwater filters are properly constructed. Inspections are recommended during the following stages of construction:

- Initial site preparation, including installation of soil erosion and sediment control measures;
- Excavation/grading to design dimensions and elevations;
- Installation of the filter structure, including the water tightness test;
- Installation of the underdrain and filter bed;
- Check that turf cover is vigorous enough to switch the facility on-line; and
- Final inspection after a rainfall event to ensure that it drains properly and all pipe connections are watertight. Develop a punch list for facility acceptance. Log the filtering practice’s GPS coordinates and submit them for entry into the BMP maintenance tracking database.

Construction phase inspection checklist for filters and the Stormwater Facility Leak Test form can be found in Appendix E Construction Inspection Checklists.

4.10.7 Filtering System Maintenance Criteria

Maintenance of filters is required and involves several routine maintenance tasks, which are outlined in Table 4.45. A cleanup should be scheduled at least once a year to remove trash and floatables that accumulate in the pretreatment cells and filter bed. Frequent sediment cleanouts in the dry and wet sedimentation chambers are recommended every 1 to 3 years to maintain the function and performance of the filter. If the filter treats runoff from a stormwater hotspot, crews may need to test the filter bed media before disposing of the media and trapped pollutants. Petroleum hydrocarbon contaminated sand or filter cloth must be disposed of according to State solid waste disposal regulations. Testing is not needed if the filter does not receive runoff from a designated stormwater hotspot, in which case the media can be safely disposed of in a landfill.

Table 4.45. Typical Annual Maintenance Activities for Filtering Practices

Frequency	Maintenance Tasks
At least 4 times per growing season	▪ Mow grass filter strips and perimeter turf around surface sand filters. Maximum grass heights should be less than 12 inches.
2 times per year (may be more or less frequently depending on land use)	▪ Check to see if sediment accumulation in the sedimentation chamber has exceeded 6 inches. If so, schedule a cleanout.
Annually	▪ Conduct inspection and cleanup. ▪ Dig a small test pit in the filter bed to determine whether the first 3 inches of sand are visibly discolored and need replacement. ▪ Check to see if inlets and flow splitters are clear of debris and are operating properly. ▪ Check concrete structures and outlets for any evidence of spalling, joint failure, leakage, corrosion, etc. ▪ Ensure that the filter bed is level and remove trash and debris from the filter bed. Sand or gravel covers should be raked to a depth of 3 inches.
Every 5 years	▪ Replace top sand layer. ▪ Till or aerate surface to improve infiltration/grass cover.
As needed	▪ Remove blockages and obstructions from inflows. Trash collected on the grates protecting the inlets shall be removed regularly to ensure the inflow capacity of the BMP is preserved. ▪ Stabilize CDA and side-slopes to prevent erosion. Filters with a turf cover should have 95% vegetative cover.
Upon failure	▪ Corrective maintenance is required any time the sedimentation basin and sediment trap do not draw down completely after 72 hours (i.e., no standing water is allowed).

Maintenance Inspections. Regular inspections by a qualified professional are critical to schedule sediment removal operations, replace filter media, and relieve any surface clogging. Frequent inspections are especially needed for underground and perimeter filters, since they are out of sight and can be easily forgotten. Depending on the level of traffic or the particular land use, a filter system may either become clogged within a few months of normal rainfall or could possibly last several years with only routine maintenance. Maintenance inspections should be conducted within 24 hours following a storm that exceeds 0.5 inch of rainfall, to evaluate the condition and performance of the filtering practice.

Note: Without regular maintenance, reconditioning sand filters can be very expensive.

Maintenance inspection checklists for filters and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.10.8 Filtering System Stormwater Compliance Calculations

Filtering practices are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 80% bacteria removal for the storage volume (Sv) provided by the (Table 4.46).

Table 4.46. Filter Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 30%
Bacteria Removal	= 80%

The practice must be sized using the guidance detailed in Section 4.8.4 Filtering Design Criteria.

4.11 Storage Practices

Storage Practices					
Definition: Practices that are explicitly designed to provide stormwater detention (2- to 25-year, and/or flood control).					
Site Applicability		**BMP Performance Summary**			
Land Uses	**Required Footprint**	**WQ Improvement:** Low			
▪ Urban ▪ Suburban ▪ Rural	**Medium**	**TSS[1]**	**Total N[1]**	**Bacteria[1]**	
		60%	10%	60%	
		Runoff Reduction			
Construction Costs	**Maintenance Burden**	**Volume**			
Moderate	Low	Low			
Maintenance Frequency:		***SWRv***			
Routine	**Non-Routine**	0%			
Quarterly	Every 10–15 years				
Advantages/Benefits		**Disadvantages/Limitation**			
▪ Flood control ▪ Typically less costly than stormwater (wet) ponds for equivalent flood storage ▪ Provides recreational and other open space opportunities between storm runoff events		▪ Minimal water quality treatment ▪ Best suited to large CDAs (at least 10 acres) ▪ Tends to re-suspend sediment			
Components		**Design considerations**			
▪ Conveyance ▪ Inlets/outlets ▪ Forebay ▪ Ponding area with available storage ▪ Micropool ▪ Spillway system(s) ▪ Liners, as needed		▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice ▪ Drawdown of 24 to 48 hours ▪ Shallow pond with large surface area performs better than deep pond of same volume ▪ Maintenance access			
Maintenance Activities					
▪ Remove debris (inlets/outlets/basin surface) ▪ Remove sediment buildup ▪ Repair and revegetate eroded areas.		▪ Perform structural repairs to inlet and outlets. ▪ Mow unwanted vegetation			

[1]*Credited pollutant load removal*

Storage practices are a common BMP used to temporarily detain runoff to reduce peak flows (Figure 4.47**).**

Figure 4.47. Dry Extended Detention Pond (Photo: Center for Watershed Protection, Inc.)

Definition. Storage practices are explicitly designed to provide stormwater detention (2- to 25-year, and/or flood control). Design variants include the following:

S-1 Underground detention vaults and tanks

S-2 Dry detention ponds

S-3 Rooftop storage

S-4 Stone storage under permeable pavement or other BMPs

Detention vaults are box-shaped underground stormwater storage facilities typically constructed with reinforced concrete. Detention tanks are underground storage facilities typically constructed with large diameter concrete or plastic pipe (see Figure 4.44). Both serve as an alternative to surface dry detention for stormwater quantity control, particularly for space-limited areas where there is not adequate land for a dry detention basin or multi-purpose detention area. Prefabricated concrete vaults are available from commercial vendors. In addition, several pipe manufacturers have developed packaged detention systems.

Dry detention ponds are widely applicable for most land uses and are best suited for larger SDAs. An outlet structure restricts stormwater flow, so it backs up and is stored within the basin (see Figure 4.

45). The temporary ponding reduces the maximum peak discharge to the downstream channel, thereby reducing the effective shear stress on the bed and banks of the receiving stream.

Storage practices do not receive any stormwater retention or treatment volume and should be considered only for management of larger storm events. Storage practices are not considered an acceptable practice to meet the SWRv. Storage practices must be combined with a separate facility to meet these requirements. Upland practices can be used to satisfy some, or all, of the stormwater retention requirements at many sites, which can help to reduce the footprint and volume of storage practices.

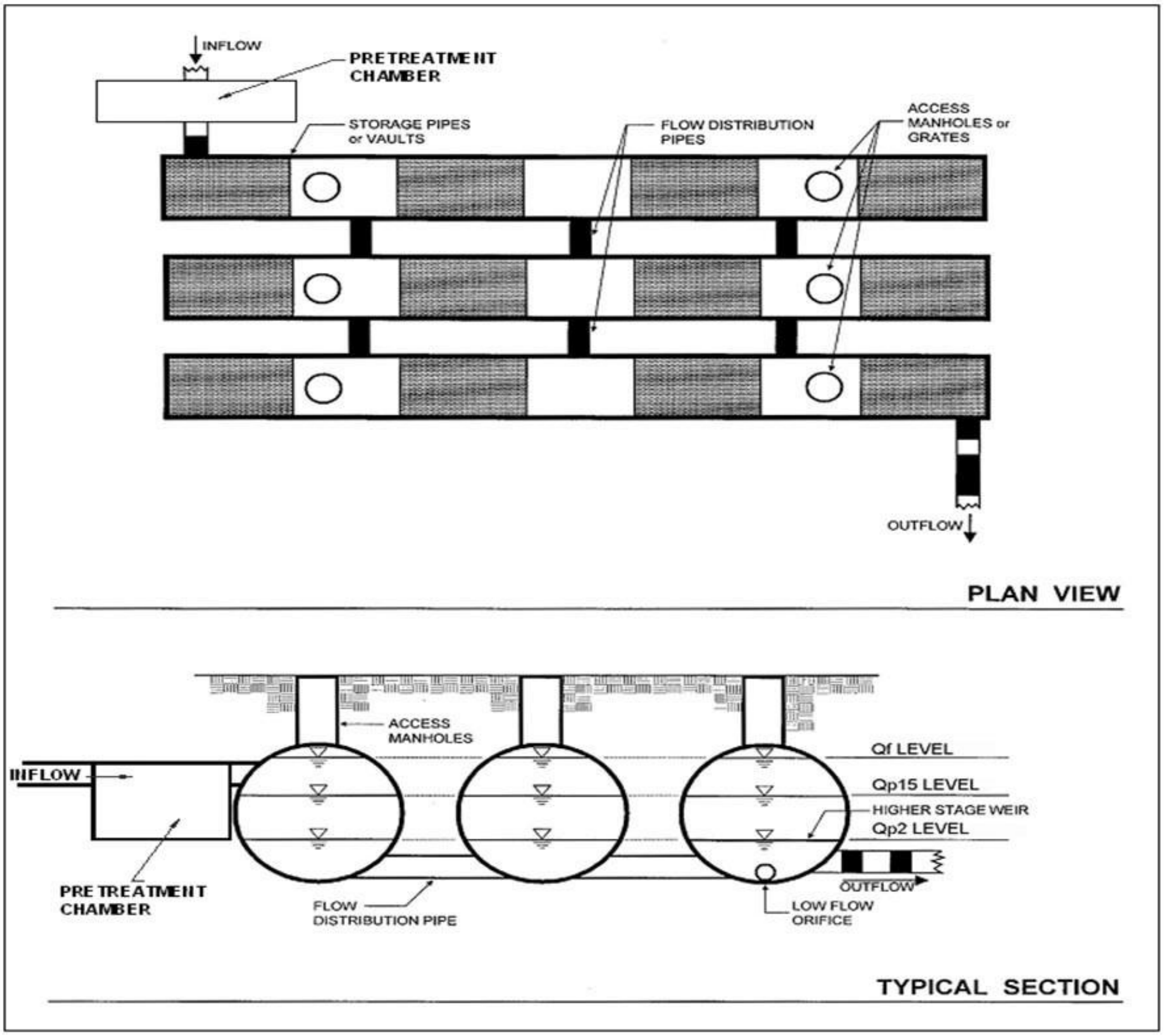


Figure 4.48 Example of an underground detention vault and/or tank (S-1).

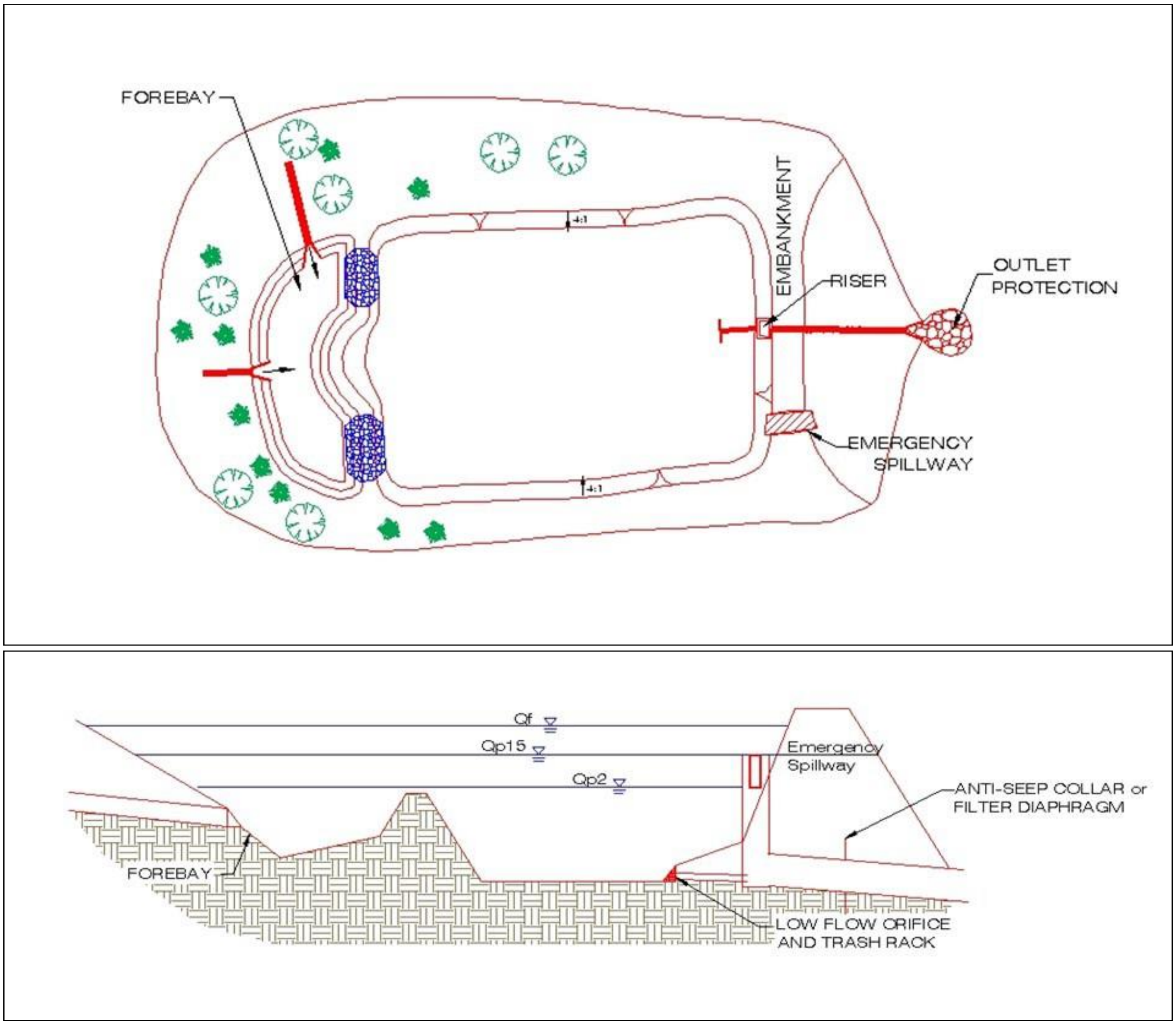


Figure 4.49 Example of a dry detention pond (S-2).

4.11.1 Storage Feasibility Criteria

The following feasibility issues need to be evaluated when storage practices are considered as the final practice in a treatment train:

Space Required. A typical storage practice requires a footprint of 1%–3% of its CDA, depending on the depth of the pond or storage vault (i.e., the deeper the practice, the smaller footprint needed).

Contributing Drainage Area. A CDA of at least 10 acres is preferred for dry ponds in order to keep the required orifice size from becoming a maintenance problem. Designers should be aware that small "pocket" ponds will typically (1) have very small orifices that will be prone to clogging, (2) experience fluctuating water levels such that proper stabilization with vegetation is very difficult, and (3) generate more significant maintenance problems.

Underground detention systems can be located downstream of other structural stormwater controls providing treatment of the design storm. For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRCS CN that reflects the volume reduction of upland practices and likely reduce the size and cost of detention (see Storage Practice Sizing in Section 4.8.4 Storage Design Criteria).

The maximum CDA to be served by a single underground detention vault or tank is 25 acres.

Available Hydraulic Head. The depth of a storage practice is usually determined by the amount of hydraulic head available at the site (dimension between the surface drainage and the bottom elevation of the site). The bottom elevation is normally the invert of the existing downstream conveyance system to which the storage practice discharges. Depending on the size of the development and the available surface area of the basin, as much as 6 to 8 feet of hydraulic head may be needed for a dry detention practice to function properly for storage. An underground storage practice will require sufficient head room to facilitate maintenance—at least 5 feet depending on the design configuration.

Setbacks. Setbacks to structures and property lines must be at least 10 feet, and adequate waterproofing protection must be provided for foundations and basements.

Depth to Water Table. Dry ponds are not allowed if the water table will be within 0.5 feet of the floor of the pond. For underground detention vaults and tanks, an anti-flotation analysis is required to check for buoyancy problems in high water table areas.

Tidal Impacts. The outlet of a dry detention practice should be located above the tidal mean high water elevation. In tidally impacted areas, detention practices may have minimal benefit, and re- questing a variance for detention requirements may be an option.

Tailwater Conditions. The flow depth in the receiving channel should be considered when determining outlet elevations and discharge rates from the dry detention practice. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis. For direct discharges to tidal waters, a king tide evaluation shall accompany the tailwater condition evaluation.

Soils. The permeability of soils is seldom a design constraint for storage practices. Soil infiltration tests should be conducted at proposed dry pond sites to estimate infiltration rates and patterns, which can be significant in HSG A soils and some group B soils. Infiltration through the bottom of the pond is typically encouraged unless it may potentially migrate laterally thorough a soil layer and impair the integrity of the embankment or other structure.

Structural Stability. Underground detention vaults and tanks must meet structural requirements for overburden support and traffic loading if appropriate as verified by shop drawings signed by an appropriately licensed professional.

Geotechnical Tests. At least one soil boring must be taken at a low point within the footprint of any proposed storage practice to establish the water table elevations and evaluate soil suitability. A geotechnical investigation is required for all underground BMPs, including underground storage systems. Geotechnical testing requirements are outlined in Appendix B Geotechnical Information Requirements for Underground BMPs.

Utilities. For a dry pond system, no utility lines shall be permitted to cross any part of the embankment where the design water depth is greater than 2 feet. Typically, utilities require a minimum 5-foot horizontal clearance from storage facilities.

Perennial Streams. Locating dry ponds on perennial streams will require both a Section 401 and Section 404 permit from the appropriate state or federal regulatory agency.

Economic Considerations. Underground detention can be expensive, but often allows for greater use of a development site. Dry detention ponds are generally inexpensive to construct and maintain. Depending upon the type of development, dry detention practices may be required to treat a larger volume of water than other BMPs. Dry detention practices must store 1 inch of runoff from the site, whereas infiltration practices and other BMPs must capture 1 inch of runoff from only the impervious cover on a site.

4.11.2 Storage Conveyance Criteria

Designers must use accepted hydrologic and hydraulic routing calculations to determine the required storage volume and an appropriate outlet design for storage practices. See Section 3.7.2 Hydrologic and Hydraulic Analysis for a summary of acceptable hydrologic methodologies and models.

For management of the 2-year storm, a control structure with a trash rack designed to release the required predevelopment Qp_2 must be provided. Ideally, the channel protection orifice should have a minimum diameter of 3 inches in order to pass minor trash and debris. However, where smaller orifices are required, the orifice must be adequately protected from clogging by an acceptable external trash rack.

As an alternative, the orifice diameter may be reduced if internal orifice protection is used (i.e., a perforated vertical stand pipe with 0.5-inch orifices or slots that are protected by wirecloth and a stone filtering jacket). Adjustable gate valves, weir manholes, and other structures designed for simple maintenance can also be used to achieve this equivalent diameter.

For overbank flood protection, an additional outlet is sized for 2- to 25-year frequency storm event control and can consist of a weir, orifice, outlet pipe, combination outlet, or other acceptable control structure.

Riprap, plunge pools or pads, or other energy dissipators are to be placed at the end of the outlet to prevent scouring and erosion and to provide a non-erosive velocity of flow from the structure to a water course. The design must specify an outfall that will be stable for the 25-year design storm event. The channel immediately below the storage practice outfall must be modified to prevent erosion. This is typically done by calculating channel velocities and flow depths, then placing appropriately sized riprap, over geotextile fabric, which can reduce flow velocities from the principal spillway to non-erosive levels (3.5 to 5.0 feet per second depending on the channel lining material). The storage practice geometry and outfall design may need to be altered in order to yield adequate channel velocities and flow.

Flared pipe sections that discharge at or near the stream invert or into a step pool arrangement should be used at the spillway outlet. An outfall analysis shall be included in the SWMP showing discharge velocities down to the nearest downstream water course. Where indicated, the developer/contractor must secure an off-site drainage easement for any improvements to the downstream channel.

When the discharge is to a manmade pipe or channel system, the system must be adequate to convey the required design storm peak discharge.

If discharge daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of riprap should be avoided.

The final release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at a downstream structure, highway, or natural point of restricted streamflow.

The following **additional** conveyance criteria apply to underground detention or ponds:

- **High Flow Bypass (underground detention).** An internal or external high flow bypass or overflow must be included in underground detention designs to safely pass the extreme flood flow.
- **Primary Spillway (dry ponds).** The primary spillway shall be designed with acceptable anti-flotation, anti-vortex, and trash rack devices. The spillway must generally be accessible from dry land. When reinforced concrete pipe is used for the principal spillway to increase its longevity, “O”-ring gaskets (ASTM C361) must be used to create watertight joints, and they should be inspected during installation.
- **Avoid Outlet Clogging (dry ponds).** The risk of clogging in outlet pipes with small orifices can be reduced by the following:
  - Providing a micropool at the outlet structure. For more information on micropool extended detention ponds see Section 4.12 Ponds.
  - Installing a trash rack to screen the low-flow orifice.
  - Using a perforated pipe under a gravel blanket with an orifice control at the end in the riser structure.
- **Emergency Spillway (dry ponds).** Dry ponds must be constructed with overflow capacity to safely pass the 100-year design storm event through either the primary spillway or a vegetated or armored emergency spillway unless waived by Beaufort County Public Works Department.
- **Inlet Protection (dry ponds).** Inflow points into dry pond systems must be stabilized to ensure that non-erosive conditions exist during storm events up to the overbank flood event (i.e., the 25-year storm event).

4.11.3 Storage Pretreatment Criteria

Dry Pond Pretreatment Forebay. A forebay must be located at each major inlet to a dry pond to trap sediment and preserve the capacity of the main treatment cell. The following criteria apply to dry pond forebay design:

- A major inlet is defined as an individual storm drain inlet pipe or open channel serving at least 10% of the storage practice’s CDA.
- The forebay consists of a separate cell, formed by an acceptable barrier (e.g., an earthen berm, concrete weir, gabion baskets, etc.).
- The forebay shall be sized to contain 0.1 inches per impervious acre of contributing drainage. The relative size of individual forebays should be proportional to the percentage of the total inflow to the dry pond.

- The forebay should be designed in such a manner that it acts as a level spreader to distribute runoff evenly across the entire bottom surface area of the main storage cell.
- Exit velocities from the forebay shall be non-erosive or an armored overflow shall be provided. Non-erosive velocities are 4 feet per second for the 2-year event and 6 feet per second for the 25-year event.
- The bottom of the forebay may be hardened (e.g., concrete, asphalt, or grouted riprap) in order to make sediment removal easier.
- Direct maintenance access for appropriate equipment shall be provided to the each forebay.

Underground Detention Pretreatment. A pretreatment structure to capture sediment, coarse trash, and debris must be placed upstream of any inflow points to underground detention. A separate sediment sump or vault chamber sized to capture 0.1 inches per impervious acre of contributing drainage, or a proprietary structure with demonstrated capability of removing sediment and trash, should be provided at the inlet for underground detention systems that are in a treatment train with off-line water quality treatment structural controls. Refer to Section 0 Proprietary Practices for information on approved proprietary practices.

4.11.4 Storage Design Criteria

Dry Pond Internal Design Features. The following apply to dry pond design:

- **No Pilot Channels.** Dry ponds shall not have a low-flow pilot channel, but instead must be constructed in a manner whereby flows are evenly distributed across the pond bottom, to avoid scour, promote attenuation and, where possible, infiltration.
- **Internal Slope.** The maximum longitudinal slope through the pond should be approximately 0.5%–1%.
- **Side Slopes.** Side slopes within the dry pond should generally have a gradient of 3H:1V to 4H:1V. The mild slopes promote better establishment and growth of vegetation and provide for easier maintenance and a more natural appearance. Ponds with side slopes steeper than 5H:1V must be fenced and include a lockable gate.
- **Long Flow Path.** Dry pond designs should have an irregular shape and a long flow path distance from inlet to outlet to increase water residence time, treatment pathways, pond performance, and to eliminate short-cutting. In terms of flow path geometry, there are two design considerations: (1) the overall flow path through the pond, and (2) the length of the shortest flow path (Hirschman et al., 2009):
  - The overall flow path can be represented as the length-to-width ratio OR the flow path ratio. These ratios must be at least 2L:1W (3L:1W preferred). Internal berms, baffles, or topography can be used to extend flow paths and/or create multiple pond cells.
  - The shortest flow path represents the distance from the closest inlet to the outlet. The ratio of the shortest flow to the overall length must be at least 0.4. In some cases—due to site geometry, storm sewer infrastructure, or other factors—some inlets may not be able to meet these ratios. However, the CDA served by these “closer” inlets must constitute no more than 20% of the total CDA.
- **Top of Bank. Dry ponds shall be provided with a 20-ft maintenance access at the top of bank with a maximum cross slope of 48:1.**

Safety Features. The following safety features must be considered for storage practices:

- The underground spillway access must be designed and constructed to prevent access by small children.
- End walls above pipe outfalls greater than 48 inches in diameter must be fenced at the top of the wall to prevent a falling hazard.
- Storage practices must incorporate an additional 1 foot of freeboard above the emergency spillway, or 2 feet of freeboard if design has no emergency spillway, for the 100-year storm.
- The emergency spillway must be located so that downstream structures will not be impacted by spillway discharges
- Underground maintenance access should be locked at all times.

Maintenance Access. All storage practices shall be designed so as to be accessible to annual maintenance. Unless waived by Beaufort County Public Works Department, a 5H:1V slope and 15-foot-wide entrance ramp is required for maintenance access to dry ponds. Adequate maintenance access must also be provided for all underground detention systems. Access must be provided over the inlet pipe and outflow structure with access steps. Access openings can consist of a standard 30-inch diameter frame, grate and solid cover, a hinged door, or removable panel. Removable panels must be designed with sufficient support so they cannot fall through the opening into the vault when removed.

Outlets. Trash racks shall be provided for low-flow pipes and for risers not having anti-vortex devices.

To reduce maintenance problems for small orifices, a standpipe design can be used that includes a smaller inner standpipe with the required orifice size, surrounded by a larger standpipe with multiple openings, and a gravel jacket surrounding the larger standpipe. This design will reduce the likelihood of the orifice being clogged by sediment.

Detention Vault and Tank Materials. Underground stormwater detention structures shall be composed of materials as approved by Beaufort County Public Works Department. All construction joints and pipe joints shall be soil-tight. Cast-in-place wall sections must be designed as retaining walls. The maximum depth from finished grade to the vault invert is 20 feet. The minimum pipe diameter for underground detention tanks is 24 inches unless otherwise approved by Beaufort County Public Works Department. Manufacturer’s specifications should be consulted for underground detention structures.

Anti-floatation Analysis for Underground Detention. Anti-flotation analysis is required to check for buoyancy problems in high water table areas. Anchors shall be designed to counter the pipe and structure buoyancy by at least a 1.2 factor of safety.

Storage Practice Sizing. Storage facilities should be sized to control peak flow rates from the 2- to 25-year frequency storm event or other design storm. Design calculations must ensure that the post-development peak discharge does not exceed the predevelopment peak discharge. See Section 3.7.2 Hydrologic and Hydraulic Analysis for a summary of acceptable hydrologic methodologies and models.

For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRCS CN that reflects the volume reduction of upland practices to compute the 2- 50-year frequency storm event that must be treated by the storage practice.

4.11.5 Storage Landscaping Criteria
No landscaping criteria apply to underground storage practices.

For dry ponds, a landscaping plan must be provided that indicates the methods used to establish and maintain vegetative coverage within the dry pond. Minimum elements of a plan include the following:

- Delineation of pondscaping zones within the pond.
- Selection of corresponding plant species.
- The planting plan.
- The sequence for preparing the wetland bed, if one is incorporated with the dry pond (including soil amendments, if needed).
- Sources of native plant material.
- The planting plan should allow the pond to mature into a native forest in the right places, but yet keep mowable turf along the embankment and all access areas. The wooded wetland concept proposed by Cappiella et al. (2005) may be a good option for many dry ponds.
- Woody vegetation may not be planted or allowed to grow within 15 feet of the toe of the embankment nor within 25 feet from the principal spillway structure.

4.11.6 Storage Construction Sequence
Construction of underground storage systems must be in accordance with manufacturer's specifications. All runoff into the system should be blocked until the site is stabilized. The system must be inspected and cleaned of sediment after the site is stabilized.

The following is a typical construction sequence to properly install a dry pond. The steps may be modified to reflect different dry pond designs, site conditions, and the size, complexity, and configuration of the proposed facility.

1. **Use of Dry Pond for Soil Erosion and Sediment Control.** A dry pond may serve as a sediment basin during project construction. Installation of the permanent riser should be initiated during the construction phase, and design elevations should be set with final cleanout of the sediment basin and conversion to the post-construction dry pond in mind. The bottom elevation of the dry pond should be lower than the bottom elevation of the temporary sediment basin. Appropriate procedures must be implemented to prevent discharge of turbid waters when the basin is being converted into a dry pond.

2. **Stabilize the Contributing Drainage Area.** Dry ponds should only be constructed after the CDA to the pond is completely stabilized. If the propose dry pond site will be used as a sediment trap or basin during the construction phase, the construction notes must clearly indicate that the facility will be dewatered, dredged, and regraded to design dimensions after the original site construction is complete.

3. **Assemble Construction Materials on Site.** Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

4. **Clear and Grade.** Bring the project area to the desired subgrade.

5. **Soil Erosion and Sediment Controls.** Install soil erosion and sediment control measures prior to construction, including temporary stormwater diversion practices. All areas surrounding the pond that are graded or denuded during construction must be planted with turf grass, native plantings, or other approved methods of soil stabilization.

6. Install the Spillway Pipe. Ensure the top invert of the spillway pipe is set to design elevation.

7. Install the Riser or Outflow Structure. Once riser and outflow structures are installed, ensure the top invert of the overflow weir is constructed level and at the design elevation.

8. Construct the Embankment and any Internal Berms. Construct the embankment and berms in 8- to 12-inch lifts and compact the lifts with appropriate equipment.

9. Excavate and Grade. Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the dry pond.

10. Construct the Emergency Spillway. The emergency spillway must be constructed in cut or structurally stabilized soils.

11. Install Outlet Pipes. The installation of outlet pipes must include a downstream riprap protection apron.

12. Stabilize Exposed Soils. All areas above the normal pool elevation should be permanently stabilized by hydroseeding or seeding over straw.

Dry Pond Construction Supervision. Ongoing construction supervision is recommended to ensure that stormwater ponds are properly constructed. Supervision/inspection is recommended during the following stages of construction:

- Preconstruction meeting
- Initial site preparation including the installation of soil erosion and sediment control measures
- Excavation/Grading (interim and final elevations)
- Installation of the embankment, the riser/primary spillway, and the outlet structure
- Implementation of the pondscaping plan and vegetative stabilization
- Immediately seed or install vegetated ground cover upon completion of sloping and grading of each storage practice, where applicable, within a project.
- Inspect within two weeks to ensure vegetation is in fact holding banks and slopes in place.
- Prior to completion of project, mechanically remove erosion deposition from ponds that occurred during the project. Criteria should be based on erosion of designed bank slopes and loss of storage capacity.
- Final inspection (develop a punch list for facility acceptance)

Construction phase inspection checklist for storage practices and the Stormwater Facility Leak Test form can be found in Appendix E Construction Inspection Checklists.

If the dry pond has a permanent pool, then to facilitate maintenance the contractor should measure the actual constructed dry pond depth at three areas within the permanent pool (forebay, mid-pond, and at the riser), and they should mark and geo-reference them on an as-built drawing. This simple data set will enable maintenance inspectors to determine pond sediment deposition rates in order to schedule sediment cleanouts.

4.11.7 Storage Maintenance Criteria

Typical maintenance activities for storage practices are outlined in Table 4.47. Maintenance requirements for underground storage facilities will generally require quarterly visual inspections from the manhole access points by a qualified professional to verify that there is no standing water or excessive sediment buildup. Entry into the system for a full inspection of the system components (pipe or vault joints, general structural soundness, etc.) should be conducted annually. Confined space entry credentials are typically required for this inspection.

Table 4.47. Typical Maintenance Activities for Storage Practices.

Schedule	Maintenance Activity
As needed	▪ Water dry pond side slopes to promote vegetation growth and survival.
Quarterly	▪ Remove sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, storage practices, and overflow structures. ▪ Ensure that the CDA, inlets, and facility surface are clear of debris. ▪ Ensure that the CDA is stabilized. Perform spot-reseeding where needed. ▪ Repair undercut and eroded areas at inflow and outflow structures.
Annual inspection	▪ Measure sediment accumulation levels in forebay. Remove sediment when 50% of the forebay capacity has been lost. ▪ Inspect the condition of stormwater inlets for material damage, erosion or undercutting. Repair as necessary. ▪ Inspect the banks of upstream and downstream channels for evidence of sloughing, animal burrows, boggy areas, woody growth, or gully erosion that may undermine pond embankment integrity. ▪ Inspect outfall channels for erosion, undercutting, riprap displacement, woody growth, etc. ▪ Inspect condition of principal spillway and riser for evidence of spalling, joint failure, leakage, corrosion, etc. ▪ Inspect condition of all trash racks, reverse sloped pipes, or flashboard risers for evidence of clogging, leakage, debris accumulation, etc. ▪ Inspect maintenance access to ensure it is free of debris or woody vegetation and check to see whether valves, manholes, and locks can be opened and operated. ▪ Inspect internal and external side slopes of dry ponds for evidence of sparse vegetative cover, erosion, or slumping, and make needed repairs immediately. ▪ Monitor the growth of wetlands, trees and shrubs planted in dry ponds. Remove invasive species and replant vegetation where necessary to ensure dense coverage.

Maintenance of storage practices is driven by annual inspections that evaluate the condition and performance of the storage practice. Based on inspection results, specific maintenance tasks will be triggered.

Maintenance inspection checklists for extended detention ponds and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.11.8 Storage Stormwater Compliance Calculations

Storage practices are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 80% bacteria removal for the SWRv (Table 4.48).

Table 4.48. Storage Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 60%
TN Removal	= 10%
Bacteria Removal	= 60%

4.12 Ponds

<table>
<tr><th colspan="5">Ponds</th></tr>
<tr><td colspan="5">Definition: Stormwater storage practices that consist of a combination of a permanent pool, micropool, or shallow marsh that promote a good environment for gravitational settling, biological uptake, and microbial activity.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Medium</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80%</td><td>30%</td><td>60%</td></tr>
<tr><th colspan="3">Runoff Reductions</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="3">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">0%</td></tr>
<tr><td>At least annually</td><td>Every 5–7 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Moderate to high pollutant removal
▪ Can be designed as a multi-functional BMP
▪ Cost effective
▪ Good for sites with high water table and/or poorly drained soils
▪ Wildlife habitat potential
▪ High community acceptance when integrated into a development</td><td colspan="3">▪ Requires large amount of flat land (1-3% of CDA)
▪ Must be properly designed, installed, and maintained to avoid nuisance problems
▪ Routine sediment cleanout may be needed
▪ Potential for thermal impacts downstream</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Forebay
▪ Ponding area with available storage
▪ Micropool
▪ Spillway system(s)
▪ Liners, as needed</td><td colspan="3">▪ CDA of at least 10 acres and slopes <15%
▪ Use CN adjustment factor ARC III for CDA that are irrigated with harvested rainwater
▪ Minimum length to width ratio = 3:1
▪ Maximum depth of permanent pool = 8’
▪ 3:1 side slopes or flatter around pond perimeter</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Remove debris from inlet and outlet structures
▪ Maintain side slopes/remove invasive vegetation</td><td colspan="3">▪ Monitor sediment accumulation and remove periodically</td></tr>
</table>

[1]*Credited pollutant load removal*

Stormwater ponds are widely applicable for most land uses and are best suited for larger drainage areas (Figure 4.47); however, they should be considered for use after all other upland retention opportunities have been exhausted and there is still a remaining treatment volume or runoff from larger storms (i.e., 2- to 25-year or flood control events) to manage.

Stormwater ponds receive no retention credit and should be considered mainly for management of larger storm events. Stormwater ponds have both community and environmental concerns (see Section 4.12.1 Pond Feasibility Criteria) that should be considered before choosing stormwater ponds as the appropriate stormwater practice on site.

Figure 4.48 Wet Pond (photo: Denise Sanger)

Definition. Stormwater ponds are stormwater storage practices that consist of a combination of a permanent pool, micropool, or shallow marsh that promote a good environment for gravitational settling, biological uptake, and microbial activity. Ponds are best suited for larger SDAs. Runoff from each new storm enters the pond and partially displaces pool water from previous storms. The pool also acts as a barrier to resuspension of sediments and other pollutants deposited during prior storms. When sized properly, stormwater ponds have a residence time that ranges from many days to several weeks, which allows numerous pollutant removal mechanisms to operate. Stormwater ponds can also provide storage above the permanent pool to help meet stormwater management requirements for larger storms. Design variants include the following (see Figure 4. 47 and Figure 4.48):

C-1 Micropool extended detention pond

C-2 Wet pond

C-3 Wet extended detention pond

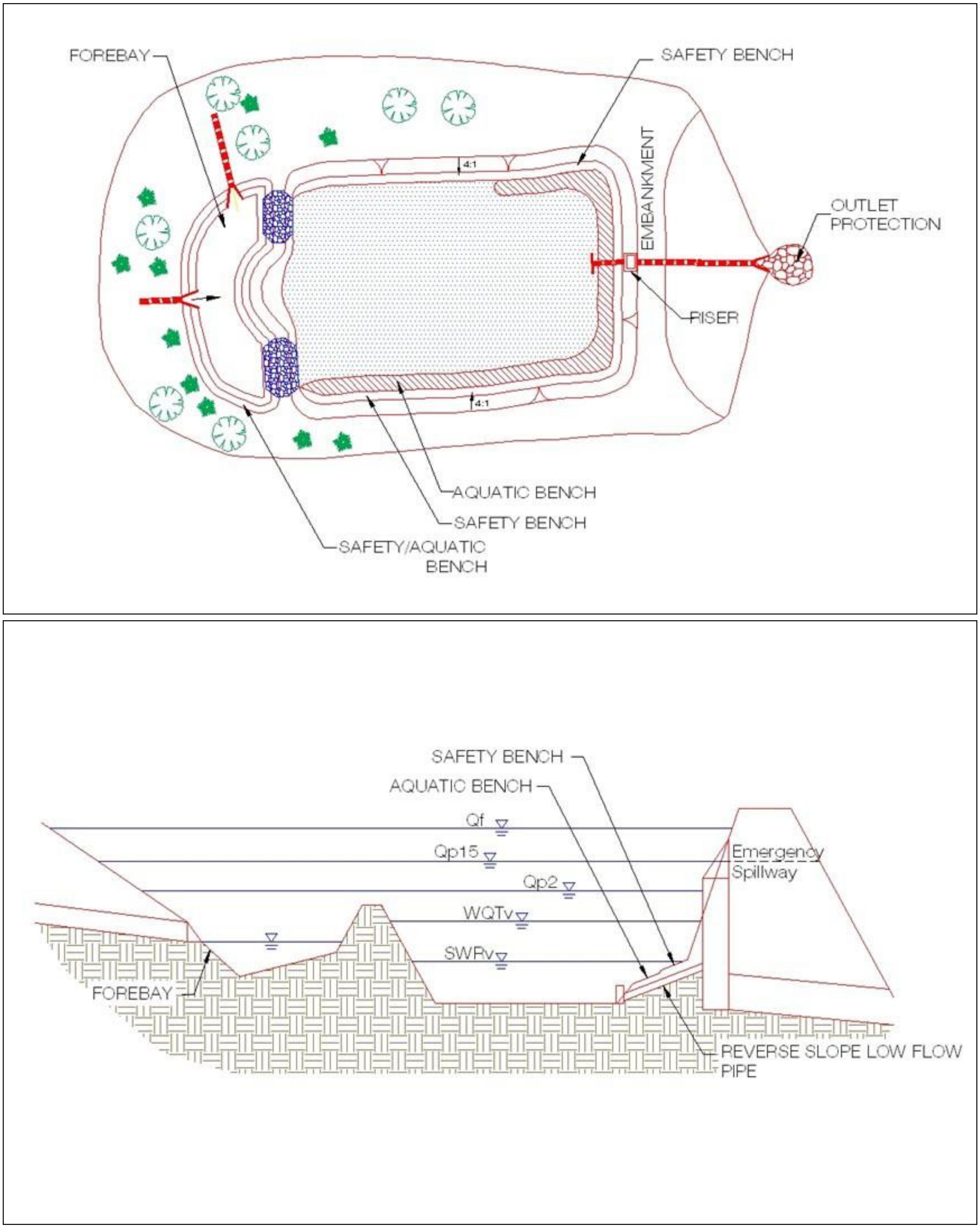
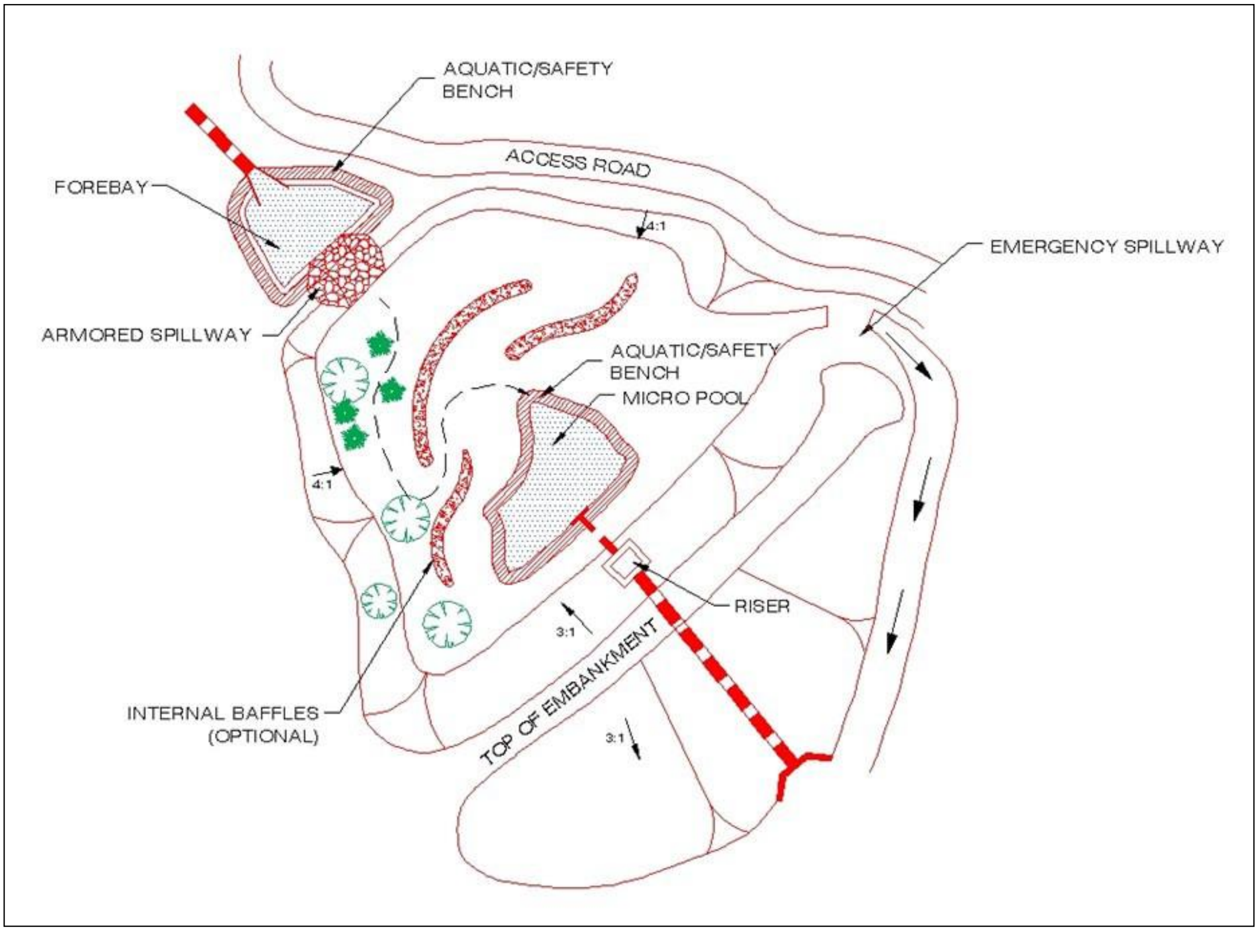


Figure 4. 50 Design schematics for a wet pond (C-2).



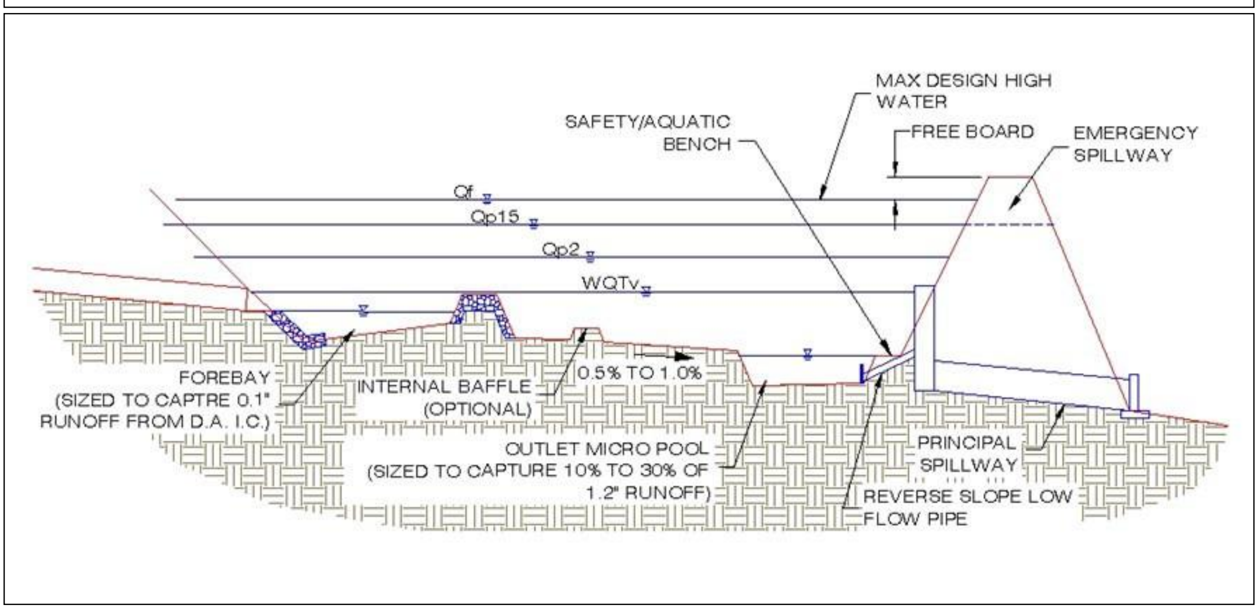


Figure 4. 51 Typical extended detention pond (C-3) details.

4.12.1 Pond Feasibility Criteria

The following feasibility issues need to be considered when ponds are considered a final stormwater management practice of the treatment train.

Adequate Water Balance. Wet ponds must have enough water supplied from groundwater, runoff, or baseflow so that the wet pools will not draw down by more than 2 feet after a 30-day summer drought. A simple water balance calculation must be performed using the Equation 4.27 in Section 4.10.4 Pond Design Criteria.

Contributing Drainage Area. A CDA of 10 to 25 acres is typically recommended for ponds to maintain constant water elevations. Ponds can still function with CDAs less than 10 acres, but designers should be aware that these “pocket” ponds will be prone to clogging, experience fluctuating water levels, and generate more nuisance conditions.

Space Requirements. The surface area of a pond will normally be at least 1%–3% of its CDA, depending on the pond’s depth.

Site Topography. Ponds are best applied when the grade of contributing slopes is less than 15%.

Available Hydraulic Head. The depth of a pond is usually determined by the hydraulic head available on the site. The bottom elevation is normally the invert of the existing downstream conveyance system to which the pond discharges. Typically, a minimum of 6 to 8 feet of head are needed to hold the wet pool and any additional large storm storage or overflow capacity for a pond to function.

Setbacks. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements.

Proximity to Utilities. For an open pond system, no utility lines shall be permitted to cross any part of the embankment of a wet pool.

Depth to Water Table. The depth to the groundwater table is not a major constraint for stormwater ponds because a high water table can help maintain wetland conditions. However, groundwater inputs can also reduce the pollutant removal rates of ponds. Further, if the water table is close to the surface, it may make excavation difficult and expensive.

Tailwater Conditions. The flow depth in the receiving channel should be considered when determining outlet elevations and discharge rates from wet pond. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis. For direct discharges to tidal waters, a king tide evaluation shall accompany the tailwater condition evaluation.

Soils. Highly permeable soils will make it difficult to maintain a healthy permanent pool. Soil infiltration tests need to be conducted at proposed pond sites to determine the need for a pond liner or other method to ensure a constant water surface elevation. Underlying soils of HSG C or D should be adequate to maintain a permanent pool. Most HSG A soils and some HSG B soils will require a liner (see Table 3.42). Geotechnical tests should be conducted to determine the saturated hydraulic conductivity and other subsurface properties of the soils beneath the proposed pond.

Use of or Discharges to Natural Wetlands. Ponds cannot be located within State waters, including wetlands, without obtaining a Section 404 permit or other permissions from the appropriate state or federal regulatory agency. In addition, the designer should investigate the wetland status of adjacent areas to determine if the discharge from the pond will change the hydroperiod of a downstream natural wetland (see Cappiella et al., 2006, for guidance on minimizing stormwater discharges to existing wetlands).

Perennial Streams. Locating ponds on perennial streams will require both US Army COE permits under Clean Water Act Section 401 and Section 404 or other permissions from the appropriate state or federal regulatory agency.

Economic Considerations. Wet detention ponds tend to have low construction costs and low space demands (in terms of the land area needed to treat a given volume of water) relative to other LID practices. In addition, the soil excavated to construct ponds can be used as fill, which is often needed for construction on low-lying coastal areas.

Community and Environmental Concerns. Ponds can generate the following community and environmental concerns that need to be addressed during design:

- Aesthetic Issues. Many residents feel that ponds are an attractive landscape feature, promote a greater sense of community and are an attractive habitat for fish and wildlife. Designers should note that these benefits are often diminished where ponds are under-sized or have small CDAs.
- Existing Forests. Construction of a pond may involve extensive clearing of existing forest cover. Designers can expect a great deal of neighborhood opposition if they do not make a concerted effort to save mature trees during pond design and construction. Consideration of Better Site Design Principles is implicit with permitting decisions related to clearing of existing forest cover.
- Safety Risk. Pond safety is an important community concern, since both young children and adults have perished by drowning in ponds through a variety of accidents, including falling through thin ice cover. Gentle side slopes and safety benches should be provided to avoid potentially dangerous drop-offs, especially where ponds are located near residential areas.
- Pollutant Concerns. Ponds collect and store water and sediment to increase residence time that will increase the likelihood for contaminated water and sediments to be neutralized. However, poorly sized, maintained, and/or functioning ponds can export contaminated sediments and/or water to receiving waterbodies (Mallin, 2000; Mallin et al., 2001; Messersmith, 2007). Further, designers are cautioned that recent research on ponds has shown that some ponds can be hotspots or incubators for algae that generate harmful algal blooms (HABs).
- Mosquito Risk. Mosquitoes are not a major problem for larger ponds (Santana et al., 1994; Ladd and Frankenburg, 2003; Hunt et al., 2005). However, fluctuating water levels in smaller or under-sized ponds could pose some risk for mosquito breeding. Mosquito problems can be minimized through simple design features and maintenance operations described in MSSC (2005).
- Geese and Waterfowl. Ponds with extensive turf and shallow shorelines can attract nuisance populations of resident geese and other waterfowl, whose droppings add to the nutrient and bacteria loads, thus reducing the removal efficiency for those pollutants. Several design and landscaping features can make ponds much less attractive to geese (see Schueler, 1992).

4.12.2 Pond Conveyance Criteria

Internal Slope. The longitudinal slope of the pond bottom should be at least 0.5% to facilitate maintenance.

Primary Spillway. The spillway shall be designed with acceptable anti-flotation, anti-vortex and trash rack devices. The spillway must generally be accessible from dry land. When reinforced concrete pipe is used for the principal spillway to increase its longevity, "O-ring" gaskets (ASTM C361) shall be used to create watertight joints.

Non-Clogging Low-Flow Orifice. A low-flow orifice must be provided that is adequately protected from clogging by either an acceptable external trash rack or by internal orifice protection that may allow for smaller diameters. Orifices less than 3 inches in diameter may require extra attention during design to minimize the potential for clogging.

- One option is a submerged reverse-slope pipe that extends downward from the riser to an inflow point 1 foot below the normal pool elevation.
- Alternative methods must employ a broad crested rectangular V-notch (or proportional) weir, protected by a half-round CMP that extends at least 12 inches below the normal pool elevation.

Emergency Spillway. Ponds must be constructed with overflow capacity to pass the 100-year design storm event through either the primary spillway or a vegetated or armored emergency spillway unless waived by Beaufort County Public Works Department.

Adequate Outfall Protection. The design must specify an outfall that will be stable for the 25-year design storm event. The channel immediately below the pond outfall must be modified to prevent erosion and conform to natural dimensions in the shortest possible distance. This is typically done by placing appropriately sized riprap over geotextile fabric, which can reduce flow velocities from the principal spillway to non-erosive levels (3.5 to 5.0 feet per second) depending on the channel lining material. Flared pipe sections, which discharge at or near the stream invert or into a step pool arrangement, should be used at the spillway outlet.

When the discharge is to a manmade pipe or channel system, the system must be adequate to convey the required design storm peak discharge.

If a pond daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of riprap should be avoided.

The final release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at a downstream structure, highway, or natural point of restricted streamflow.

Inlet Protection. Inflow points into the pond must be stabilized to ensure that non-erosive conditions exist during storm events up to the overbank flood event (i.e., the 25-year storm event). Inlet pipe inverts should generally be located at or slightly below the permanent pool elevation. A forebay shall be provided at each inflow location, unless the inlet is submerged or inflow provides less than 10% of the total design storm inflow to the pond.

Dam Safety Permits. The designer must verify whether or not Dam Safety permits or approvals are required for the embankment.

4.12.3 Pond Pretreatment Criteria

Sediment forebays are considered to be an integral design feature to maintain the longevity of all ponds. A forebay must be located at each major inlet to trap sediment and preserve the capacity of the main treatment cell. The following criteria apply to forebay design:

- A major inlet is defined as an individual storm drain inlet pipe or open channel serving at least 10% of the pond's CDA.
- The forebay consists of a separate cell, formed by an acceptable barrier (e.g., an earthen berm, concrete weir, gabion baskets, etc.).
- The forebay should be between 4 and 6 feet deep and must be equipped with a variable width aquatic bench for safety purposes. The aquatic bench should be 4 to 6 feet wide at a depth of 1 to 2 feet below the water surface. Small forebays may require alternate geometry to achieve the goals of pretreatment and safety within a small area.
- The forebay shall be sized to contain 0.1 inches of runoff from the contributing drainage impervious area. The relative size of individual forebays should be proportional to the percentage of the total inflow to the pond.
- The bottom of the forebay may be hardened (e.g., with concrete, asphalt, or grouted riprap) to make sediment removal easier.
- The forebay must be equipped with a metered rod in the center of the pool (as measured lengthwise along the low-flow water travel path) for long-term monitoring of sediment accumulation.
- Exit velocities from the forebay shall be non-erosive or an armored overflow shall be provided. Non-erosive velocities are 4 feet per second for the 2-year event, and 6 feet per second for the 25-year event.
- Direct maintenance access for appropriate equipment shall be provided to each forebay.
- Designers of ponds that are used for irrigation should be mindful of pretreatment provisions that help prevent irrigation system pluggages and operational issues.

4.12.4 Pond Design Criteria

Pond Storage Design. The pond permanent pool must be sized to store a volume equivalent to the SWRv. Volume storage may be provided in multiple cells. Performance is enhanced when multiple treatment pathways are provided by using multiple cells, longer flowpaths, high surface area to volume ratios, complex microtopography, and/or redundant treatment methods (combinations of pool, ED, and marsh). Volume storage below the permanent pool is not considered in the detention calculations.

Pond Geometry. Pond designs should have an irregular shape and a long flow path from inlet to outlet to increase water residence time and pond performance. The minimum length to width ratio (i.e., length relative to width) for ponds is 1.5:1. Greater flowpaths and irregular shapes are recommended. Internal berms, baffles, or vegetated peninsulas can be used to extend flow paths and/or create multiple pond cells.

Permanent Pool Depth. The maximum depth of the permanent pool should not generally exceed 8 feet unless the pond is designed for multiple uses.

Micropool. A micropool is a 3- to 6-foot-deep pool used to protect the low-flow pipe from clogging and to prevent sediment resuspension. For micropool extended detention ponds, the micropool shall be designed to hold at least 10%–25% of the 85^{th} or 95^{th} percentile storm event.

Side Slopes. Side slopes for ponds should generally have a gradient no steeper than 3H:1V. Mild slopes promote better establishment and growth of vegetation and provide for easier maintenance and a more natural appearance.

Maximum Extended Detention Levels. The total storage, including any ponding for larger flooding events (100-year storm) should not extend more than 5 feet above the pond permanent pool unless specific design enhancements to ensure side slope stability, safety, and maintenance are identified and approved.

Top of Bank. Storm ponds shall be provided with a 20-ft maintenance access at the top of bank with a maximum cross slope of 48:1.

Stormwater Pond Benches. The perimeter of all pool areas greater than 4 feet in depth must be surrounded by two benches, as follows:

- **Safety Bench.** This is a flat bench located just outside of the perimeter of the permanent pool to allow for maintenance access and reduce safety risks. Except when the stormwater pond side slopes are 5H:1V or flatter, provide a safety bench that generally extends 8 to 15 feet outward from the normal water edge to the toe of the stormwater pond side slope. The maximum slope of the safety bench is 5%.
- **Aquatic Bench.** This is a shallow area just inside the perimeter of the normal pool that promotes growth of aquatic and wetland plants. The bench also serves as a safety feature, reduces shoreline erosion, and conceals floatable trash. Incorporate an aquatic bench that generally extends up to 10 feet inward from the normal shoreline, has an irregular configuration, and extends a maximum depth of 18 inches below the normal pool water surface elevation.

Liners. When a stormwater pond is located over highly permeable soils, a liner may be needed to sustain a permanent pool of water. If geotechnical tests confirm the need for a liner, acceptable options include the following:

1. a clay liner following the specifications outlined in Table 4.49;
2. a 30-mil- poly-liner;
3. bentonite;
4. use of chemical additives; or
5. an engineering design, as approved on a case-by-case basis by Beaufort County Public Works Department.

A clay liner must have a minimum thickness of 12 inches with an additional 12-inch layer of compacted soil above it, and it must meet the specifications outlined in Table 4.49. Other synthetic liners can be used if the designer can supply supporting documentation that the material will achieve the required performance.

Table 4.49. Clay Liner Specifications

Property	Test Method	Unit	Specification
Permeability	ASTM D2434	cm/s	1×10^{-6}
Plasticity Index of Clay	ASTM D4318	%	Not less than 15
Liquid Limit of Clay	ASTM D2216	%	Not less than 30
Clay Particles Passing	ASTM D422	%	Not less than 30
Clay Compaction	ASTM D2216	%	95% of standard proctor density

Source: DCR (1999). VA

Required Geotechnical Testing. Soil borings must be taken below the proposed embankment, in the vicinity of the proposed outlet area, and in at least two locations within the proposed pond treatment area. Soil boring data is needed to (1) determine the physical characteristics of the excavated material, (2) determine its adequacy for use as structural fill or spoil, (3) provide data for structural designs of the outlet works (e.g., bearing capacity and buoyancy), (4) determine compaction/composition needs for the embankment, (5) determine the depth to groundwater and (6) evaluate potential infiltration losses (and the potential need for a liner).

Non-clogging Low-Flow (Extended Detention) Orifice. The low-flow ED orifice shall be adequately protected from clogging by an acceptable external trash rack. The preferred method is a submerged reverse-slope pipe that extends downward from the riser to an inflow point 1 foot below the normal pool elevation. Alternative methods are to employ a broad crested rectangular, V-notch, or proportional weir, protected by a half-round CMP that extends at least 12 inches below the normal pool.

Riser in Embankment. The riser should be located within the embankment for maintenance access, safety, and aesthetics. Access to the riser is to be provided by lockable manhole covers and manhole steps within easy reach of valves and other controls. The principal spillway opening can be "fenced" with pipe or rebar at 8-inch intervals for safety purposes.

Trash Racks. Trash racks shall be provided for low-flow pipes and for riser openings not having anti-vortex devices.

Pond Drain. Ponds should have a drainpipe that can completely or partially drain the permanent pool. In cases where a low-level drain is not feasible (such as in an excavated pond), a pump well must be provided to accommodate a temporary pump intake when needed to drain the pond.

- The drain pipe must have an upturned elbow or protected intake within the pond to help keep it clear of sediment deposition, and a diameter capable of draining the pond within 24 hours.
- The pond drain must be equipped with an adjustable valve located within the riser, where it will not be normally inundated and can be operated in a safe manner.

Care must be exercised during pond drawdowns to prevent downstream discharge of sediments or anoxic water and rapid drawdown. The approving authority shall be notified before draining a pond.

Safety Features.

- The principal spillway opening must be designed and constructed to prevent access by small children.
- End walls above pipe outfalls greater than 48 inches in diameter must be fenced to prevent a falling hazard.
- Storage practices must incorporate an additional 1 foot of freeboard above the emergency spillway, or 2 feet of freeboard if design has no emergency spillway, for the 100-year storm.
- The emergency spillway must be located so that downstream structures will not be impacted by spillway discharges.
- Both the safety bench and the aquatic bench should be landscaped with vegetation that hinders or prevents access to the pool.
- Warning signs prohibiting swimming must be posted.
- Where permitted, fencing of the perimeter of ponds is discouraged. The preferred method to reduce risk is to manage the contours of the stormwater pond to eliminate drop-offs or other safety hazards. Fencing is required at or above the maximum water surface elevation in the rare situations when the pond slope is a vertical wall.
- Side slopes to the pond shall not be steeper than 3H:1V, and shall terminate on a 15-foot-wide safety bench. Both the safety bench and the aquatic bench may be landscaped to prevent access to the pool. The bench requirement may be waived if slopes are 4H:1V or flatter.

Maintenance Reduction Features. Many maintenance issues can be addressed through well designed access. All ponds must be designed for annual maintenance. Good access is needed so crews can remove sediments, make repairs, and preserve pond-treatment capacity. Design for the following:

- Adequate maintenance access must extend to the forebay, safety bench, riser, and outlet structure and must have sufficient area to allow vehicles to turn around.
- The riser should be located within the embankment for maintenance access, safety, and aesthetics. Access to the riser should be provided by lockable manhole covers and manhole steps within easy reach of valves and other controls.
- Access roads must (1) be constructed of load-bearing materials or be built to withstand the expected frequency of use, (2) have a minimum width of 20 feet, and (3) have a profile grade that does not exceed 5H:1V.
- A maintenance right-of-way or easement must extend to the stormwater pond from a public or private road.
- No permanent structures (mechanical, electrical, phone, fences) or landscaping are allowed within the 20’ pond maintenance access easement.

- **Material Specifications.** ED ponds are generally constructed with materials obtained on site, except for the plant materials, inflow and outflow devices (e.g., piping and riser materials), possibly stone for inlet and outlet stabilization, and geotextile fabric for lining banks or berms.

- **Pond Sizing.** Stormwater ponds can be designed to capture and treat the remaining stormwater discharged from upstream practices from the design storm (SWRv). Additionally, stormwater ponds may be sized to control peak flow rates from the 2- to 25-year frequency storm event or other design storms as required. Design calculations must ensure that the post-development peak discharge does not exceed the predevelopment peak discharge. See Section 3.7.2 Hydrologic and Hydraulic Analysis and Appendix I for a summary of acceptable hydrologic methodologies and models.

  For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRSC CN that reflects the volume reduction of upland practices to compute the 2- 50-year frequency storm event that must be treated by the stormwater pond.

  The pond permanent pool must be sized to store a volume equivalent to the SWRv or design volume.

  The storage volume (Sv) of the practice is equal to the volume provided by the pond permanent pool (Equation 4. 26). The total Sv cannot exceed the design SWRv.

Equation 4. 26 Pond Storage Volume

$$SSRR = PPDDDDdd\ ppDDDDDDppDDDDDDDD\ ppDDDDpp\ RRDDppvvDDDD$$

- **Water Balance Testing.** A water balance calculation is recommended to document that sufficient inflows to wet ponds and wet ED ponds exist to compensate for combined infiltration and evapotranspiration losses during a 30-day summer drought without creating unacceptable drawdowns (see Equation 4.27, adapted from Hunt et al., 2007). The recommended minimum pool depth to avoid nuisance conditions may vary; however, it is generally recommended that the water balance maintain a minimum 24-inch reservoir.

Equation 4. 27 Water Balance Equation for Acceptable Water Depth in a Wet Pond

$$DDPP > EEEE + IIIIII + RREESS - MMMM$$

Where:

DP	=	average design depth of the permanent pool (in.)
ET	=	summer evapotranspiration rate (in.) (assume 8 in.)
INF	=	monthly infiltration loss (assume 7.2 inches at 0.01 in./hour)
RES	=	reservoir of water for a factor of safety (assume 24 in.)
MB	=	measured baseflow rate to the pond, if any convert to pond-inches (in.)

Design factors that will alter this equation are the measurements of seasonal base flow and infiltration rate. The use of a liner could eliminate or greatly reduce the influence of infiltration. Similarly, land use changes in the upstream watershed could alter the base flow conditions over time (e.g., urbanization and increased impervious cover).

Translating the baseflow to inches refers to the depth within the pond. Therefore, Equation 4. 28 can be used to convert the baseflow, measured in cubic feet per second (cfs), to pond-inches:

Equation 4. 28 Baseflow Conversion

$$PPDDDDdd - DDDiihDDDD = \frac{MMMM \times 2.592 \times 10^6 \times 12}{SSSS}$$

where:

Pond – inches	=	depth within the pond (in,)
MB	=	measured baseflow rate to the pond (cfs)
2.592 × 106	=	conversion factor, converting cfs to ft^3/month
12	=	conversion factor, converting feet to inches
SA	=	surface area of pond (ft^2)

4.12.5 Pond Landscaping Criteria

Pond Benches. The perimeter of all deep pool areas (4 feet or greater in depth) must be surrounded by two benches:

- A safety bench that extends 8 to 15 feet outward from the normal water edge to the toe of the pond side slope. The maximum slope of the safety bench shall be 6%.
- An aquatic bench that extends up to 10 feet inward from the normal shoreline and has a maximum depth of 18 inches below the normal pool water surface elevation.

Landscaping and Planting Plan. A landscaping plan must be provided that indicates the methods used to establish and maintain vegetative coverage in the pond and its buffer (see Section 4.3.5 Bioretention Landscaping Criteria for extended landscaping and planting details). Minimum elements of a landscaping plan include the following:

- Delineation of pondscaping zones within both the pond and buffer.
- Selection of corresponding plant species.
- The planting plan.
- The sequence for preparing the wetland benches (including soil amendments, if needed).
- Sources of native plant material.
- The landscaping plan should provide elements that promote diverse wildlife and waterfowl use within the stormwater wetland and buffers.
- Woody vegetation may not be planted or allowed to grow within 15 feet of the toe of the embankment nor within 25 feet from the principal spillway structure.
- A vegetated buffer should be provided that extends at least 25 feet outward from the maximum water surface elevation of the pond. Permanent structures (e.g., buildings) should not be constructed within the buffer area. Existing trees should be preserved in the buffer area during construction.

- The soils in the stormwater buffer area are often severely compacted during the construction process, to ensure stability. The density of these compacted soils can be so great that it effectively prevents root penetration and, therefore, may lead to premature mortality or loss of vigor. As a rule of thumb, planting holes should be three times deeper and wider than the diameter of the root ball for bare root and ball-and-burlap stock, and five times deeper and wider for container-grown stock.
- Avoid species that require full shade or are prone to wind damage. Extra mulching around the base of trees and shrubs is strongly recommended as a means of conserving moisture and suppressing weeds.

For more guidance on planting trees and shrubs in pond buffers, consult Cappiella et al. (2006).

4.12.6 Pond Construction Sequence

The following is a typical construction sequence to properly install a stormwater pond. The steps may be modified to reflect different pond designs; site conditions; and the size, complexity and configuration of the proposed facility.

1. Use of Ponds for Soil Erosion and Sediment Control. A pond may serve as a sediment basin during project construction. If this is done, the volume should be based on the more stringent sizing rule (soil erosion and sediment control requirement versus storage volume requirement). Installation of the permanent riser should be initiated during the construction phase, and design elevations should be set with final cleanout of the sediment basin and conversion to the post-construction pond in mind. The bottom elevation of the pond should be lower than the bottom elevation of the temporary sediment basin. Appropriate procedures must be implemented to prevent discharge of turbid waters when the basin is being converted into a pond.

Approval from Beaufort County Public Works Department must be obtained before any sediment pond can be used for stormwater management.

2. Stabilize the Contributing Drainage Area. Ponds should only be constructed after the CDA to the pond is completely stabilized. If the proposed pond site will be used as a sediment trap or basin during the construction phase, the construction notes should clearly indicate that the facility will be de-watered, dredged, and regraded to design dimensions after the original site construction is complete.

3. Assemble Construction Materials on Site. Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

4. Clear and Strip. Bring the project area to the desired subgrade.

5. Soil Erosion and Sediment Controls. Install soil erosion and sediment control measures prior to construction, including temporary de-watering devices and stormwater diversion practices. All areas surrounding the pond that are graded or denuded during construction must be planted with turf grass, native plantings, or other approved methods of soil stabilization.

6. Excavate the Core Trench and Install the Spillway Pipe.

7. Install the Riser or Outflow Structure. Once riser and outflow structures are installed ensure the top invert of the overflow weir is constructed level at the design elevation.

8. Construct the Embankment and any Internal Berms. These features must be installed in 8- to 12-inch lifts; compact the lifts with appropriate equipment.

9. Excavate and Grade. Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the pond.

10. Construct the Emergency Spillway. The emergency spillway must be constructed in cut or structurally stabilized soils.

11. Install Outlet Pipes. The installation of outlet pipes must include a downstream riprap protection apron.

12. Stabilize Exposed Soils. Use temporary seed mixtures appropriate for the pond buffer to stabilize the exposed soils. All areas above the normal pool elevation must be permanently stabilized by hydroseeding or seeding over straw.

13. Plant the Pond Buffer Area. Establish the planting areas according to the pondscaping plan (see Section 4.12.5 Pond Landscaping Criteria).

Construction Supervision. Supervision during construction is recommended to ensure that stormwater ponds are properly constructed, especially during the following stages of construction:

- Preconstruction meeting
- Initial site preparation including the installation of soil erosion and sediment control measures
- Excavation/Grading (interim and final elevations)
- Installation of the embankment, the riser/primary spillway, and the outlet structure
- Implementation of the pondscaping plan and vegetative stabilization
- Immediately seed or install vegetated ground cover upon completion of sloping and grading of each stormwater pond within a project.
- Inspect within two weeks to insure vegetation is in fact holding banks and slopes in place.
- Prior to completion of project, mechanically remove erosion deposition from ponds that occurred during the project. Criteria should be based on erosion of designed bank slopes and loss of storage capacity.
- Final inspection (develop a punch list for facility acceptance)

Construction phase inspection checklist for ponds can be found in Appendix E Construction Inspection Checklists.

To facilitate maintenance, contractors should measure the actual constructed pond depth at three areas within the permanent pool (forebay, mid-pond and at the riser), and they should mark and geo-reference them on an as-built drawing. This simple data set will enable maintenance inspectors to determine pond sediment deposition rates in order to schedule sediment cleanouts.

4.12.7 Pond Maintenance Criteria

Maintenance is needed so stormwater ponds continue to operate as designed on a long-term basis. Ponds normally have fewer routine maintenance requirements than other stormwater control measures. Stormwater pond maintenance activities vary regarding the level of effort and expertise required to perform them. Routine stormwater pond maintenance, such as mowing and removing debris and trash, is needed several times each year (see Table 4.50). More significant maintenance (e.g., removing accumulated sediment) is needed less frequently but requires more skilled labor and special equipment. Inspection and repair of critical structural features (e.g., embankments and risers) needs to be performed by a qualified professional (e.g., a structural engineer) who has experience in the construction, inspection, and repair of these features.

Table 4.50. Pond Maintenance Tasks and Frequency.

Frequency	Maintenance Items
During establishment, as needed (first year)	▪ Inspect the site at least twice after storm events that exceed a 1/2 inch of rainfall. ▪ Plant the aquatic benches with emergent wetland species, following the planting recommendations contained in Section 4.11.6 Stormwater Wetland Landscaping Criteria. ▪ Stabilize any bare or eroding areas in the CDA or around the pond buffer. ▪ Water trees and shrubs planted in the pond buffer during the first growing season. In general, consider watering every 3 days for first month, and then weekly during the remainder of the first growing season (April through October), depending on rainfall.
Quarterly or after major storms (>1 inch of rainfall)	▪ Mowing (twice a year) ▪ Remove debris and blockages ▪ Repair undercut, eroded, and bare soil areas
Twice a year	▪ Mowing of the buffer and pond embankment
Annually	▪ Shoreline cleanup to remove trash, debris, and floatables ▪ A full maintenance inspection ▪ Open up the riser to access and test the valves ▪ Repair broken mechanical components, if needed
Once—during the second year following construction	▪ Pond buffer and aquatic bench reinforcement plantings
Every 5 to 7 years	▪ Forebay sediment removal
From 5 to 25 years	▪ Repair pipes, the riser, and spillway, as needed

Sediment removal in the pond pretreatment forebay should occur every 5 to 7 years or after 50% of total forebay capacity has been lost. The designer should also check to see whether removed sediments can be spoiled on site or must be hauled away. Sediments excavated from ponds are not usually considered toxic or hazardous. They can be safely disposed of by either land application or land filling. Sediment testing may be needed prior to sediment disposal if the pond serves a pollutant hotspot land use, as the sediment could be potentially toxic or hazardous (Weinstein et al., 2008). In lieu of local regulations for sediment testing, the parameters in Table 4.51 may be used.

Table 4.51. Ceiling Levels Governing Management of Accumulated Sediment[1]

Parameter	Ceiling Level (ppm or mg/kg)
Total Arsenic	8
Total Cadmium	10
Total Chromium	100

Total Lead	250
pH	Less than 5 or greater than 10 standard units
Electrical Conductivity	8 deciSiemens/meter (dS/m) at 25°C
[1] *Excerpt from Wisconsin Administrative Code NR 528.03, Table 2*	

Maintenance Plans. Maintenance plans must clearly outline how vegetation in the pond and its buffer will be managed or harvested in the future. Periodic mowing of the stormwater buffer is only required along maintenance rights-of-way and the embankment. The remaining buffer can be managed as a meadow (mowing every other year) or forest. The maintenance plan should schedule a shoreline cleanup at least once a year to remove trash and floatables. For information on chemical control methods for aquatic plants, consult Clemson's fact sheet entitled "Aquatic Weed Control Overview" available online at http://www.clemson.edu/extension/hgic/plants/other/landscaping/hgic1714.html.

Maintenance Inspections. Maintenance of a pond is driven by annual inspections by a qualified professional who evaluates the condition and performance of the pond. Based on inspection results, specific maintenance tasks will be triggered.

Maintenance inspection checklist for stormwater ponds and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law. However, sediment testing may be needed prior to sediment disposal because sediments excavated from ponds could be contaminated.

4.12.8 Pond Stormwater Compliance Calculations

Stormwater ponds are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 60% bacteria removal for the storage volume (Sv) provided by in the permanent pool (Table 4.52).

Table 4.52. Pond Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 30%
Bacteria Removal	= 60%

4.13 Stormwater Wetlands

<table>
<tr><th colspan="6">Stormwater Wetlands</th></tr>
<tr><td colspan="6">Definition: Practices that create shallow marsh areas to treat urban stormwater, which often incorporate small permanent pools and/or extended detention storage. Stormwater wetlands are explicitly designed to provide stormwater detention for larger storms (2- to 25-year, or flood control events) above the design storm (SWRv) storage.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Medium</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80%</td><td>25%</td><td>60%</td></tr>
<tr><th colspan="3">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="3">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">0%</td></tr>
<tr><td>At least annually</td><td>Every 2 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ High removal of typical stormwater pollutants
▪ Provides habitat for wildlife
▪ Attractive when integrated into site development
▪ Good for sites with high water table and/or poorly drained soils</td><td colspan="3">▪ Requires large amount of flat land (3% of CDA)
▪ Must be properly designed, installed, and maintained to avoid nuisance problems
▪ Needs constant source of water
▪ Routine sediment cleanout may be needed
▪ Potential for thermal impacts downstream</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Forebay
▪ Deep ponding area
▪ High marsh and transition zones
▪ Micropool
▪ Spillway system(s)</td><td colspan="3">▪ CDA must be large enough to sustain permanent water level
▪ Flow path through the wetland system should be at least 2L:1W
▪ 25% of pool depth should be 18-48 inches
▪ Water balance must be maintained</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Reinforce plantings as needed
▪ Remove accumulated sediments
▪ Remove invasive vegetation</td><td colspan="3">▪ Thin/harvest vegetation every 2 years on embankments and access areas; elsewhere every 5–10 years</td></tr>
</table>

[1] *Credited pollutant load removal*

Stormwater wetlands, sometimes called constructed wetlands, are shallow depressions that receive stormwater inputs for water quality treatment. Runoff from each new storm displaces runoff from previous storms, and the long residence time allows multiple pollutant removal processes to operate. The wetland environment provides an ideal environment for gravitational settling, biological uptake, and microbial activity. Wetlands include various design adaptations to allow them to be applied in specific settings. For example, some designs incorporate trees within the wetland area.

Stormwater wetlands should be considered for use after all other upland retention opportunities have been exhausted and there is still a remaining treatment volume or runoff from larger storms (i.e., 2- to 25-year or flood control events) to manage. Stormwater wetlands receive no stormwater retention credit and should be considered mainly for management of larger storm events. Stormwater wetlands have both community and environmental concerns (see Section 4.13.1 Stormwater Wetland Feasibility Criteria) that should be considered before choosing stormwater ponds for the appropriate stormwater practice on site.

Figure 4.52 Stormwater Wetland at Carolina Forest Recreation Center, Myrtle Beach (photo: Kathryn Ellis).

Definition. Practices that create shallow marsh areas to treat urban stormwater, which often incorporate small permanent pools and/or extended detention storage. Stormwater wetlands are explicitly designed to provide stormwater detention for larger storms (2 – 25-year, or flood control events) above the design storm (SWRv) storage. Wetlands are typically less than 1 foot deep (although they have greater depths at the forebay and in micropools) and possess variable microtopography to promote dense and diverse wetland cover. Design variants include the following:

W-1 Shallow wetland

W-2 Extended detention shallow wetland

Several stormwater wetland design features are illustrated in Figure 4. 48 through Figure 4. 52.

Note: All of the pond performance criteria presented in Section 4.1~~0~~ Ponds also apply to the design of stormwater wetlands. Additional criteria that govern the geometry and establishment of created wetlands are presented in this section.

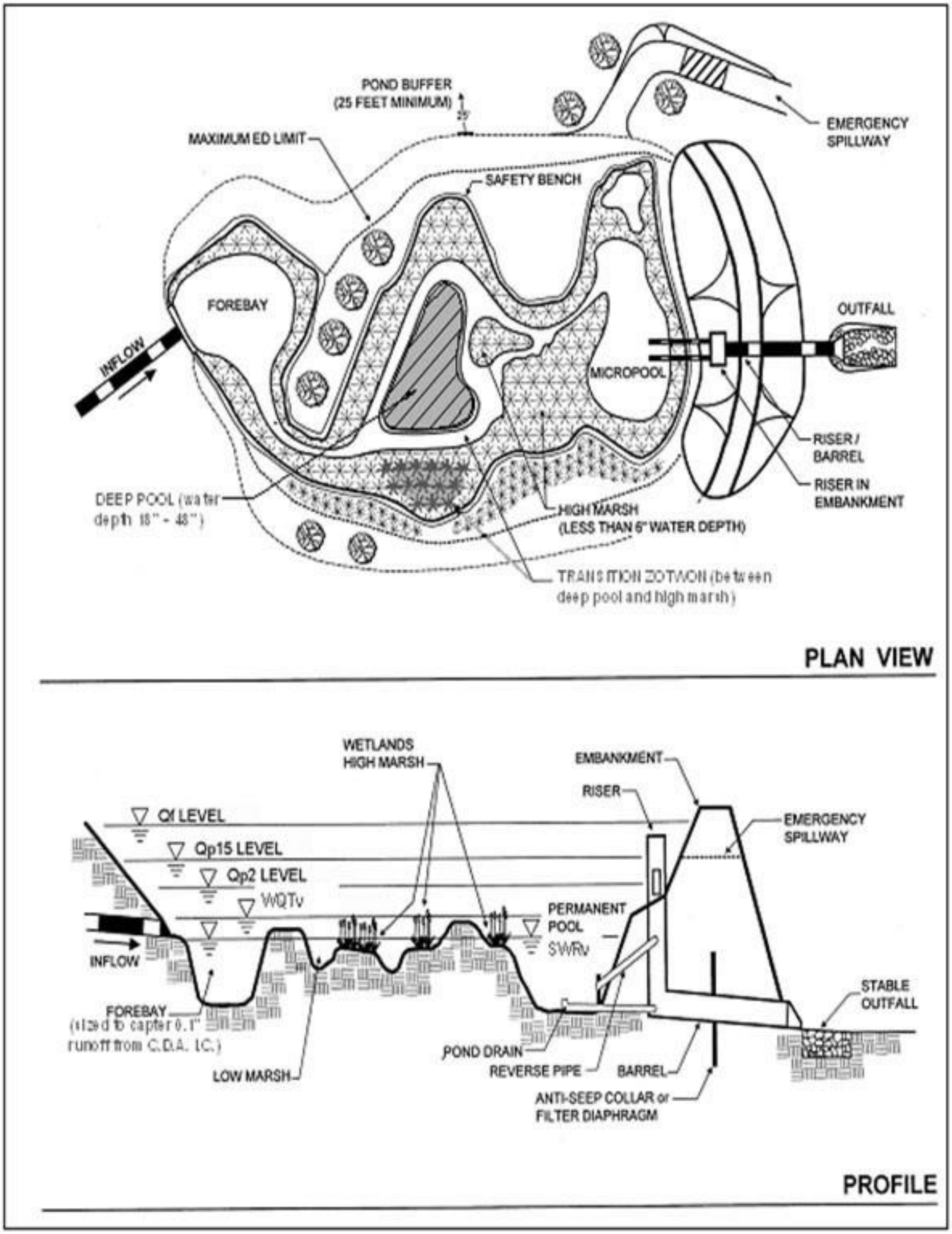


Figure 4. 53 Example of extended detention shallow wetland.

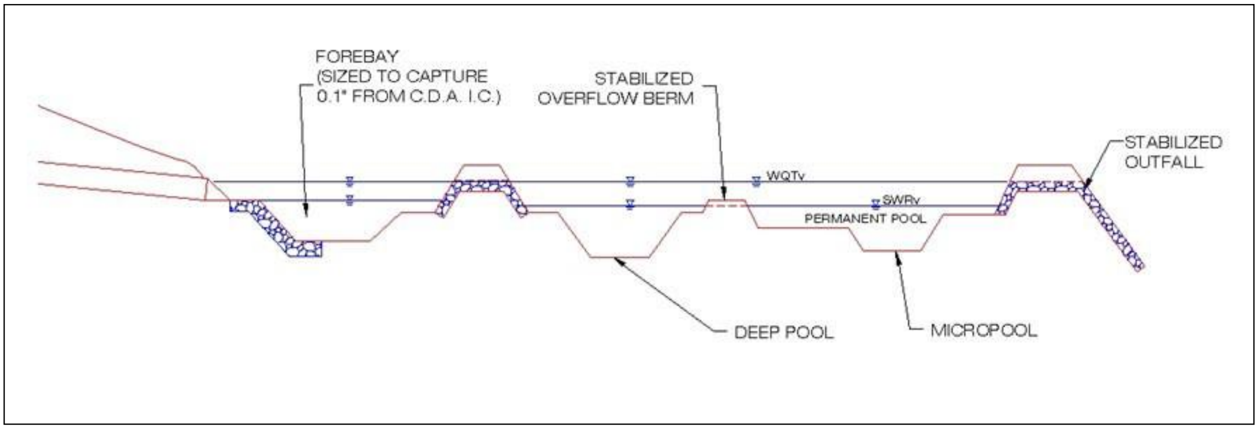


Figure 4. 54 Cross section of a typical stormwater wetland.

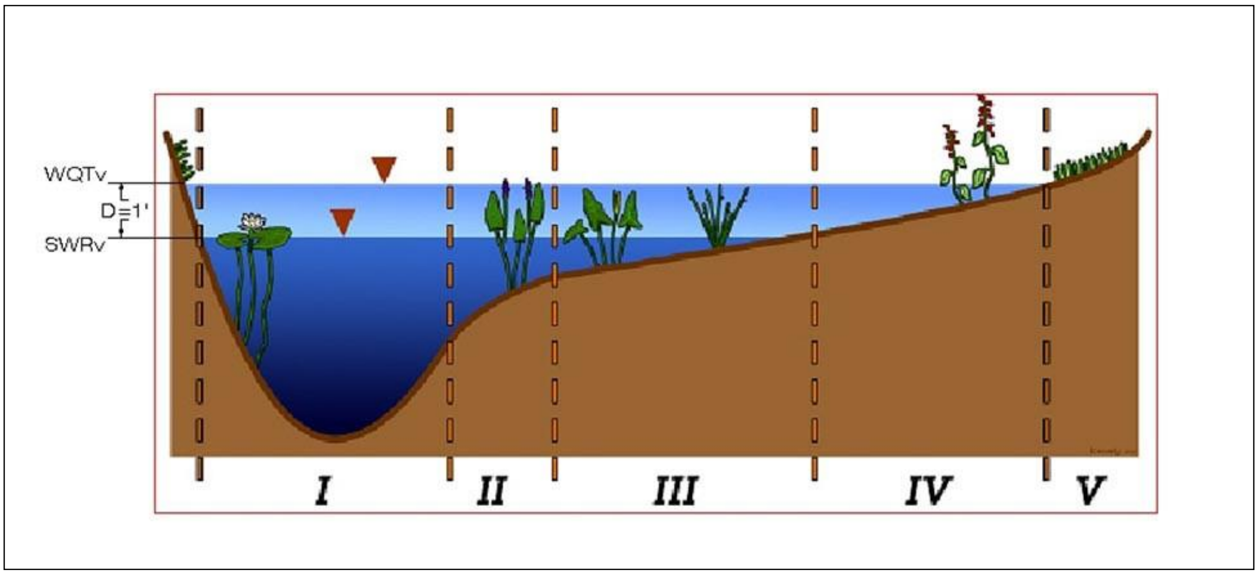


Figure 4. 55 Interior wetland zones
(I) Deep Pool (depth -48 to -18 inches),
(II) Transition Zone (depth -18 to -6 inches),
(III and IV) High Marsh Zone (depth -6 to +6 inches),
(IV) Temporary Inundation Area, and
(V) Upper Bank
Adapted from Hunt et al., 2007

4.13.1 Stormwater Wetland Feasibility Criteria

Constructed wetland designs are subject to the following site constraints:

Adequate Water Balance. Stormwater wetlands must have enough water supplied from groundwater, runoff, or baseflow so that the permanent pools will not draw down by more than 2 feet after a 30-day summer drought. A simple water balance calculation must be performed using the equation provided in Section 4.11.4 Stormwater Wetland Design Criteria.

Contributing Drainage Area. The CDA must be large enough to sustain a permanent water level within the stormwater wetland. If the only source of wetland hydrology is stormwater runoff, then several dozen acres of CDA are typically needed to maintain constant water elevations. Smaller CDAs are acceptable if the bottom of the stormwater wetland intercepts the groundwater table or if the designer or approving agency is willing to accept periodic wetland drawdown.

Space Requirements. Constructed wetlands normally require a footprint that takes up about 3% of the CDA, depending on the average depth of the wetland and the extent of its deep pool features.

Site Topography. Stormwater wetlands are best applied when the grade of contributing slopes is less than 8%.

Steep Slopes. A modification of the constructed wetland (and linear wetland or wet swale system) is the regenerative stormwater conveyance (RSC) or step pool storm conveyance channel. The RSC can be used to bring stormwater down steeper grades through a series of step pools. This can serve to bring stormwater down outfalls where steep drops on the edge of the tidal receiving system can create design challenges. A description of this practice is provided in Section 4.9 Open Channel Systems.

Available Hydraulic Head. The depth of a constructed wetland is usually constrained by the hydraulic head available on the site. The bottom elevation is fixed by the elevation of the existing downstream conveyance system to which the wetland will ultimately discharge. Because constructed wetlands are typically shallow, the amount of head needed (usually a minimum of 2 to 4 feet) is typically less than for wet ponds.

Setbacks. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements.

Depth to Water Table. The depth to the groundwater table is not a major constraint for constructed wetlands, since a high water table can help maintain wetland conditions. However, designers should keep in mind that high groundwater inputs may increase excavation costs (refer to Section 4.12 Ponds).

Soils. Soil tests should be conducted to determine the saturated hydraulic conductivity and other subsurface properties of the soils underlying the proposed stormwater wetland. Highly permeable soils will make it difficult to maintain a healthy permanent pool. Underlying soils of HSG C or D should be adequate to maintain a permanent pool. Most HSG A soils and some HSG B soils will require a liner (see Table 4.49 in Section 4.12 Ponds).

Use of or Discharges to Natural Wetlands. Constructed wetlands may not be located within jurisdictional waters, including wetlands, without obtaining a Section 404 permit from the appropriate federal regulatory agency. In addition, designer should investigate the status of adjacent wetlands to determine if the discharge from the constructed wetland will change the hydroperiod of a downstream natural wetland. See Cappiella et al. (2006) for guidance on minimizing stormwater discharges to existing wetlands.

Regulatory Status. Constructed wetlands built for the express purpose of stormwater treatment are generally not considered jurisdictional wetlands, but designers should check with their wetland regulatory authorities to ensure the status.

Perennial Streams. Locating a constructed wetland along or within a perennial stream will require both Section 401 and Section 404 permits from the state or federal regulatory authority.

Economic Considerations. If space is available, wetlands can be a very cost-effective stormwater practice.

Community and Environmental Concerns. In addition to the community and environmental concerns that exist for stormwater ponds, the following must be addressed during design of stormwater wetlands:

- **Aesthetics and Habitat.** Constructed wetlands can create wildlife habitat and can also become an attractive community feature. Designers should think carefully about how the wetland plant community will evolve over time, since the future plant community seldom resembles the one initially planted.
- **Existing Forests.** Given the large footprint of a constructed wetland, there is a strong chance that the construction process may result in extensive tree clearing. The designer should preserve mature trees during the facility layout and may consider creating a wooded wetland (see Cappiella et al., 2006).
- **Safety Risk.** Constructed wetlands are safer than other types of ponds, although forebays and micropools must be designed with aquatic benches to reduce safety risks.
- **Mosquito Risk.** Mosquito control can be a concern for stormwater wetlands if they are under-sized or have a small CDA. Deepwater zones serve to keep mosquito populations in check by providing habitat for fish and other pond life that prey on mosquito larvae. Few mosquito problems are reported for well-designed, properly sized, and frequently maintained constructed wetlands; however, no design can eliminate them completely. Simple precautions can be taken to minimize mosquito breeding habitat within constructed wetlands (e.g., constant inflows, benches that create habitat for natural predators, and constant pool elevations—MSSC, 2005).

4.13.2 Stormwater Wetland Conveyance Criteria

- The slope profile within individual stormwater wetland cells should generally be flat from inlet to outlet (adjusting for microtopography). The recommended maximum elevation drop between wetland cells is 1 foot or less.
- Since most constructed wetlands are on-line facilities, they need to be designed to safely pass the maximum design storm (e.g., the 25-year and 100-year design storms). While the ponding depths for the more frequent 2-year storm are limited in order to avoid adverse impacts to the planting pallet, the overflow for the less frequent 25-100-year storms must likewise be carefully designed to minimize the depth of ponding. A maximum depth of 4 feet over the wetland pool is recommended.
- While many options are available for setting the normal pool elevation, it is strongly recommended that removable flashboard risers be used, given their greater operational flexibility to adjust water levels following construction (see Hunt et al., 2007). Also, a weir can be designed to accommodate passage of the larger storm flows at relatively low ponding depths.

4.13.3 Stormwater Wetland Pretreatment Criteria

Sediment regulation is critical to sustain stormwater wetlands. Consequently, a forebay shall be located at the inlet and a micropool shall be located at the outlet. A micropool is a 3- to 6-foot-deep pool used to protect the low-flow pipe from clogging and to prevent sediment resuspension. Forebays are designed in the same manner as stormwater ponds (see Section 4.12.3 Pond Pretreatment Criteria). The design of forebays should consider the possibility of heavy trash loads from public areas.

4.13.4 Stormwater Wetland Design Criteria

Internal Design Geometry. Research and experience have shown that the internal design geometry and depth zones are critical in maintaining the pollutant removal capability and plant diversity of stormwater wetlands. Stormwater wetland performance is enhanced when the wetland has multiple cells, longer flowpaths, and a high ratio of surface area to volume. Whenever possible, constructed wetlands should be irregularly shaped with long, sinuous flow paths. The following design elements are required for stormwater wetlands:

Multiple-Cell Wetlands. Stormwater wetlands can be divided into at least four internal sub-cells of different elevations: the forebay, a micro-pool outlet, and two additional cells. Cells can be formed by sand berms (anchored by rock at each end), back-filled coir fiber logs, or forested peninsulas (extending as wedges across 95% of the wetland width). The vegetative target is to ultimately achieve a 50-50 mix of emergent and forested wetland vegetation within all four cells.

The first cell (the forebay) is deeper and is used to receive runoff from the pond cell or the inflow from a pipe or open channel and distribute it as sheetflow into successive wetland cells. The surface elevation of the second cell is the normal pool elevation. It may contain a forested island or a sand wedge channel to promote flows into the third cell, which is 3 to 6 inches lower than the normal pool elevation. The purpose of the wetland cells is to create an alternating sequence of aerobic and anaerobic conditions to maximize pollutant removal. The fourth wetland cell is located at the discharge point and serves as a micro-pool with an outlet structure or weir.

Extended Detention Ponding Depth. When extended detention is provided for management of larger storm events, the total ED volume shall not comprise more than 50% of the total volume stored by the stormwater wetland, and its maximum water surface elevation shall not extend more than 3 feet above the normal pool.

Deep Pools. Approximately 25% of the stormwater surface area must be provided in at least three deeper pools—located at the inlet (forebay), center, and outlet (micropool) of the wetland—with each pool having a depth of from 18 to 48 inches. Refer to the sizing based on water balance below for additional guidance on the minimum depth of the deep pools.

High Marsh Zone. Approximately 70% of the stormwater wetland surface area must exist in the high marsh zone (-6 inches to +6 inches, relative to the normal pool elevation).

Transition Zone. The low marsh zone is no longer an acceptable wetland zone, and is only allowed as a short transition zone from the deeper pools to the high marsh zone (-6 to -18 inches below the normal pool elevation). In general, this transition zone should have a maximum slope of 5H:1V (or preferably flatter) from the deep pool to the high marsh zone. It is advisable to install biodegradable erosion control fabrics or similar materials during construction to prevent erosion or slumping of this transition zone.

Flow Path. In terms of the flow path, there are two design objectives:

- The overall flow path through the stormwater wetland can be represented as the length-to-width ratio OR the flow path ratio. A minimum overall flow path of 2:1 must be provided across the stormwater wetland.
- The shortest flow path represents the distance from the closest inlet to the outlet. The ratio of the shortest flow path to the overall length must be at least 0.5. In some cases—due to site geometry, storm sewer infrastructure, or other factors—some inlets may not be able to meet these ratios. However, the CDA served by these “closer” inlets must constitute no more than 20% of the total CDA.

Side Slopes. Side slopes for the stormwater wetland should generally have gradients of 4H:1V or flatter. These mild slopes promote better establishment and growth of the wetland vegetation. They also contribute to easier maintenance and a more natural appearance.

Micro-Topographic Features. Stormwater wetlands must have internal structures that create variable micro-topography, which is defined as a mix of above-pool vegetation, shallow pools, and deep pools that promote dense and diverse vegetative cover.

Stormwater Wetland Material Specifications. Stormwater wetlands are generally constructed with materials obtained on site, except for the plant materials, inflow and outflow devices (e.g., piping and riser materials), possibly stone for inlet and outlet stabilization, and geotextile fabric for lining banks or berms. Plant stock should be nursery grown, unless otherwise approved (e.g. by the local regulatory authority), and must be healthy and vigorous native species free from defects, decay, disfiguring roots, sun-scald, injuries, abrasions, diseases, insects, pests, and all forms of infestations or objectionable disfigurements, as determined during the local plan review.

Stormwater Wetland Sizing. Stormwater wetlands can be designed to capture and treat the remaining stormwater discharged from upstream practices from the design storm (SWRv). Additionally, stormwater wetlands can be sized to control peak flow rates from the 2- 50-year frequency storm event or other design storm. Design calculations must ensure that the post-development peak discharge does not exceed the predevelopment peak discharge. See Section 3.7.2 Hydrologic and Hydraulic Analysis for a summary of acceptable hydrologic methodologies and models.

For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRCS CN that reflects the volume reduction of upland practices to compute the 2- 100-year frequency storm event that must be treated by the stormwater wetland.

The wetland permanent pools (volume stored in deep pools and pool depths) must be sized to store a volume equivalent to the SWRv or design volume.

The storage volume (Sv) of the practice is equal to the volume provided by the wetland permanent pool (Equation 4.29). The total Sv cannot exceed the SWRv.

Equation 4. 29 Stormwater Wetland Storage Volume

$$SSRR = SSDDDDDDDDSSppDDDDDD\ SSDDDDppppppDDdd\ ppDDDDDDppDDDDDDDD\ ppDDDDpp\ RRDDppvvDDDD$$

Sizing for Minimum Pool Depth. Initially, it is recommended that there be no minimum CDA requirement for the system, although it may be necessary to calculate a water balance for the wet pond cell when its CDA is less than 10 acres (Refer to Section 4.12 Ponds).

Similarly, if the hydrology for the constructed wetland is not supplied by groundwater or dry weather flow inputs, a simple water balance calculation must be performed, using Equation 4.30 (Hunt et al., 2007), to assure the deep pools will not go completely dry during a 30-day summer drought.

Equation 4.30 Water Balance for Acceptable Water Depth in a Stormwater Wetland

$$DP = \left(RF_m \times EF \times \frac{WS}{WL}\right) - (ET - INF - RES)$$

Where:

DP	=	depth of pool (in.)
RF_m	=	monthly rainfall during drought (in.)
EF	=	fraction of rainfall that enters the stormwater wetland (in.) (CDA × Rv)
WS/WL	=	ratio of contributing drainage area to stormwater wetland surface area
ET	=	summer evapotranspiration rate (in.) (assume 8 in.)
INF	=	monthly infiltration loss (assume 7.2 inches at 0.01 in./hr)
RES	=	reservoir of water for a factor of safety (assume 6 in.)

Using Equation 4.30, setting the groundwater and (dry weather) base flow to zero and assuming a worst-case summer rainfall of 0 inches, the minimum depth of the pool calculates as follows (Equation 4.31):

Equation 4.31 Minimum Depth of the Permanent Pool

$$DP = RF_m - ET - INF - RES = 21.2$$

Where:

DP	=	depth of pool (in.)
RF_m	=	monthly rainfall during drought (in.)
ET	=	summer evapotranspiration rate (in.) (assume 8 in.)
INF	=	monthly infiltration loss (assume 7.2 inches at 0.01 in./hr)
RES	=	reservoir of water for a factor of safety (assume 6 in.)

Therefore, unless there is other input, such as base flow or groundwater, the minimum depth of the pool should be at least 22 inches (rather than the 18-inch minimum depth noted in Section 4.11.4 Stormwater Wetland Design Criteria).

4.13.5

Stormwater Wetland Construction Sequence

The construction sequence for stormwater wetlands depends on site conditions, design complexity, and the size and configuration of the proposed facility. The following two-stage construction sequence is recommended for installing an on-line stormwater wetland facility and establishing vigorous plant cover.

Stage 1 Construction Sequence: Wetland Facility Construction.

1. **Stabilize Contributing Drainage Area.** Stormwater wetlands should only be constructed after the CDA to the wetland is completely stabilized. If the proposed stormwater wetland site will be used as a sediment trap or basin during the construction phase, the construction notes must clearly indicate that the facility will be de-watered, dredged, and re-graded to design dimensions after the original site construction is complete.

2. **Assemble Construction Materials on Site.** Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

3. **Clear and Strip. Bring the project area** to the desired subgrade.

4. **Install Soil Erosion and Sediment Control Measures** prior to construction, including sediment basins and stormwater diversion practices. All areas surrounding the stormwater wetland that are graded or denuded during construction of the wetland are to be planted with turf grass, native plant materials, or other approved methods of soil stabilization. Grass sod is preferred over seed to reduce seed colonization of the stormwater wetland. During construction, the stormwater wetland must be separated from the CDA so that no sediment flows into the wetland areas. In some cases, a phased or staged soil erosion and sediment control plan may be necessary to divert flow around the stormwater wetland area until installation and stabilization are complete.

5. **Excavate the Core Trench for the Embankment and Install the Spillway Pipe.**

6. **Install the Riser or Outflow Structure** and ensure that the top invert of the overflow weir is constructed level and at the proper design elevation (flashboard risers are strongly recommended by Hunt et al., 2007).

7. **Construct the Embankment and any Internal Berms** in 8- to 12-inch lifts and compact them with appropriate equipment.

8. **Excavate and Grade.** Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the stormwater wetland. This is normally done by “roughing up” the interim elevations with a skid loader or other similar equipment to achieve the desired topography across the wetland. Spot surveys should be made to ensure that the interim elevations are 3 to 6 inches below the final elevations for the wetland.

9. **Install Micro-Topographic Features and Soil Amendments** within the stormwater wetland area. Since most stormwater wetlands are excavated to deep sub-soils, they often lack the nutrients and organic matter needed to support vigorous growth of wetland plants. It is therefore essential to add sand, compost, topsoil, or wetland mulch to all depth zones in the stormwater wetland. The importance of soil amendments in excavated stormwater wetlands cannot be over-emphasized; poor survival and future wetland coverage are likely if soil amendments are not added. The planting soil should be a high organic content loam or sandy loam, placed by mechanical methods, and spread by hand. Planting soil depth should be at least 4 inches for shallow wetlands. No machinery should be allowed to traverse over the planting soil during or after construction. Planting soil should be tamped as directed in the design

specifications, but it should not be overly compacted. After the planting soil is placed, it should be saturated and allowed to settle for at least one week prior to installation of plant materials.

10. **Construct the Emergency Spillway** in cut or structurally stabilized soils.

11. **Install Outlet Pipes.** The installation of outlet pipes must include a downstream riprap protection apron.

12. **Stabilize Exposed Soils** with temporary seed mixtures appropriate for a wetland environment. All wetland features above the normal pool elevation should be temporarily stabilized by hydro-seeding or seeding over straw.

Stage 2 Construction Sequence: Establishing the Wetland Vegetation.

13. **Finalize the Stormwater Wetland Landscaping Plan.** At this stage the engineer, landscape architect, and wetland expert work jointly to refine the initial wetland landscaping plan after the stormwater wetland has been constructed. Several weeks of standing time is needed so that the designer can more precisely predict the following:

- Where the inundation zones are located in and around the stormwater wetland; and
- Whether the final grade and wetland microtopography will persist over time.

This allows the designer to select appropriate species and additional soil amendments, based on field confirmation of soils properties and the actual depths and inundation frequencies occurring within the stormwater wetland.

14. **Open Up the Stormwater Wetland Connection.** Once the final grades are attained, the pond and/or CDA connection should be opened to allow the wetland cell to fill up to the normal pool elevation. Gradually inundate the stormwater wetland to avoid erosion of unplanted features. Inundation must occur in stages so that deep pool and high marsh plant materials can be placed effectively and safely. Wetland planting areas should be at least partially inundated during planting to promote plant survivability.

15. **Measure and Stake Planting Depths** at the onset of the planting season. Depths in the stormwater wetland should be measured to the nearest inch to confirm the original planting depths of the planting zone. At this time, it may be necessary to modify the plan to reflect altered depths or a change in the availability of wetland plant stock. Surveyed planting zones should be marked on the as-built or design plan, and their locations should also be identified in the field, using stakes or flags.

16. **Propagate the Stormwater Wetland.** Two techniques are used in combination to propagate the emergent community over the wetland bed:

17. **Initial Planting of Container-Grown Wetland Plant Stock.** The transplanting window extends from early March through May. Planting after these dates can decrease the chance of survival, since emergent wetland plants need a full growing season to build the root reserves needed to get through the winter. It is recommended that plants be ordered at least 6 months in advance to ensure the availability and on-time delivery of desired species.

18. **Broadcasting Wetland Seed Mixes.** The higher wetland elevations should be established by broadcasting wetland seed mixes to establish diverse emergent wetlands. Seeding of switchgrass or wetland seed mixes as a ground cover is recommended for all zones above 3 inches below the normal pool elevation. Hand broadcasting or hydroseeding can be used to spread seed, depending on the size of the wetland cell.

19. Install Goose Protection to Protect Newly Planted or Newly Growing Vegetation. This is particularly critical for newly established emergent and herbaceous plants, as predation by Canada geese can quickly decimate wetland vegetation. Goose protection can consist of netting, webbing, or string installed in a crisscross pattern over the surface area of the stormwater wetland, above the level of the emergent plants.

20. Plant the Stormwater Wetland Fringe and Buffer Area. This zone generally extends from 1 to 3 feet above the normal pool elevation (from the shoreline fringe to about half of the maximum water surface elevation for the 2-year storm). Consequently, plants in this zone are infrequently inundated (5 to 10 times per year) and must be able to tolerate both wet and dry periods.

Construction Supervision. Supervision during construction is recommended to ensure that stormwater wetlands are properly constructed and established. Multiple site visits and inspections by a qualified professional are recommended during the following stages of the stormwater wetland construction process:

- Preconstruction meeting
- Initial site preparation including the installation of soil erosion and sediment control measures
- Excavation/Grading (interim and final elevations)
- Installation of the embankment, the riser/primary spillway, and the outlet structure
- Implementation of the pondscaping plan and vegetative stabilization
- Immediately seed or install vegetated ground cover upon completion of sloping and grading, where applicable, of each stormwater wetland within a project.
- Inspect within two weeks to ensure vegetation is in fact holding banks and slopes in place.
- Prior to completion of project, mechanically remove erosion deposition from ponds that occurred during the project. Criteria should be based on erosion of designed bank slopes and loss of storage capacity.
- Final inspection (develop a punch list for facility acceptance)

Construction inspection checklist for Stormwater Wetlands can be found in Appendix E Construction Inspection Checklists.

4.13.6 Stormwater Wetland Landscaping Criteria

An initial stormwater wetland landscaping plan is required for any stormwater wetland and should be jointly developed by the engineer and a wetlands expert or experienced landscape architect. The plan should outline a detailed schedule for the care, maintenance, and possible reinforcement of vegetation in the wetland and its buffer for up to 10 years after the original planting.

The plan should outline a realistic, long-term planting strategy to establish and maintain desired wetland vegetation. The plan should indicate how wetland plants will be established within each inundation zone (e.g., wetland plants, seed-mixes, volunteer colonization, and tree and shrub stock) and whether soil amendments are needed to get plants started. At a minimum, the plan should contain the following:

- Plan view(s) with topography at a contour interval of no more than 1 foot and spot elevations throughout the cell showing the stormwater wetland configuration, different planting zones (e.g., high marsh, deep water, upland), microtopography, grades, site preparation, and construction sequence.

- A plant schedule and planting plan specifying emergent, perennial, shrub and tree species, quantity of each species, stock size, type of root stock to be installed, and spacing. To the degree possible, the species list for the constructed wetland should contain plants found in similar local wetlands.

The following general guidance is provided:

- **Use Native Species Where Possible.** Table 4.53 provides a list of common native shrub and tree species and Table 4.54 provides a list of common native emergent, submergent, and perimeter plant species, all of which have proven to do well in stormwater wetlands in the mid-Atlantic region and are generally available from most commercial nurseries. Other native species can be used that appear in state-wide plant lists. The use of native species is strongly encouraged, but in some cases, non-native ornamental species may be added as long as they are not invasive. Invasive species such as cattails (*Typha latifolia*), common reed (*Phragmites australis*), and purple loosestrife (*Lythrum salicaria*) must not be planted.
- **Match Plants to Inundation Zones.** The various plant species shown in Table 4.53 and Table 4.54 should be matched to the appropriate inundation zone. The first four inundation zones are particularly applicable to stormwater wetlands, as follows:

  Zone 1 -6 inches to -12 inches below the normal pool elevation

  Zone 2 -6 inches to the normal pool elevation

  Zone 3 From the normal pool elevation to +12 inches above

  Zone 4 +12 inches to +36 inches above the normal pool elevation (i.e., above ED Zone)

  Note: The Low Marsh Zone (-6 to -18 inches below the normal pool elevation) has been dropped since experience has shown that few emergent wetland plants flourish in this deeper zone.
- **Aggressive Colonizers.** To add diversity to the stormwater wetland, five to seven species of emergent wetland plants should be planted, using at least four emergent species designated as aggressive colonizers (shown in bold in Table 4.54). No more than 25% of the high marsh wetland surface area needs to be planted. If the appropriate planting depths are achieved, the entire stormwater wetland should be colonized within 3 years. Individual plants should be planted 18 inches on center within each single species "cluster."
- **Suitable Tree Species.** The major shift in stormwater wetland design is to integrate trees and shrubs into the design, in tree islands, peninsulas, and fringe buffer areas. Deeper-rooted trees and shrubs that can extend to the stormwater wetland's local water table are important for creating a mixed wetland community. Table 4. 53 above presents some recommended tree and shrub species for different inundation zones. A good planting strategy includes varying the size and age of the plant stock to promote a diverse structure. Using locally grown container or bare root stock is usually the most successful approach if planting in the spring. It is recommended that buffer planting areas be over-planted with a small stock of fast-growing successional species to achieve quick canopy closure and shade out invasive plant species. Trees may be planted in clusters to share rooting space on compacted wetland side-slopes. Planting holes should be amended with compost (a 2:1 ratio of loose soil to compost) prior to planting.
- **Pre- and Post-Nursery Care.** Plants should be kept in containers of water or moist coverings to protect their root systems and keep them moist when in transporting them to the planting location.

As much as 6 to 9 months of lead time may be needed to fill orders for wetland plant stock from aquatic plant nurseries. Consult local regulatory authorities for information on area suppliers.

Table 4.53. Popular, Versatile, and Available Native Trees and Shrubs for Stormwater Wetlands

Shrubs		Trees	
Common and *Scientific* Names	**Zone[1]**	**Common and *Scientific* Names**	**Zone[1]**
Button Bush *(Cephalanthus occidentalis)*	2, 3	Atlantic White Cedar *(Charnaecyparis thyoides)*	2, 3
Common Winterberry *(Ilex verticillatta)*	3, 4	Bald Cypress *(Taxodium distichum)*	2, 3
Elderberry *(Sambucus canadensis)*	3	Black Willow *(Salix nigra)*	3, 4
Indigo Bush *(Amorpha fruticosa)*	3	Box Elder *(Acer Negundo)*	2, 3
Inkberry *(Ilex glabra)*	2, 3	Green Ash *(Fraxinus pennsylvanica)*	3, 4
Smooth Alder *(Alnus serrulata)*	2, 3	Grey Birch *(Betula populifolia)*	3, 4
Spicebush *(Lindera benzoin)*	3, 4	Red Maple *(Acer rubrum)*	3, 4
Swamp Azalea *(Azalea viscosum)*	2, 3	River Birch *(Betula nigra)*	3, 4
Swamp Rose *(Rosa palustris)*	2, 3	Swamp Tupelo *(Nyssa biflora)*	2, 3
Sweet Pepperbush *(Clethra ainifolia)*	2, 3	Sweetbay Magnolia *(Magnolia virginiana)*	3, 4
		Sweetgum *(Liquidambar styraciflua)*	3, 4
		Sycamore *(Platanus occidentalis)*	3, 4
		Water Oak *(Quercus nigra)*	3, 4
		Willow Oak *(Quercus phellos)*	3,4

[1] Zone 1: -6 to -12 inches below the normal pool elevation
Zone 2: -6 inches to the normal pool elevation
Zone 3: From the normal pool elevation to +12 inches
Zone 4: +12 to +36 inches; above ED zone

Source: Virginia DCR Stormwater Design Specification No. 13: Constructed Wetlands Version 1.8. 2010.

Table 4.54. Popular, Versatile, and Available Native Emergent and Submergent Vegetation for Stormwater Wetlands

Plant	Zone[1]	Form	Inundation Tolerance	Wildlife Value	Notes
Arrow Arum *(Peltandra virginica)*	2	Emergent	Up to 1 ft	High; berries are eaten by wood ducks	Full sun to partial shade
Broad-Leaf Arrowhead (Duck Potato) *(Saggitaria latifolia)*	2	Emergent	Up to 1 ft	Moderate; tubers and seeds eaten by ducks	Aggressive colonizer
Blueflag Iris* *(Iris versicolor)*	2, 3	Emergent	Up to 6 in.	Limited	Full sun (to flower) to partial shade
Broomsedge *(Andropogon virginianus)*	2, 3	Perimeter	Up to 3 in.	High; songbirds and browsers; winter food and cover	Tolerant of fluctuating water levels and partial shade
Bulltongue Arrowhead *(Sagittaria lancifolia)*	2, 3	Emergent	0 to 24 in.	Waterfowl, small mammals	Full sun to partial shade
Burreed *(Sparganium americanum)*	2, 3	Emergent	0 to 6 in.	Waterfowl, small mammals	Full sun to partial shade
Cardinal Flower* *(Lobelia cardinalis)*	3	Perimeter	Periodic inundation	Attracts hummingbirds	Full sun to partial shade
Common Rush *(Juncus spp.)*	2, 3	Emergent	Up to 12 in.	Moderate; small mammals, waterfowl, songbirds	Full sun to partial shade
Common Three Square *(Scipus pungens)*	2	Emergent	Up to 6 in.	High; seeds, cover, waterfowl, songbirds	Fast colonizer; can tolerate periods of dryness; full sun; high metal removal
Duckweed (*Lemna sp.)*	1, 2	Submergent / Emergent	Yes	High; food for waterfowl and fish	May biomagnify metals beyond concentrations found in the water
Joe Pye Weed *(Eupatorium purpureum)*	2, 3	Emergent	Drier than other Joe-Pye Weeds; dry to moist areas; periodic inundation	Butterflies, songbirds, insects	Tolerates all light conditions
Lizard's Tail *(Saururus cernus)*	2	Emergent	Up to 1 ft	Low; except for wood ducks	Rapid growth; shade-tolerant

Plant	Zone[1]	Form	Inundation Tolerance	Wildlife Value	Notes
Marsh Hibiscus *(Hibiscus moscheutos)*	2, 3	Emergent	Up to 3 in.	Low; nectar	Full sun; can tolerate periodic dryness
Pickerelweed *(Pontederia cordata)*	2, 3	Emergent	Up to 1 ft	Moderate; ducks, nectar for butterflies	Full sun to partial shade
Pond Weed *(Potamogeton pectinatus)*	1	Submergent	Yes	Extremely high; waterfowl, marsh and shore birds	Removes heavy metals from the water
Rice Cutgrass *(Leersia oryzoides)*	2, 3	Emergent	Up to 3 in.	High; food and cover	Prefers full sun, although tolerant of shade; shoreline stabilization
Sedges *(Carex spp.)*	2, 3	Emergent	Up to 3 in.	High; waterfowl, songbirds	Wetland and upland species
Softstem Bulrush *(Scipus validus)*	2, 3	Emergent	Up to 2 ft	Moderate; good cover and food	Full sun; aggressive colonizer; high pollutant removal
Smartweed *(Polygonum spp.)*	2	Emergent	Up to 1 ft	High; waterfowl, songbirds; seeds and cover	Fast colonizer; avoid weedy aliens, such as *P. Perfoliatum*
Spatterdock *(Nuphar luteum)*	2	Emergent	Up to 1.5 ft	Moderate for food, but High for cover	Fast colonizer; tolerant of varying water levels
Switchgrass *(Panicum virgatum)*	2, 3, 4	Perimeter	Up to 3 in.	High; seeds, cover; waterfowl, songbirds	Tolerates wet/dry conditions
Sweet Flag* *(Acorus calamus)*	2, 3	Perimeter	Up to 3 in.	Low; tolerant of dry periods	Tolerates acidic conditions; not a rapid colonizer
Waterweed *(Elodea canadensis)*	1	Submergent	Yes	Low	Good water oxygenator; high nutrient, copper, manganese, and chromium removal
Wild celery *(Valisneria americana)*	1	Submergent	Yes	High; food for waterfowl; habitat for fish and invertebrates	Tolerant of murkey water and high nutrient loads
Wild Rice *(Zizania aquatica)*	2	Emergent	Up to 1 ft	High; food, birds	Prefers full sun
Woolgrass Bulrush *(Scirpus cyperinus)*	3, 4	Emergent	Yes	High: waterfowl, small mammals	Fresh tidal and non-tidal, swamps, forested wetlands, meadows, ditches

Aggressive colonizers are shown in bold type

[1] Zone 1: -6 to -12 inches below the normal pool elevation

Plant	Zone[1]	Form	Inundation Tolerance	Wildlife Value	Notes

Zone 2: -6 inches to the normal pool elevation
Zone 3: From the normal pool elevation to +12 inches
Zone 4: +12 to +36 inches; above ED zone
***Not a major colonizer, but adds color**
Source: Virginia DCR Stormwater Design Specification No. 13: Constructed Wetlands Version 1.8. 2010.

4.13.7 Stormwater Wetland Maintenance Criteria

Successful establishment of constructed wetland areas requires that the following tasks be undertaken in the first 2 years:

- **Initial Inspections.** During the first 6 months following construction, the site should be inspected by a qualified professional at least twice after storm events that exceed 0.5 inch of rainfall.
- **Spot Reseeding.** Inspections should include looking for bare or eroding areas in the CDA or around the wetland buffer and make sure they are immediately stabilized with grass cover.
- **Watering.** Trees planted in the buffer and on wetland islands and peninsulas need watering during the first growing season. In general, consider watering every 3 days for first month, and then weekly during the first growing season (April through October), depending on rainfall.
- **Reinforcement Plantings.** Regardless of the care taken during the initial planting of the stormwater wetland and buffer, it is probable that some areas will remain unvegetated and some species will not survive. Poor survival can result from many unforeseen factors, such as predation, poor quality plant stock, water level changes, and drought. Thus, it is advisable to budget for an additional round of reinforcement planting after one or two growing seasons. Construction contracts should include a care and replacement warranty extending at least two growing seasons after initial planting, to selectively replant portions of the stormwater wetland that fail to fill in or survive. If a minimum coverage of 50% is not achieved in the planted wetland zones after the second growing season, a reinforcement planting will be required.

Managing vegetation is an important ongoing maintenance task at every constructed wetland and for each inundation zone. Following the design criteria above should result in a reduced need for regular mowing of the embankment and access roads. Vegetation within the stormwater wetland, however, will require some annual maintenance.

Designers should expect significant changes in wetland species composition to occur over time. Inspections should carefully track changes in wetland plant species distribution over time. Invasive plants should be dealt with as soon as they begin to colonize the stormwater wetland. As a general rule, control of undesirable invasive species (e.g., cattails and Phragmites) should commence when their coverage exceeds more than 15% of a wetland cell area. Although the application of herbicides is not recommended, some types (e.g., Glyphosate) have been used to control cattails with some success. Extended periods of dewatering may also work, since early manual removal provides only short-term relief from invasive species. While it is difficult to exclude invasive species completely from stormwater wetlands, their ability to take over the entire wetland can be reduced if the designer creates a wide range of depth zones and a complex internal structure within the wetland.

- For more information on invasive plants, consult the South Carolina Exotic Pest Plant Council. Resources are available online at http://www.se-eppc.org/southcarolina/invasivePlants.cfm.

- For more information related to chemical control methods for aquatic plants, please review the fact sheet "Aquatic Weed Control Overview" provided by Clemson's Cooperative Extension Service and available online at http://www.clemson.edu/extension/hgic/plants/other/landscaping/hgic1714.html.

Thinning or harvesting of excess forest growth may be periodically needed to guide the forested stormwater wetland into a more mature state. Vegetation may need to be harvested periodically if the constructed wetland becomes overgrown. Thinning or harvesting operations should be scheduled to occur approximately 5 and 10 years after the initial stormwater wetland construction. Removal of woody species on or near the embankment and maintenance access areas should be conducted every 2 years.

Designers should refer to Section 4.12.7 Pond Maintenance Criteria for additional maintenance responsibilities associated with stormwater wetlands. Ideally, maintenance of constructed wetlands should be driven by annual inspections by a qualified professional that evaluates the condition and performance of the stormwater wetland. Based on inspection results, specific maintenance tasks will be triggered.

Maintenance inspection checklist for stormwater wetlands and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.13.8 Stormwater Wetland Stormwater Compliance Calculations

Stormwater wetlands are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 60% bacteria removal for the storage volume (Sv) provided by in the permanent pool (Table 4.55).

Table 4.55. Stormwater Wetland Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 25%
Bacteria Removal	= 60%

4.14 Tree Planting & Preservation

Tree Planting and Preservation
Definition: Existing trees can be preserved or new trees can be planted to reduce stormwater runoff.

Site Applicability		BMP Performance Summary		
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High		
▪ Urban ▪ Suburban ▪ Rural	**Small**	**TSS**[1]	**Total N**[1]	**Bacteria**[1]
		N/A	N/A	N/A
		Runoff Reductions		
Construction Costs	**Maintenance Burden**	**Volume**		
Low	Low	Low		

Maintenance Frequency:		*SWRv**				
Routine	**Non-Routine**	**T-1 Small**	**T-1 Large**	**T-2 Small**	**T-2 Large**	**T-2 Special**
At least annually	Every 10–15 years	5 ft^3	10 ft^3	10 ft^3	20 ft^3	30 ft^3

Advantages/Benefits	Disadvantages/Limitation
▪ High community acceptance ▪ Relatively low maintenance requirements ▪ Increases property value ▪ Easily incorporated with other practices ▪ Excellent for soils	▪ Preserved trees must be protected during construction ▪ Must be within LOD ▪ Must maintain tree health

Components	Design considerations
▪ Inventory of existing trees ▪ Identification of trees to preserve or plant ▪ Preference for Special trees ▪ Average tree spread	▪ Inventory of existing trees ▪ Identification of trees to preserve or plant ▪ Preference for Special trees ▪ Slope-steep slopes must be terraced/benched ▪ Maintenance access

Maintenance Activities	
▪ If staked during establishment, remove stakes within 1 year of planting	▪ Maintain appropriate mulch cover ▪ Ensure tree health

[1]*Credited pollutant load removal*

Per planted/preserved tree

Easily combined with other practices, tree planting and preservation provide stormwater interception, beauty, and shade, thereby increasing aesthetics and property values. See Figure 4. 57

Figure 4. 56 Tree Planting and Preservation in Bioretention
Photo: Center for Watershed Protection

Definition. Existing trees can be preserved or new trees can be planted to reduce stormwater runoff. The design includes the following:

T-1 Tree planting

T-2 Tree preservation

Tree canopy can intercept a significant amount of rainfall before it becomes runoff, particularly if the tree canopy covers impervious surfaces, as in the case of street trees. Through the processes of evapotranspiration and nutrient uptake, trees—even when located on a development site—have the capacity to reduce stormwater runoff volumes and improve water quality. Further, through root growth, trees can improve the infiltration capacity of the soils in which they grow.

Both tree planting and tree preservation can contribute to stormwater management on a site. Note that retention credit is available for preserved trees only when they are within the limits of disturbance of a project. Preserved trees outside of the limits of disturbance may offer an opportunity for additional retention when they constitute an area of natural cover and stormwater is conveyed to that area.

4.14.1 Preserving Existing Trees during Construction

The preferred method for increasing tree cover at a development site is to preserve existing trees during construction, particularly where mature trees are present. Existing trees are preserved during construction through a four-step process:

1. Inventory existing trees.
2. Identify trees to preserve.
3. Protect trees and soil during construction.
4. Protect trees after construction.

Inventory Existing Trees. An inventory of existing trees and forested areas at the development site must be conducted before any site design, clearing, or construction takes place, as specified by the DDOT UFD. The inventory must be conducted by one of the following qualified professionals, which includes, but is not limited to:

- South Carolina Licensed Forester
- South Carolina Licensed Tree Expert
- South Carolina Experienced Forester
- South Carolina Licensed Landscape Architect
- International Society of Arboriculture (ISA) Certified Arborist

The inventory must include a survey of existing trees and determine their size, species, condition, and ecological value. Locations of trees and forest stands must be recorded.

Identify Trees to Preserve. From the tree inventory, individual trees can be identified for preservation and protection during site development. Preserved trees fall into three categories of retention credit: tree species with an average mature spread less than or equal to 40 feet ("small" trees) receive 10 cubic feet of retention credit; trees species with an average mature spread greater than or equal to 40 feet ("large" trees) receive 20 cubic feet of retention credit; and trees with an existing diameter greater than 14" ("Special" trees receive 30 cubic feet of retention credit, regardless of mature spread size. Additional selection criteria may include tree species, size, condition, and location (see Table 4.56).

Table 4.56. Selecting Priority Trees and Forests for Preservation

Selection Criteria	Examples of Priority Tree and Forests to Conserve
Species	▪ Rare, threatened, or endangered species ▪ Specimen trees ▪ High quality tree species (e.g., white oaks and sycamores because they are structurally strong and live longer than trees such as silver maple and cottonwood) ▪ Species that are tolerant of specific site conditions and soils
Size	▪ Trees over a specified diameter at breast height (DBH) or other size measurement ▪ Trees designated as national, state, or local champions ▪ Contiguous forest stands

Selection Criteria	Examples of Priority Tree and Forests to Conserve
Condition	▪ Healthy trees that are structurally sound in "fair" or better condition ▪ High quality forest stands with high forest structural diversity
Location	▪ Trees located where they will provide direct benefits at the site (e.g., shading, privacy, windbreak, buffer from adjacent land use) ▪ Forest stands that are connected to off-site forests that create wildlife habitat and corridors ▪ Trees located in protected natural areas such as floodplains, stream buffers, wetlands, erodible soils, critical habitat areas, and steep slopes. ▪ Forest stands that are connected to off-site non-forested natural areas or protected land (e.g., has potential to provide wildlife habitat)

Trees selected for preservation and protection must be clearly marked both on construction drawings and at the actual site. Flagging or fencing is typically used to protect trees at the construction site. Areas of trees to preserve should be marked on the site map and walked during preconstruction meetings.

Protect Trees and Soil During Construction. Physical barriers must be properly installed around the Critical Root Zone (CRZ) of trees to be preserved. The CRZ shall be determined by a landscape professional from the above list, and in general is equal to 1.5 feet of tree protection (radius of circle) for every 1 inch in tree diameter. For example, a 10-inch diameter tree would have a CRZ radius extending 15 feet from the tree. The barriers must be maintained and enforced throughout the construction process. Tree protection barriers include highly visible, well-anchored temporary protection devices, such as 6-foot-tall chain link fencing.

All protection devices must remain in place throughout construction.

When excavation is proposed immediately adjacent to the CRZ, roots must first be pruned at the edge of the excavation with a trenching machine, vibratory knife or rock saw to a depth of 18 inches. Any requirements here may be superseded by the requirements of the CDC.

Protect Trees After Construction. Maintenance covenants, as described below, are required to ensure that preserved trees are protected.

4.14.2 Planting Trees

Considerations at Development Sites. New development sites provide many opportunities to plant new trees. Planting trees at development sites is done in three steps:

1. Select tree species.

2. Evaluate and improve planting sites.

3. Plant and maintain trees.

Tree Species. Planted trees fall into two categories of retention: tree species with an average mature spread less than or equal to 40 feet ("small" trees) receive 5 cubic feet of retention and trees species with an average mature spread greater than or equal to 40 feet ("large" trees) receive 10 cubic feet of retention. Trees to be planted must have a minimum caliper size of 1.5 inches.

Planting Sites. Ideal planting sites within a development are those that create interception opportunities around impervious surfaces. These include areas along pathways, roads, islands and median strips, and parking lot interiors and perimeters. Other areas of a development site may benefit from planting trees (including stream valleys and floodplains, areas adjacent to existing forest, steep slopes, and portions of the site where trees would provide buffers, screening, noise reduction, or shading).

It is important to evaluate and record the conditions, such as soil type, soil pH, soil compaction, and the hydrology of proposed planting sites to ensure they are suitable for planting. These evaluations provide a basis for species selection and determination of the need for any special site preparation techniques.

A minimum of 1,500 cubic feet of rootable soil volume must be provided per large tree. In planting arrangements that allow for shared rooting space amongst multiple trees, a minimum of 1,000 cubic feet of rootable soil volume must be provided for each large tree. Rootable soil volume must be within 3 feet of the surface.

Smaller trees with an average mature spread of less than or equal to 40 feet must have a minimum of 600 cubic feet of rootable soil volume. In planting arrangements that permit shared rooting space amongst multiple trees, a minimum of 400 cubic feet of rootable soil volume must be provided for each tree. Rootable soil volume must be within 3 feet of the surface.

Site characteristics determine what tree species will flourish there and whether any of the conditions, such as soils, can be improved through the addition of compost or other amendments. Table 4.57 presents methods for addressing common constraints to urban tree planting.

Table 4.57. Methods for Addressing Urban Planting Constraints

Potential Impact	Potential Resolution
Limited Soil Volume	▪ Provide 1,500 cubic feet of rootable soil volume per large tree (greater than or equal to 40-foot spread) and 600 cubic feet of rootable soil volume per small tree (less than or equal to 40-foot spread). This soil must be within 3 feet of the surface. ▪ Use planting arrangements that allow shared rooting space. A minimum of 1,000 cubic feet of rootable soil volume must be provided for each tree in shared rooting space arrangements. A minimum of 400 cubic feet of rootable soil volume must be provided for each small tree in shared rooting arrangements.
Poor Soil Quality	▪ Test soil and perform appropriate restoration. ▪ Select species tolerant of soil pH, compaction, drainage, etc. ▪ Replace very poor soils if necessary.
Air Pollution	▪ Select species tolerant of air pollutants.
Damage from Lawnmowers	▪ Use mulch to protect trees.
Damage from Vandalism	▪ Use tree cages or benches to protect trees. ▪ Select species with inconspicuous bark or thorns. ▪ Install lighting nearby to discourage vandalism.
Damage from Vehicles	▪ Provide adequate setbacks between vehicle parking stalls and trees.

Potential Impact	Potential Resolution
Damage from animals such as deer, rodents, rabbits, and other herbivores	▪ Use protective fencing or chemical retardants.
Exposure to pollutants in stormwater runoff	▪ Select species that are tolerant of specific pollutants, such as oils and metals.
Soil moisture extremes	▪ Select species that are tolerant of inundation or drought. ▪ Install underdrains if necessary. ▪ Select appropriate backfill soil and mix thoroughly with site soil. ▪ Improve soil drainage with amendments and tillage if needed.
Increased temperature	▪ Select drought tolerant species.
Increased wind	▪ Select drought tolerant species.
Abundant populations of invasive species	▪ Control invasive species prior to planting. ▪ Continually monitor for and remove invasive species.
Conflict with infrastructure	▪ Design the site to keep trees and infrastructure separate. ▪ Provide appropriate setbacks from infrastructure. ▪ Select appropriate species for planting near infrastructure. ▪ Use alternative materials to reduce conflict.
Disease or insect infestation	▪ Select resistant species

Planting trees at development sites requires prudent species selection, a maintenance plan, and careful planning to avoid impacts from nearby infrastructure, runoff, vehicles or other urban elements.

Trees Along Streets and in Parking Lots. When considering a location for planting, clear lines of sight must be provided, as well as safe travel surfaces, and overhead clearance for pedestrians and vehicles. Also, ensure enough soil volume for healthy tree growth. Usable soil must be uncompacted and may not be covered by impervious material. Having at least a 6-foot-wide planting strip or locating sidewalks between the trees and street allows more rooting space for trees in adjacent property.

Select tree species that are drought tolerant, can grow in poor or compacted soils, and are tolerant to typical urban pollutants (oil and grease, metals, and chlorides). Additionally, select species that do not produce excessive fruits, nuts, or leaf litter, that have fall color, spring flowers or some other aesthetic benefit, and can be limbed up to 6 feet to provide pedestrian and vehicle traffic underneath.

Planting Techniques. Prepare a hole no deeper than the root ball or mass but two to three times wider than the spread of the root ball or mass. The majority of the roots on a newly planted tree will develop in the top 12 inches of soil and spread out laterally. There are some additional considerations depending on the type of plant material being used (Table 4.58).

Table 4.58. Tree Planting Techniques

Plant Material	Planting Technique	Planting Season
Bare root	Hand plant	Spring or fall when tree is dormant
Container grown	Hand plant or use mechanical planting tools (e.g., auger)	Spring or fall, summer if irrigated
Balled and burlapped	Use backhoe (or other specialized equipment) or hand plant	Spring or fall

Sources: Palone and Todd (1998), WSAHGP (2002)

One of the most important planting guidelines is too make sure the tree is not planted too deeply. The root collar, the lowest few inches of trunk just above its junction with the roots (often indicated by a flare), should be exposed. Trees planted too deeply have buried root collars, and are weakened, stressed, and predisposed to pests and disease. Trees planted too deeply can also form adventitious roots (roots that form from non-root tissue) near the soil surface in an attempt to compensate for the lack of available oxygen to buried roots. Adventitious roots are not usually large enough to provide support for a large tree and may eventually lead to collapse. ISA (2005) provides additional guidance on how to avoid planting too deeply. It is generally better to plant the tree a little high, that is, with the base of the trunk flare 2 to 3 inches above the soil, rather than at or below the original growing level.

Proper handling during planting is essential to avoid prolonged transplant shock and ensure a healthy future for new trees and shrubs. Trees should always be handled by the root ball or container, never by the trunk. Specifications for planting a tree are illustrated in Figure 4.58. Trees must be watered well after planting.

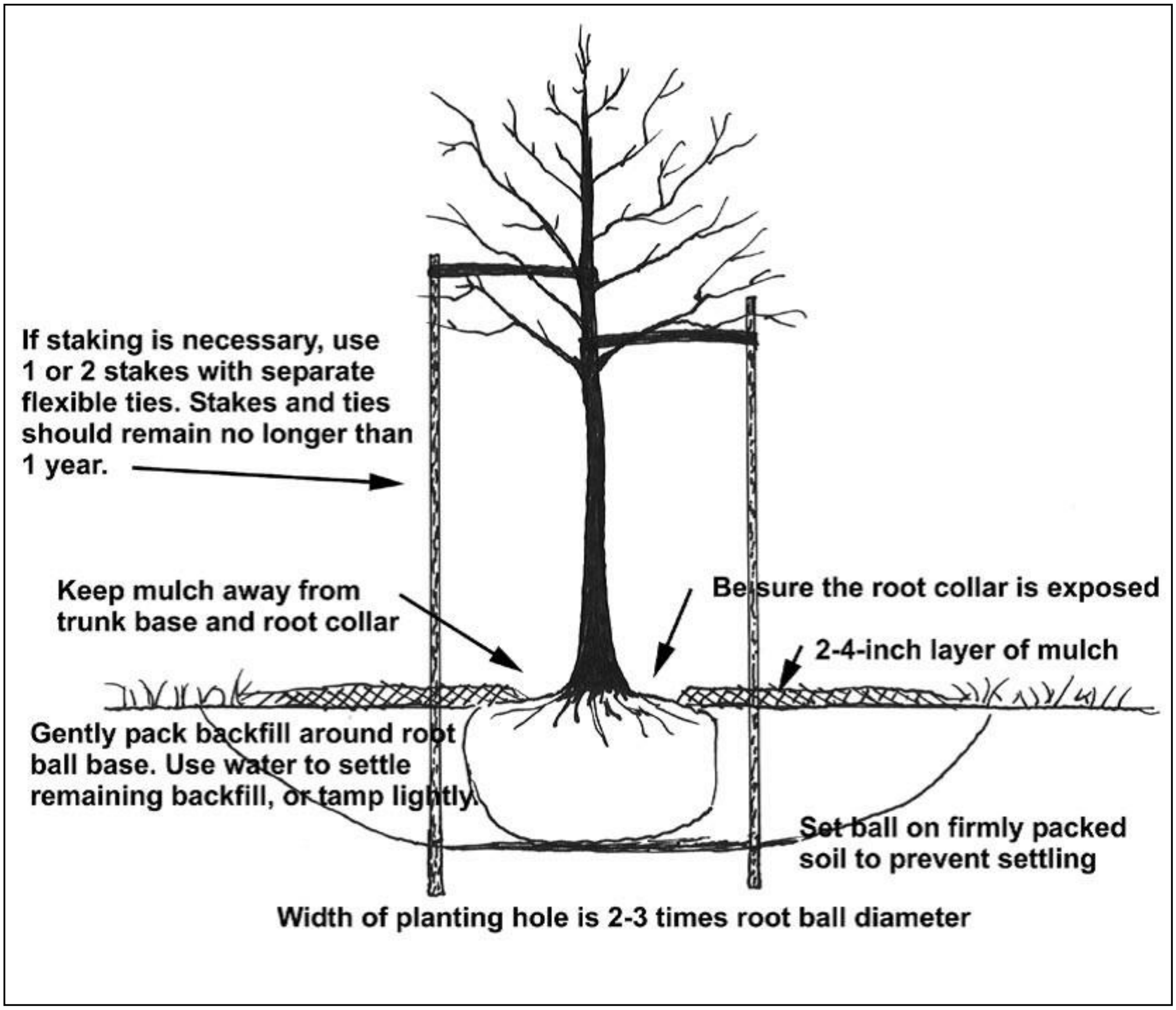


Figure 4.57. Tree planting guidelines. Adapted from Flott, 2004 and ISA, 2003b.

Steep slopes require additional measures to ensure planting success and reduce erosion, especially if the slope receives stormwater runoff from upland land uses. Depending on the steepness of the slope and the runoff volume, rill or gully erosion may occur on these slopes, requiring a twofold approach: controlling the stormwater and stabilizing the slope.

Erosion control blankets are recommended to temporarily stabilize soil on slopes until vegetation is established. Erosion control fabrics come in a variety of weights and types and should be combined with vegetation establishment such as seeding. Other options for stabilizing slopes include applying compost or bark mulch, plastic sheeting, or sodding.

Trees will add stability to slopes because of their deep roots, provided they are not planted by digging rows of pits across a slope. Required maintenance will include mowing (if slopes are not too steep) and establishing cover on bare or eroded areas.

Planting methods for slopes steeper than 3H:1V involve creating a level planting space on the slope (see Figure 4.59). A terrace can be dug into the slope in the shape of a step by cutting into the existing slope and using the excavated soil as fill to create the step area. A low soil berm (or rock berm) can be formed at the front edge of each step or terrace to slow the flow of water. Trees can also be planted in clusters on slopes (using the above method) to limit potential for desiccation. Staggering tree placement and mulching will prevent water from running straight downhill.

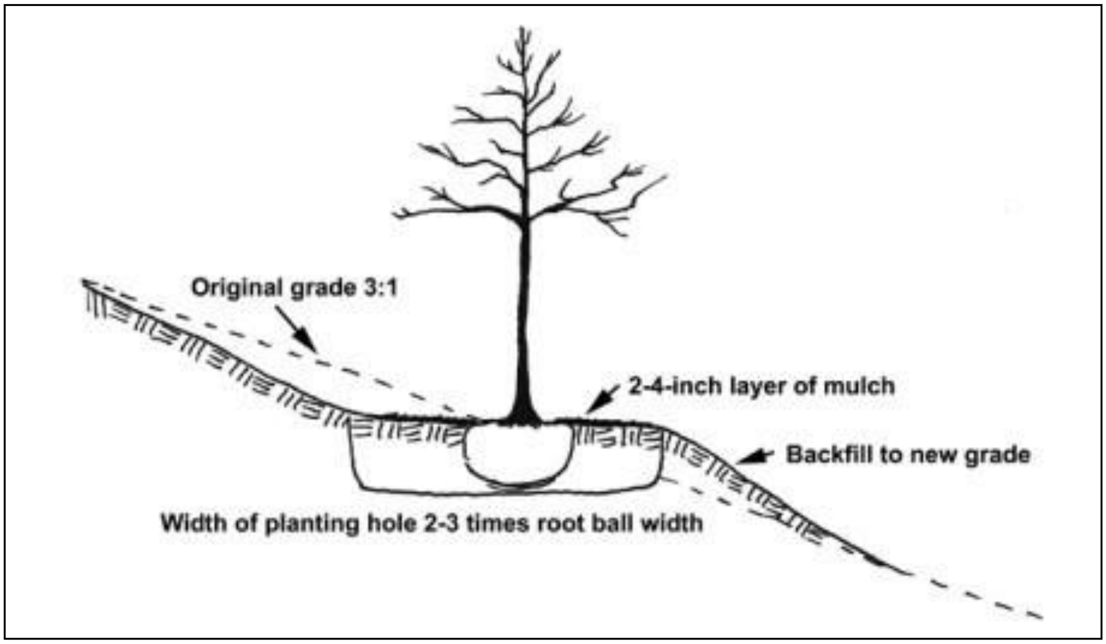


Figure 4.58 Trees planted on steep slopes require a constructed level planting surface.

Post-Planting Tree Protection

Mulching: Once the tree has been properly planted, 2 to 4 inches (maximum) of organic mulch must be spread over the soil surface out to the drip line (the outermost circumference of the tree canopy) of the tree. A mulch-free area, 2 to 3 inches wide at the base of the tree, must be provided to avoid moist bark conditions and prevent decay

If planting a cluster of trees, mulch the entire planting area, ensuring a 2- to 3-inch wide mulch free area at the base of each tree.

Slow-decomposing organic mulches, such as shredded bark, compost, leaf mulch, or wood chips provide many added benefits for trees. Mulch that contains a combination of chips, leaves, bark, and twigs is ideal for reforestation sites. Grass clippings and sawdust are not recommended as mulches because they decompose rapidly and require frequent application, resulting in reduced benefits.

For well-drained sites, up to 4 inches of mulch may be applied. For poorly drained sites, a thinner layer of mulch should be applied. Mulch should never be more than 4 inches deep or applied right next to the tree trunk; however, a common sight in many landscaped areas is the “mulch volcano.” This over-mulching technique can cause oxygen and moisture-level problems, and decay of the living bark at the base of the tree.

Staking: Studies have shown that trees will establish more quickly and develop stronger trunk and root systems if they are not staked at the time of planting. Staking for support may be necessary only for top-heavy trees or at sites where vandalism or windy exposure are a concern.

If staking is necessary for support, two stakes used in conjunction with a wide flexible tie material will hold the tree upright, provide flexibility, and minimize injury to the trunk. To prevent damage to the root ball, stakes should be placed in undisturbed soil beyond the outer edges of the root ball.

Perhaps the most important part of staking is its removal. Over time, guy wires (or other tie material) can cut into the growing trunk bark and interfere with the movement of water and nutrients within the tree. Staking material should be removed within 1 year of planting.

4.14.3 Tree Inspection Criteria

An initial inspection by a qualified professional should be done to ensure the tree has been planted, watered, and protected correctly with locations flagged if appropriate. For newly planted trees, transplant shock is common and causes stress on the tree. For this reason, newly planted trees should be inspected more frequently than established trees. The time it takes for a tree to become established varies with the size at planting, species, stock, and site conditions, but generally, trees should be inspected every few months during the first 3 years after planting, to identify problems and implement repairs or modify maintenance strategies.

After the first 3 years, annual inspections are sufficient to check for problems. Trees should also be inspected after major storm events for any damage that may have occurred. The inspection should take only a few minutes per tree, but prompt action on any problems encountered results in healthier, stronger trees. Inspections should include an assessment of overall tree health, an assessment of survival rate of the species planted, cause of mortality, if maintenance is required, insect or disease problems, tree protection adjustment, and weed control condition.

Construction inspection checklist for tree planting and preservation can be found in Appendix E Construction Inspection Checklists.

4.14.4 Tree Maintenance Criteria

Water newly planted trees regularly (at least once a week) during the first growing season. Water trees less frequently (about once a month) during the next two growing seasons. After 3 growing seasons, water trees only during drought. The exact watering frequency will vary for each tree and site.

A general horticultural rule of thumb is that trees need 1 inch of rainfall per week during the growing season. This means new trees need a minimum of 25 gallons of water a week to stay alive (http://caseytrees.org/get-involved/water/). Water trees deeply and slowly near the roots. Light, frequent watering of the entire plant can encourage roots to grow at the surface. Soaker hoses and drip irrigation work best for deep watering of trees. It is recommended that slow leak watering bags or tree buckets are installed to make watering easier and more effective. Continue watering until mid-fall, tapering off during lower temperatures.

Pruning is usually not needed for newly planted trees but may be beneficial for tree structure. If necessary, prune only dead, diseased, broken or crossing branches at planting. As the tree grows, lower branches may be pruned to provide clearance above the ground, or to remove dead or damaged limbs.

Maintenance inspection checklist for tree planting and preservation and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.15 Proprietary Practices

Proprietary Practices					
Definition: Manufactured stormwater treatment practices that utilize settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to manage the impacts stormwater runoff. Performance varies based on manufacturer's design.					
Site Applicability		**BMP Performance Summary**			
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High			
▪ Urban ▪ Suburban ▪ Rural	**Small**	**TSS[1]**	**Total N[1]**	**Bacteria[1]**	
		Varies*	Varies*	Varies*	
		Runoff Reductions			
Construction Costs	**Maintenance Burden**	**Volume**			
Moderate	Moderate	Varies*			
Maintenance Frequency:		***SWRv***			
Routine	**Non-Routine**	Refer to Device Manufacturers Specifications			
At least annually	Variable				
Advantages/Benefits		**Disadvantages/Limitation**			
▪ On- or off-line treatment ▪ Useful in challenging stormwater site designs ▪ Water quality treatment		▪ Devices can be costly ▪ Most devices do not provide retention			
Components		**Design considerations**			
▪ Pretreatment ▪ Conveyance ▪ Bypass mechanism		▪ Must safely overflow or bypass flow from 2- to 25-year design storms. ▪ Manufacturer's specifications ▪ Adequate maintenance access required			
Maintenance Activities					
▪ Based on manufacturer's specifications		▪ Routine inspection for proper function			

[1]Credited pollutant load removal

**Varies according to proprietary practice*

Definition. Proprietary practices are manufactured stormwater treatment practices that utilize settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to manage the impacts stormwater runoff. The design includes the following:

M-1 Proprietary practices

Proprietary practices may be used to achieve treatment compliance, provided they have been approved by the State and meet the performance criteria outlined in this specification. Historically, proprietary practices do not provide retention volume. A proprietary practice will not be valued for retention volume unless the practice can demonstrate the occurrence of retention processes.

4.15.1 Proprietary Practice Feasibility Criteria

Individual proprietary practices will have different site constraints and limitations. Manufacturer's specifications should be consulted to ensure that proprietary practices are feasible for application on a site-by-site basis.

4.15.2 Proprietary Practice Conveyance Criteria

All proprietary practices must be designed to safely overflow or bypass flows from larger storm events to downstream drainage systems. The overflow associated with the 2- to 25-year design storms must be controlled so that velocities are non-erosive at the outlet point (i.e., to prevent downstream erosion).

Manufactured treatment devices may be constructed on-line or off-line. On-line systems receive upstream runoff from all storms, providing runoff treatment for the stormwater quality design storm and conveying the runoff from larger storms through an overflow. In off-line devices, most, or all, of the runoff from storms larger than the stormwater quality design storm bypass the device through an upstream diversion or other mechanism.

4.15.3 Proprietary Practice Pretreatment Criteria

Individual proprietary practices may require pretreatment or may be appropriate for use as pretreatment devices. Manufacturer's specifications should be consulted to determine the device-specific pretreatment requirements.

4.15.4 Proprietary Practice Design Criteria

The basic design parameters for a proprietary practice will depend on the techniques it employs to control stormwater runoff and remove particulate and dissolved pollutants from runoff. In general, the design of devices that treat runoff with no significant storage and flow rate attenuation must be based upon the peak design flow rate. However, devices that do provide storage and flow rate attenuation must be based, at a minimum, on the design storm runoff volume and, in some instances, on a routing of the design runoff hydrograph. Hydrologic design is discussed further in Appendix I Hydrology and Hydraulics Design Requirements.

Proprietary practices approval is contingent on adherence to the New Jersey Department of Environmental Protection Certification (NJDEP) protocols and testing. The NJDEP Certification Process includes details of the verification process and the required data submittals for determination of proprietary practice performance. The current NJDEP version should be followed and is included in the References below.

Adequate maintenance access must be provided for all proprietary practice systems. Access, with access steps, as applicable, must be provided for the inlet pipe, outflow structure, and over any other functional components.

4.15.5 Proprietary Practice Landscaping Criteria

Proprietary devices may or may not require landscaping considerations. Manufacturer's specifications should be consulted to determine any landscaping requirements for the device.

4.15.6 Proprietary Practice Construction Sequence

The construction and installation of individual proprietary practices will vary based on the specific proprietary practice. Manufacturer's specifications should be consulted to determine the device specific construction sequencing requirements.

Construction inspection checklist for generic structural BMPs can be found in Appendix E Construction Inspection Checklists.

4.15.7 Proprietary Practice Maintenance Criteria

In order to ensure effective and long-term performance of a proprietary practice, regular maintenance tasks and inspections are required.

All proprietary practices should be inspected by a qualified professional and maintained in accordance with the manufacturer's instructions and/or recommendations and any maintenance requirements associated with the device's verification by Beaufort County Public Works Department.

Maintenance inspection checklist for generic structural BMPs and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.15.8 Proprietary Practice Stormwater Compliance Calculations

Proprietary practices receive retention credit when explicitly approved by the Beaufort County Public Works Department. Pollutant removal (TSS EMC reduction) may be awarded for specific practices provided they meet the performance criteria outlined in Section 4.15.4 Proprietary Practice Design Criteria.

4.16 Conservation Area

If a site includes a Conservation Area which is protected under a conservation easement or equivalent form of protection, a portion of the conservation area may be “removed” from the site for the purposes of calculating the stormwater retention volume (SWRv). There are four scenarios that could qualify for a conservation area credit.

4.16.1 Scenario 1: Natural Conservation Area

Scenario 1 is applicable if a portion of the post-developed area is left in its natural condition and protected, in perpetuity, by a conservation easement or equivalent form of protection. If this scenario is applicable, subtract 100% of the protected natural area from the total site area when calculating the SWRv.

4.16.2 Scenario 2: Reforestation/Revegetation

Scenario 2 is applicable if a portion of the post-developed area employs site reforestation/revegetation and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the reforested/revegetated area from the total site area when calculating the SWRv.

4.16.3 Scenario 3: Soil Restoration

Scenario 3 is applicable if a portion of the post-developed area employs soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the soil restoration area from the total site area when calculating the SWRv.

4.16.4 Scenario 4: Reforestation/Revegetation & Soil Restoration

Scenario 4 is applicable if the same portion of the post-developed area employs site reforestation/revegetation as well as soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection, subtract 100% of the acres of development with restored soils in a reforested and revegetated area from the total site area when calculating the SW

Chapter 5. Erosion & Sediment Control

Sedimentation involves three basic geologic processes: erosion, transportation, and deposition. These are natural geologic phenomena; however, land development activities may initiate severe, highly undesirable and damaging alterations in the natural sedimentation cycle by drastically accelerating the erosion and transportation process. Receiving waters are the final destination for sediment transport and deposition. However, natural streams and lakes are not capable of handling the excessive sediments created by this accelerated cycle. Therefore, excessive sediment loads result in turbid waters and heavy deposition over the substrate. The impact of these events directly affects the propagation of aquatic life, which relies on clear substrates and water to feed and reproduce. Sediment-laden waters affect human activities through the degradation of waters used for aquatic recreation and sport fishing and complicate water treatment processes. Consequently, minimizing the occurrence of erosion and effective control of sediment transport is imperative to all.

5.1 Sedimentation Cycle

Soil erosion is usually caused by the impact force of raindrops and by the sheer stress of runoff flowing in rills and streams. Raindrops falling on bare or sparsely vegetated soil detach soil particles; runoff, in the form of sheet flow along the ground, picks up and carries these particles to surface waters. As the runoff gains velocity and concentration, it detaches more soil particles, cuts deeper rills and gullies into the surface of the soil, and adds to its own sediment load. Coalescing rivulets produce streams which have a larger volume and usually an increased velocity. These increasing streams have a greater capacity to remove sediment and transport it downstream. The further the runoff runs uncontrolled, the greater its erosive force and the greater the resulting damage. As the distance and volume of uncontrolled flow increase, the control becomes increasingly difficult. At some point, the energy in the stream dissipates to level that can no longer support the transport of the sediment. At this time, the sediment falls out of the water column and deposits. Over time the sediment will either be incorporated into the substrate or be re-suspended for further transport.

5.2 Factors Influencing Erosion

The erosion potential of a site is principally determined by the soil type, vegetative cover, topography, climate, and season. These factors contribute to the detachment of soil particles and their transport off-site.

- **Soil Type** – Erodibility, the amount of energy needed to break down soil structure, is dependent on soil composition and texture. Soils with high erodibility require less energy to detach soil particles.
- **Vegetative Cover** – Vegetation shields soils from the impact energy of raindrops and traps suspended sediment from runoff.
- **Topography** – Steeper and longer slopes generate runoff with more velocity and energy to erode and transport more sediment.
- **Climate** – Rainfall frequency and intensity cumulatively contribute energy in the form of raindrop impact and runoff volume to detach and transport soil particles.
- **Season** – Seasonal variations in wind, temperature, humidity, and rainfall may create more ideal conditions for erosion.

5.3 Concepts of Erosion & Sediment Control

Principles of erosion and sedimentation control are based on minimizing the effects of the soil and climatologic factors just discussed. None of the following concepts provide a singular solution for controlling those factors, nor can they all be performed at every site. However, the integration of as many concepts as possible provides the most effective erosion and sedimentation control:

A. Compatible Site Planning
   - Minimize development within sensitive areas (e.g. highly erosive soils).
   - Limit the length and steepness of the designed slopes.
   - Maintain natural vegetative cover when possible.

B. Disturbed Areas Reduction
   - Minimize the extent of the disturbed area and the duration of exposure.
   - Phase or stage development so that only the areas that are actively being developed are disturbed.
   - Minimize large or critical area grading during the season of maximum erosion potential.

C. Disturbed Areas Protection
   - Complete grading as quickly as possible.
   - Establish permanent vegetation as soon as possible on disturbed areas.
   - Divert runoff from disturbed areas.

D. Sediment Retention within Site Boundaries
   - Filter runoff as it flows from a disturbed area.
   - Impound sediment-laden runoff temporarily so that the soil particles are deposited onsite.

The NPDES Phase II storm water regulations enacted by the Clean Water Act of 1972 and promulgated by Stormwater Phase II Final Rule (1999) require that any activity disturbing an acre or greater of land, or a smaller project part of a larger common plan for development or sale, obtain NPDES construction permit coverage. This regulation differs somewhat from the South Carolina state regulations relating to areas of disturbance. Any land disturbing activity in the *Beaufort County* that meets the aforementioned criteria of one acre or more of disturbance will need to will comply with the state process for permitting. Application and issuance of an approved permit under the South Carolina state regulations for erosion and sedimentation control will meet the requirements for coverage under NPDES Phase II as well (DHEC, 2012).

5.4 General Criteria

All construction site activities must adhere to the SCDHEC General Permit SC0010000 for Large and Small Site Construction Activities. In addition, the *Beaufort County* will require as a minimum, implementation of the following construction site BMPs:

Single Family Development, not part of a larger common plan of development:

1. Silt Fencing buried a minimum of 6 inches below disturbed grade, where applicable;
2. In areas where more than two feet of fill material has been placed or in areas adjacent to all wetlands, silt fencing meeting the requirements of SCDOT must be used;

3. Temporary gravel driveways a minimum of 15 feet by 10 feet, where applicable; and
4. Sediment barriers surrounding all catch basins or drop inlets on site and sediment socks on all catch basins or drop inlets adjoining to the site.

Single Family and Multi-Family Development, part of a larger common plan of development, and Non-residential Development:

1. Silt Fencing buried a minimum of 6 inches below disturbed grade;
2. Temporary gravel driveways a minimum of 15 feet by 10 feet;
3. Sediment barriers surrounding all catch basins or drop inlets on site and sediment socks on all catch basins or drop inlets adjoining to the site;
4. Flow dissipation devices, such as check dams, in all swales and ditches;
5. Temporary stabilization shall be placed within 7 days after construction activity is complete unless construction activity is going to resume within 21 days;
6. Floating pump suctions for all temporary or permanent ponds or pumping of excavations;
7. Discharge velocities shall be reduced to provide non-erosive flows from dewatering for all temporary or permanent ponds or pumping of excavations;
8. Site inspections must be performed by a *Beaufort County* qualified individual. Copies of inspection reports shall be provided to the *Beaufort County* within 7 days of inspection;
9. Temporary stockpile areas and appropriate BMPs to be identified on plans; and
10. Two rows of silt fence are required between land disturbing activities and adjacent wetlands.

Ch 6. Enforcement and Violations

Beaufort County is required to conform to the most recent revisions of the NPDES General Permit for Discharges from Regulated SMS4, permit #SCR03000, NPDES General Permit for Stormwater Discharges from Construction Activities, Permit #SCR100000, and the Southern Lowcountry Design Manual and Ordinance. Stormwater runoff can carry pollutants to our local waterways through a variety of means. In order to control these discharges, Beaufort County is required to enforce and issue violations to property owners, contractors, subcontractors, developers, etc that have land disturbance or BMP's installed on property to ensure they are maintained and in compliance with the permits and ordinances cited above.

The escalating enforcement plan (EEP) was developed to help contractors manage and reduce potential impacts on active construction sites to the maximum extent practicable (MEP) through effective enforcement procedures.

- Any deficiencies or non-compliance issues identified during a County inspection will be reported to the project contractor, on-site supervisor, property owner, and/or engineer for addressing. Some corrective measures may require immediate, 48-hr, 72-hr, or 96-hr action depending on the nature of the violation.
- BMP's experiencing frequent failures can be required by staff to be replaced with alternative control methods. All changes should be communicated with the Stormwater Management Department and documented in the OS-SWPPP.
- Failure to address concerns or implement required changes may result in notices of violation, stop work orders, or fines.
- Sites with repeated violations may be subject to additional compliance actions, special inspection schedules or inspections as determined by the Stormwater Management Department.

2. Enforcement

If the County determines a project is in noncompliance with the Stormwater Ordinance or SoLoCo Manual, then the inspector may direct conformity by proceeding with an appropriate enforcement action. The County uses enforcement actions that include verbal warnings, Notices of Violation, Stop Work Orders, and/or civil penalties. The enforcement mechanism to be utilized will depend on the circumstances as described in the following sections.

3. Notice of Violation

The inspector will issue a Notice of Violation (NOV) for the first offenses of non-compliance with the County Stormwater Ordinance. The purpose of the NOV is to give notice of the deficiencies, identify expected corrective results and provide a reasonable timeframe to the contractor/land owner/developer prior to the County taking further action to ensure compliance. All NOV's shall be issued shall be issued per the ordinance and noted in the project file. A Notice of Violation may be issued in the following cases, but not limited to, when there is:

- Failure to coordinate an initial inspection (residential) or pre-construction meeting (commercial) prior to construction.

- Failure comply with the approved Stormwater design plans to include failure to properly install and maintain BMP measures.
- Failure to properly maintain permanent Stormwater management structures.
- Failure to comply with any portion of the Stormwater ordinance.

The contractor and land owner will be informed the inspection has failed inspection within 48-hrs of the failure. The inspector may issue a verbal Notice of Violation, but will also make the NOV available via an emailed PDF. Based on the severity of the failure and the discretion of the inspector, the contractor will be given 48 – 96 hrs to make corrective actions. The contractor may request an on-site meeting within the specified time frame to review site deficiencies and corrective actions taken. The contractor may request an extension to resolve violation issues, but it is at the discretion of the inspector to approve the request.

NOV's do not have to be issued for the same compliance failures before escalating to a Stop Work Order. A NOV will be void upon the next passed inspection.

4. Stop Work Order

An inspector will issue a Stop Work Order if compliance cannot be obtained through the issuance of NOV's or a violation is so severe immediate action must be taken. These actions can include, but are not limited to, the following:

- Construction Activities are occurring without County permits and/or an approved SWPPP.
- Past enforcement actions taken by the County have not been addressed with appropriate and prompt action to the satisfaction of the Stormwater Manager.
- Non-compliance with the approved plans has resulted in a health or safety issue.
- Offsite sedimentation resulting from non-compliance with the approved SWPPP has eliminated or severely degraded a use in a downstream water body or that such degradation is imminent.
- Non-compliance with the approved SWPPP has caused severe damage to adjacent land.
- Failure to comply with any other provisions of the Stormwater Ordinance.

If a Stop Work Order is issued, a sign will be placed at the main entrance of the site. All construction activities must immediately cease and will not begin again until the violation has been mitigated. A Stop Work Order will remain in effect for a minimum of 24 hours. The contractor or land owner must call the inspector to schedule a re-inspection. In the event the inspector is not satisfied with efforts of compliance, a fine may be issued in accordance with the Stormwater Ordinance. A stop work order will be void after the next passed inspection.

5. Civil Penalties

Violations may be subject the contractor/land owner to civil penalties outlined in the Stormwater Ordinance for each violation. Each day a violation continues constitutes a new and separate violation.

6. Criminal Penalties

In addition to any applicable civil penalties, and person who negligently, willfully, or intentionally violates any provision of the Ordinance shall be guilty of a misdemeanor and shall be punished within the jurisdictional limits of the magistrate's court. The Stormwater Manager may issue a notice to appear for a violation of this ordinance. Civil penalties imposed are outlined in the Stormwater Ordinance. Each day a violation continues constitutes a new and separate violation.

Chapter 99 STORMWATER MANAGEMENT[1]

ARTICLE I. IN GENERAL

Secs. 99-1—99-100. Reserved.

ARTICLE II. STORMWATER MANAGEMENT UTILITY

Sec. 99-101. Findings of fact.

The county council of Beaufort County, South Carolina, makes the following findings of fact:

(a) The professional engineering and financial analyses conducted on behalf of and submitted to the county properly assesses and defines the stormwater management problems, needs, goals, program priorities, costs of service, need for interlocal cooperation, and funding opportunities of the county.

(b) Given the problems, needs, goals, program priorities, costs of service, needs for interlocal cooperation, and funding opportunities identified in the professional engineering and financial analyses submitted to the county, it is appropriate to authorize the establishment of a separate enterprise accounting unit which shall be dedicated specifically to the management, construction, maintenance, protection, control, regulation, use, and enhancement of stormwater systems and programs in Beaufort County in concert with other water resource management programs.

(c) Stormwater management is applicable and needed throughout the unincorporated portions of Beaufort County, but interlocal cooperation between the county and the incorporated cities and towns within the county is also essential to the efficient provision of stormwater programs, services, systems, and facilities. Intense urban development in some portions of the county has radically altered the natural hydrology of the area and the hydraulics of stormwater systems, with many natural elements having been replaced or augmented by manmade facilities. Other areas of the county remain very rural in character, with natural stormwater systems predominating except along roads where ditches and culverts have been installed. As a result, the specific program, service, system, and facility demands differ from area to area in the county. While the county manages, operates, and improves stormwater programs, services, systems and facilities in the rural as well as urban areas, the need for improved stormwater management is greatest in the urban areas and nearby, including areas within incorporated cities and towns. Therefore, a stormwater utility service area subject to stormwater service fees should encompass, in so far as possible through interlocal agreements, the entirety of Beaufort County and the stormwater management utility service fee rate structure should reflect the amount of impervious area on individual properties and the runoff impact from water quantity and water quality.

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[1]Editor's note(s)—Ord. No. 2015/24 , adopted Sept. 28, 2015, amended and replaced ch. 99 to read as herein set out. Former ch. 99 pertained to the same subject matter, and derived from Ord. No. 2005/33 , adopted Sept. 22, 2005; and Ord. No. 2009/21 , adopted May 26, 2009.

(d) The stormwater needs in Beaufort County include, but are not limited to, protecting the public health, safety, and welfare. Provision of stormwater management programs, services, systems, and facilities therefore renders and/or results in both service and benefit to individual properties, property owners, citizens, and residents of the county and to properties, property owners, citizens, and residents of the county concurrently in a variety of ways as identified in the professional engineering and financial analyses.

(e) The service and benefit rendered or resulting from the provision of stormwater management programs, services, systems, and facilities may differ over time depending on many factors and considerations, including, but not limited to, location, demands and impacts imposed on the stormwater programs, systems, and facilities, and risk exposure. It is not practical to allocate the cost of the county's stormwater management programs, services, systems, and facilities in direct and precise relationship to the services or benefits rendered to or received by individual properties or persons over a brief span of time, but it is both practical and equitable to allocate the cost of stormwater management among properties and persons in proportion to the long-term demands they impose on the county's stormwater programs, services, systems, and facilities which render or result in services and benefits.

(f) Beaufort County presently owns and operates stormwater management systems and facilities that have been developed, installed, and acquired through various mechanisms over many years. The future usefulness and value of the existing stormwater systems and facilities owned and operated by Beaufort County, and of future additions and improvements thereto, rests on the ability of the county to effectively manage, construct, protect, operate, maintain, control, regulate, use, and enhance the stormwater systems and facilities in the county, in concert with the management of other water resources in the county and in cooperation with the incorporated cities and towns. In order to do so, the county must have adequate and stable funding for its stormwater management program operating and capital investment needs.

(g) The county council finds, concludes, and determines that a stormwater management utility provides the most practical and appropriate means of properly delivering stormwater management services and benefits throughout the county, and the most equitable means to fund stormwater services in the county through stormwater service fees and other mechanisms as described in the professional engineering and financial analyses prepared for the county.

(h) The county council finds, concludes, and determines that a schedule of stormwater utility service fees be levied upon and collected from the owners of all lots, parcels of real estate, and buildings that discharge stormwater or subsurface waters, directly or indirectly, to the county stormwater management system and that the proceeds of such charges so derived be used for the stormwater management system.

(i) The county council finds that adjustments and credits against stormwater utility service fees are an appropriate means to grant properties providing stormwater management program services that would otherwise be provided by the county and will afford Beaufort County cost savings. These reductions will be developed by the public works director and will be reviewed on an annual basis to allow for any modifications to practices required by Beaufort County.

The county council finds that both the total gross area and impervious area on each property are the most important factors influencing the cost of stormwater management in Beaufort County and, the runoff impact from water quantity and water quality.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-102. Establishment of a stormwater management utility and a utility enterprise fund.

There is hereby established within the environmental engineering division of Beaufort County a stormwater management utility for the purpose of conducting the county's stormwater management program. The county administrator shall establish and maintain a stormwater management utility enterprise fund in the county budget and accounting system, which shall be and remain separate from other funds. All revenues of the utility shall be placed into the stormwater management utility enterprise fund and all expenses of the utility shall be paid from the fund, except that other revenues, receipts, and resources not accounted for in the stormwater management utility enterprise fund may be applied to stormwater management programs, services, systems, and facilities as deemed appropriate by the Beaufort County Council. The county administrator may designate within the stormwater management utility enterprise fund such sub-units as necessary for the purpose of accounting for the geographical generation of revenues and allocation of expenditures pursuant to interlocal governmental agreements with the cities and towns of Beaufort County.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2020/18, 5-26-2020 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-103. Purpose and responsibility of the utility.

The Beaufort County Stormwater Management Utility is established for the purpose of managing, acquiring, constructing, protecting, operating, maintaining, enhancing, controlling, and regulating the use of stormwater drainage systems in the county. The utility shall, on behalf of the county and the citizens of the county: administer the stormwater management program; perform studies and analyses as required; collect service fees; system development fees, in-lieu of construction fees and other funding as allowed by law, and obtain and administer grants and loans as authorized by the county council; prepare capital improvement plans and designs; perform routine maintenance and remedial repair of the stormwater systems; acquire, construct, and improve stormwater systems; acquire necessary lands, easements, rights-of-way, rights-of-entry and use, and other means of access to properties to perform its duties; regulate the on-site control, conveyance, and discharge of stormwater from properties; obtain federal and state permits required to carry out its purpose; enter into operating agreements with other agencies; allocate funds pursuant to interlocal governmental agreements; educate and inform the public about stormwater management; and perform, without limitation except by law, any stormwater management functions and activities necessary to ensure the public safety, protect private and public properties and habitat, and enhance the natural environment and waters of the county.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-104. Limitation of scope of responsibility.

The purpose and responsibility of the stormwater management utility shall be limited by the following legal and practical considerations:

(a) Beaufort County owns or has legal access for purposes of operation, maintenance and improvement only to those stormwater systems and facilities which:

   (1) Are located within public streets, other rights-of-way, and easements;

   (2) Are subject to easements, rights-of-entry, rights-of-access, rights-of-use, or other permanent provisions for adequate access for operation, maintenance, monitoring, and/or improvement of systems and facilities; or

   (3) Are located on public lands to which the county has adequate access for operation, maintenance, and/or improvement of systems and facilities.

(b) Operation, maintenance, and/or improvement of stormwater systems and facilities which are located on private property or public property not owned by Beaufort County and for which there has been no public dedication of such systems and facilities for operation, maintenance, monitoring, and/or improvement of the systems and facilities shall be and remain the legal responsibility of the property owner, except as that responsibility may be otherwise affected by the laws of the State of South Carolina and the United States of America.

(c) It is the express intent of this article to protect the public health, safety, and welfare of all properties and persons in general, but not to create any special duty or relationship with any individual person or to any specific property within or outside the boundaries of the county. Beaufort County expressly reserves the right to assert all available immunities and defenses in any action seeking to impose monetary damages upon the county, its officers, employees and agents arising out of any alleged failure or breach of duty or relationship as may now exist or hereafter be created.

(d) To the extent any permit, plan approval, inspection or similar act is required by the county as a condition precedent to any activity or change upon property not owned by the county, pursuant to this or any other regulatory ordinance, regulation, or rule of the county or under federal or state law, the issuance of such permit, plan approval, or inspection shall not be deemed to constitute a warranty, express or implied, nor shall it afford the basis for any action, including any action based on failure to permit or negligent issuance of a permit, seeking the imposition of money damages against the county, its officers, employees, or agents.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-105. Boundaries and jurisdiction.

The boundaries and jurisdiction of the stormwater management utility shall encompass all those portions of unincorporated Beaufort County, as they may exist from time to time and such additional areas lying inside the corporate limits of those cities and towns in Beaufort County as shall be subject to interlocal agreements for stormwater management as approved by county council and participating municipal councils.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-106. Definitions.

Unless the context specifically indicates otherwise, the meaning of words and terms used in this article shall be as set forth in S.C. Code § 48-14-20, and 26 S.C. Code Regulation 72-301, mutatis mutandis.

Abatement. Any action deemed necessary by the county or its officers or agents to remedy, correct, control, or eliminate a condition within, associated with, or impacting a stormwater drainage system or the water quality of receiving waters shall be deemed an abatement action.

Adjustments. Adjustments shall mean a change in the amount of a stormwater service fee predicated upon the determination reached by the public works director and referenced to the adjustments and credit manual.

Bill class. Every property falls into one of several bill classes. The bill class determines the fee calculation of that property.

Condominiums. Properties with individual ownership of a particular dwelling unit in a building and the common right to share, with other co-owners, in the general and limited common elements of the real property.

Countywide infrastructure operation and maintenance and capital projects. The county maintains some typically larger infrastructure within each of the four municipalities in addition to within the unincorporated area.

The rate structure will allocate the costs for the county to maintain just the countywide drainage infrastructure across the entire rate base in all jurisdictions based on infrastructure linear feet per jurisdiction.

Customers of the stormwater management utility. Customers of the stormwater management utility shall be broadly defined to include all persons, properties, and entities served by and/or benefiting, directly and indirectly, from the utility's acquisition, management, construction, improvement, operation, maintenance, extension, and enhancement of the stormwater management programs, services, systems, and facilities in the county, and by its control and regulation of public and private stormwater systems, facilities, and activities related thereto.

Developed land. Developed land shall mean property altered from its natural state by construction or installation of improvements such as buildings, structures, or other impervious surfaces, or by other alteration of the property that results in a meaningful change in the hydrology of the property during and following rainfall events. Existing county maintained dirt roads which are improved and/or paved as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 and existing private dirt roads which are improved or paved and where the project is not related to a pending or proposed development of adjacent land are deemed not to constitute "developed land".

Exemption. Exemption shall mean not applying to or removing the application of the stormwater management utility service fee from a property. No permanent exemption shall be granted based on taxable or non-taxable status or economic status of the property owner.

Fixed costs. Costs associated with the public service provided equally to each property owner. These costs include, but are not limited to, the following: billing and collections, data management and updating, programming, and customer support.

Gross area. Gross area is the acreage of a parcel as identified by the Beaufort County Assessor records.

Hydrologic response. The hydrologic response of a property is the manner whereby stormwater collects, remains, infiltrates, and is conveyed from a property. It is dependent on several factors including, but not limited to, the size and overall intensity of development of each property, its impervious area, shape, topographic, vegetative, and geologic conditions, antecedent moisture conditions, and groundwater conditions and the nature of precipitation events. Extremely large undeveloped properties naturally attenuate but do not eliminate entirely the discharge of stormwater during and following rainfall events.

Jurisdictional infrastructure operations, maintenance and capital projects. Each of the five jurisdictions maintains its own stormwater drainage infrastructure and funds those costs from utility revenue. Revenue from this fee component will be returned to the service provider, the individual jurisdiction.

Impervious surfaces. Impervious surfaces shall be a consideration in the determination of the development intensity factor. Impervious surfaces are those areas that prevent or impede the infiltration of stormwater into the soil as it entered in natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, sidewalks, walkways, patio areas, driveways, parking lots, storage areas, compacted gravel and soil surfaces, awnings and other fabric or plastic coverings, and other surfaces that prevent or impede the natural infiltration of stormwater runoff that existed prior to development.

Minimum charge. A charge that reflects the minimum amount of demand a property will place on the service provider.

MS4 permit. Each jurisdiction within Beaufort County will be subject to the federally mandated MS4 permit requirements. Compliance requirements include, but are not limited to, monitoring, plan review, inspections, outreach and public education.

Nonresidential properties. Properties developed for uses other than permanent residential dwelling units and designated by the assigned land use code in the Beaufort County tax data system.

Other developed lands. Other developed lands shall mean, but not be limited to, mobile home parks, commercial and office buildings, public buildings and structures, industrial and manufacturing buildings, storage

buildings and storage areas covered with impervious surfaces, parking lots, parks, recreation properties, public and private schools and universities, research facilities and stations, hospitals and convalescent centers, airports, agricultural uses covered by impervious surfaces, water and wastewater treatment plants, and lands in other uses which alter the hydrology of the property from that which would exist in a natural state. Properties that are used for other than single-family residential use shall be deemed other developed lands for the purpose of calculating stormwater service fees.

Residential dwelling classifications. The following categories will identify the appropriate dwelling unit classifications to be utilized in applying the stormwater utility fee structure to the designations contained in the Beaufort County tax data system:

Single-family

Apartments

Townhouses

Condominiums

Mobile home

Salt water marsh. Those parcels, typically contiguous to water, identified as inundated daily due to tidal action and unbuildable. These properties are 100 percent below mean high tide and/or beyond established critical line as defined by the South Carolina Department of Health and Environmental Control's Office of Coastal Resource Management (DHEC-OCRM). The county tax assessor's office shall make this determination based on best available data.

Stormwater management programs, services, systems and facilities. Stormwater management programs, services, systems and facilities are those administrative, engineering, operational, regulatory, and capital improvement activities and functions performed in the course of managing the stormwater systems of the county, plus all other activities and functions necessary to support the provision of such programs and services. Stormwater management systems and facilities are those natural and manmade channels, swales, ditches, swamps, rivers, streams, creeks, branches, reservoirs, ponds, drainage ways, inlets, catch basins, pipes, head walls, storm sewers, lakes, and other physical works, properties, and improvements which transfer, control, convey or otherwise influence the movement of stormwater runoff and its discharge to and impact upon receiving waters.

Stormwater service fees. Stormwater service fees shall mean the service fee imposed pursuant to this article for the purpose of funding costs related to stormwater programs, services, systems, and facilities. These fees will be calculated based upon the impervious and gross area at an 80/20 allocation; stormwater service fee categories; any state agricultural exemptions or caps; an account administrative fee, countywide jurisdiction operation maintenance and capital project fees; and jurisdictional operation, maintenance and capital project fee.

Single-family unit (SFU). The single-family unit shall be defined as the impervious area measurements obtained from a statistically representative sample of all detached single-family structures within Beaufort County. The representative value will be 4,906 square feet.

Stormwater service fee categories. The appropriate categories for determining SFUs will be as follows:

	SFU Calculation (SFUs equal)
Tier 1: Single-family unit (≤2,521 square feet)	Dwelling units x 0.5
Tier 2: Single-family unit (2,522 to 7,265 square feet)	Dwelling units x 1
Tier 3: Single-family unit (≥7,266 square feet)	Dwelling units x 1.5
Mobile home	Dwelling units x 0.36
Apartments	Dwelling units x 0.39
Townhouses	Dwelling units x 0.60

Condominiums	Dwelling units x 0.27
Commercial	Impervious area * 4,906 sq. ft.*

* Commercial billed at a rate of one SFU per 4,906 square feet or a portion thereof.

Submerged property. Those parcels, typically contiguous to water, identified as eroded due to tidal action and unbuildable. These properties are 100 percent below mean low tide and/or beyond established critical line as defined by South Carolina Department of Health and Environment Control's Office of Coastal Resource Management (DHEC-OCRM). The county tax assessor's office shall make this determination based on best available data.

Townhomes. See Condominiums.

Variable costs. An impervious and gross area rate structure that allocates some cost to each of the two variables based on the amount of impervious surface and gross area.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2018/6, 3-12-2018 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-107. Reserved.

Editor's note(s)—Ord. No. 2016/38 , adopted Oct. 24, 2016, deleted § 99-107, which pertained to requirements for on-site stormwater systems; enforcement, methods, and inspections, and derived from Ord. No. 2015/24 , adopted Sept. 28, 2015.

Sec. 99-108. General funding policy.

(a) It shall be the policy of Beaufort County that funding for the stormwater management utility program, services, systems, and facilities shall be equitably derived through methods which have a demonstrable relationship to the varied demands and impacts imposed on the stormwater program, services, systems, and facilities by individual properties or persons and/or the level of service rendered by or resulting from the provision of stormwater programs, systems and facilities. Stormwater service fee rates shall be structured so as to be fair and reasonable, and the resultant service fees shall bear a substantial relationship to the cost of providing services and facilities throughout the county. Similarly situated properties shall be charged similar rentals, rates, fees, or licenses. Service fee rates shall be structured to be consistent in their application and shall be coordinated with the use of any other funding methods employed for stormwater management within the county, whether wholly or partially within the unincorporated portions of the county or within the cities and towns. Plan review and inspection fees, special fees for services, fees in-lieu of regulatory requirements, impact fees, system development fees, special assessments, general obligation and revenue bonding, and other funding methods and mechanisms available to the county may be used in concert with stormwater service fees and shall be coordinated with such fees in their application to ensure a fair and reasonable service fee rate structure and overall allocation of the cost of services and facilities.

(b) The cost of stormwater management programs, systems, and facilities subject to stormwater service fees may include operating, capital investment, and non-operating expenses, prudent operational and emergency reserve expenses, and stormwater quality as well as stormwater quantity management programs, needs, and requirements.

(c) To the extent practicable, adjustments to the stormwater service fees will be calculated by the Beaufort County Public Works Director or his/her designee in accordance with the standards and procedures adopted by the public works director's office.

(d) The stormwater service fee rate may be determined and modified from time to time by the Beaufort County Council so that the total revenue generated by said fees and any other sources of revenues or other resources allocated to stormwater management by the county council to the stormwater management utility shall be sufficient to meet the cost of stormwater management services, systems, and facilities, including, but not limited to, the payment of principle and interest on debt obligations. operating expense, capital outlays, nonoperating expense, provisions for prudent reserves, and other costs as deemed appropriate by the county council.

Beaufort County service fee rate will be based on impervious and gross area at an 80/20 allocation; stormwater service fee categories; any state agricultural exemptions or caps; an account administrative fee, countywide jurisdiction operation maintenance and jurisdictional operation, maintenance and capital project fee. The rates are set by the Beaufort County Stormwater Rate Study adopted August 24, 2015.

The gross area charge for all parcels, except master account properties for condominiums, is calculated in equivalent units as follows:

First 2 acres	$X
For every acre above 2 acres and up to 10 acres	0.5 x $X
For every acre above 10 acres, and up to 100 acres	0.4 x $X
For every acre above 100 acres	0.3 x $X

Condominium accounts will receive a minimum gross area charge of 0.2 x $X. The master account associated with the condominium subdivision will not receive a gross area charge.

Each municipal jurisdiction may have a different fee predicated upon the municipal jurisdiction's revenue needs. The stormwater service fee rates shall be adopted by the municipal jurisdictions and may be amended from time to time by the individual governing body.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-109. Exemptions and credits applicable to stormwater service fees.

Except as provided in this section, no public or private property shall be exempt from stormwater utility service fees. No exemption, credit, offset, or other reduction in stormwater service fees shall be granted based on the age, tax, or economic status, race, or religion of the customer, or other condition unrelated to the stormwater management utility's cost of providing stormwater programs, services, systems, and facilities. A stormwater management utility service fee credit manual shall be prepared by the public works director specifying the design and performance standards of on-site stormwater services, systems, facilities, and activities that qualify for application of a service fee credit, and how such credits shall be calculated.

(a) *Credits.* The following types of credits against stormwater service fees shall be available:

(1) Freshwater wetlands. All properties except those classified as detached single-family dwelling units may receive a credit against the stormwater service fee applicable to the property based on granting and dedicating a perpetual conservation easement on those portions of the property that are classified as freshwater wetlands and as detailed in the stormwater management utility service fee credit manual. The conservation easement shall remove that portion of the subject property from any future development.

(2) Salt water marsh. All properties except those classified as detached single-family dwelling units may receive a credit against the stormwater service fee applicable to the property based on those portions of the property that are classified as salt water marsh and as detailed in the stormwater management utility service fee credit manual.

(3) Submerged properties. All properties may receive a credit against the stormwater service fee applicable to the property based on those portions of the property that are classified as submerged and as detailed in the stormwater management utility service fee credit manual.

(4) Those properties that apply for consideration of an adjustment shall satisfy the requirements established by the Beaufort County Public Works Director or his/her designee and approved reduced stormwater service fee.

(b) *Exemptions.* The following exemptions from the stormwater service fees shall be allowed:

(1) Improved public road rights-of-way that have been conveyed to and accepted for maintenance by the state department of transportation and are available for use in common for vehicular transportation by the general public.

(2) Improved public road rights-of-way that have been conveyed to and accepted for maintenance by Beaufort County and are available for use in common for vehicular transportation by the general public.

(3) Improved private roadways that are shown as a separate parcel of land on the most current Beaufort County tax maps and are used by more than one property owner to access their property.

(4) Improved private roadways that are not shown as a separate parcel of land on the most current Beaufort County tax maps but are used by more than one property owner to access their property.

(5) Railroad tracks shall be exempt from stormwater service fees. However, railroad stations, maintenance buildings, or other developed land used for railroad purposes shall not be exempt from stormwater service fees.

(6) Condominium boat slips shall be exempt from stormwater service fees.

(7) Properties determined by the assessor having 100 percent of the gross area of the property submerged, salt water marsh, or freshwater wetland will not receive an administrative charge, if applicable in the utility rate structure, after the applicable credit defined in paragraph (a) above has been applied to the account.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2020/18, 5-26-2020 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-110. Stormwater service fee billing, delinquencies and collections.

(a) *Method of billing.* A stormwater service fee bill may be attached as a separate line item to the county's property tax billing or may be sent through the United States mail or by alternative means, notifying the customer of the amount of the bill, the date the fee is due (January 15), and the date when past due (March 17 - see Title 12, Section 45-180 of the South Carolina State Code). The stormwater service fee bill may be billed and collected along with other fees, including, but not limited to, the Beaufort County property tax billing, other Beaufort County utility bills, or assessments as deemed most effective and efficient by the Beaufort County Council. Failure to receive a bill is not justification for non-payment. Regardless of the party to whom the bill is initially directed, the owner of each parcel of land shall be ultimately obligated to pay such fees and any associated fines or penalties, including, but not limited to, interest on delinquent service fees. If a customer is under-billed or if no bill is sent for a particular property, Beaufort County may retroactively bill for a period of up to one-year, but shall not assess penalties for any delinquency during that previous unbilled period.

(b) *Declaration of delinquency.* A stormwater service fee shall be declared delinquent if not paid within 60 days of the date of billing or upon the date (March 17) of delinquency of the annual property tax billing if the stormwater service fee is placed upon the annual property tax billing or enclosed with or attached to the annual property tax billing.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-111. Appeals.

Any customer who believes the provisions of this article have been applied in error may appeal in the following manner and sequence:

(a) An appeal of a stormwater service fee must be filed in writing with the Beaufort County Public Works Director, or his/her designee within 30 days of the fee being mailed or delivered to the property owner and stating the reasons for the appeal. In the case of stormwater service fee appeals, the appeal shall include a survey prepared by a registered land surveyor or professional engineer containing information on the impervious surface area and any other feature or conditions that influence the development of the property and its hydrologic response to rainfall events.

(b) Using information provided by the appellant, the county public works director or his/her designee shall conduct a technical review of the conditions on the property and respond to the appeal in writing within 30 days after receipt of the appeal. In response to an appeal, the county public works director or his/her designee may adjust the stormwater service fee applicable to the property in conformance with the general purposes and intent of this article.

(c) A decision of the public works director or his/her designee that is adverse to an appellant may be further appealed to the county administrator or his/her designee within 30 days of the adverse decision. The appellant, stating the grounds for further appeal, shall deliver notice of the appeal to the county administrator or his designee. The county administrator or his designee shall issue a written decision on the appeal within 30 days. All decisions by the county administrator or his designee shall be served on the customer personally or by registered or certified mail, sent to the billing address of the customer. All decisions of the county administrator or his designee shall be final.

(d) The appeal process contained in this section shall be a condition precedent to an aggrieved customer seeking judicial relief. Any decisions of the county administrator or his designee may be reviewed upon application for writ of certiorari before a court of competent jurisdiction, filed within 30 days of the date of the service of the decision.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-112. No suspension of due date.

No provision of this article allowing for an administrative appeal shall be deemed to suspend the due date of the service fee with payment in full. Any adjustment in the service fee for the person pursuing an appeal shall be made by refund of the amount due.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-113. Enforcement and penalties.

Any person who violates any provision of this article may be subject to a civil penalty of not more than $1,000.00, or such additional maximum amount as may become authorized by state law, provided the owner or

other person deemed to be in violation has been notified of a violation. Notice shall be deemed achieved when sent by regular United States mail to the last known address reflected on the county tax records, or such other address as has been provided by the person to the county. Each day of a continuing violation may be deemed a separate violation. If payment is not received or equitable settlement reached within 30 days after demand for payment is made, a civil action may be filed on behalf of the county in the circuit court to recover the full amount of the penalty. This provision on penalties shall be in addition to and not in lieu of other provisions on penalties, civil or criminal, remedies and enforcement that may otherwise apply.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-114. Investment and reinvestment of funds and borrowing.

Funds generated for the stormwater management utility from service fees, fees, rentals, rates, bond issues, other borrowing, grants, loans, and other sources shall be utilized only for those purposes for which the utility has been established as specified in this article, including, but not limited to: regulation; planning; acquisition of interests in land, including easements; design and construction of facilities; maintenance of the stormwater system; billing and administration; water quantity and water quality management, including monitoring, surveillance, private maintenance inspection, construction inspection; public information and education, and other activities which are reasonably required. Such funds shall be invested and reinvested pursuant to the same procedures and practices established by Title 12, Section 45-70 of the South Carolina State Code for investment and reinvestment of funds. County council may use any form of borrowing authorized by the laws of the State of South Carolina to fund capital acquisitions or expenditures for the stormwater management utility. County council, in its discretion and pursuant to standard budgetary procedures, may supplement such funds with amounts from the general fund.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-115. Responsibilities of the stormwater management utility.

The county stormwater management utility shall perform adequate studies throughout the area served by the utility to determine the following:

(1) Baseline study of water quality in the receiving waters;

(2) Identification of pollutants carried by stormwater runoff into the receiving waters;

(3) Recommended mitigation efforts to address pollutants carried by stormwater runoff into the receiving waters;

(4) Inventory of the existing drainage system;

(5) Recommended maintenance practices and standards of the existing drainage system;

(6) Identification of capital improvements to the system to include construction or installation of appropriate BMPs;

(7) A five-year spending plan;

(8) Ensure compliance with the federally mandated MS4 permit requirements;

(9) Efficient utility administration including, but not limited to, billing, collection, defining rate structures, data management and customer support.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-116. Stormwater management utility board.

(1) *Purpose.* In compliance with and under authority of Beaufort County Ordinance 2001/23, the Beaufort County Council hereby establishes the stormwater management utility board (hereinafter referred to as the "SWU board") to advise the council as follows:

(a) To determine appropriate levels of public stormwater management services for residential, commercial, industrial and governmental entities within Beaufort County;

(b) To recommend appropriate funding levels for provision of services in the aforementioned sectors;

(c) To advise the staff of the stormwater management utility on master planning efforts and cost of service/rate studies; and

(d) To support and promote sound stormwater management practices that mitigates non-point source pollution and enhances area drainage within Beaufort County.

Municipal councils are encouraged to organize similar boards to advise them on stormwater management programs and priorities within their boundaries.

In keeping with discussions held during the formation of the stormwater utility, it is anticipated that the municipalities will appoint staff professionals as their representative on the advisory board.

(2) *Stormwater districts.* Stormwater districts are hereby established as follows:

District 1 - City of Beaufort

District 2 - Town of Port Royal

District 3 - Town of Hilton Head Island

District 4 - Town of Bluffton

District 5 - Unincorporated Sheldon Township

District 6 - Unincorporated Port Royal Island

District 7 - Unincorporated Lady's Island

District 8 - Unincorporated St. Helena Island Islands East

District 9 - Unincorporated Bluffton Township and Daufuskie Island

(3) Membership.

(a) The SWU board is formed in accordance with Beaufort County Ordinance 92-28 and shall consist of a total of seven voting representatives from each of the following districts as noted below:

No. of Reps.	Stormwater District	Area
1	5	Unincorporated Sheldon Township
1	6	Unincorporated Port Royal Island
1	7	Unincorporated Lady's Island
1	8	Unincorporated St. Helena Island Islands East
2	9	Unincorporated Bluffton Township and Daufuskie Island
1	—	"At large"

All members of the SWU board will be appointed by county council and shall be residents of those districts or "at large" members from unincorporated Beaufort County.

(b) The SWU board shall also consist of one nonvoting (ex officio) representative from the following districts:

Stormwater District	Municipality
1	City of Beaufort
2	Town of Port Royal
3	Town of Hilton Head Island
4	Town of Bluffton

All ex officio members from municipalities shall be appointed by their respective municipal councils for four-year terms.

(c) All citizen members shall be appointed for a term of four years. The terms shall be staggered with one or two members appointed each year.

(d) While no other eligibility criteria is established, it is recommended that members possess experience in one or more of the following areas: Stormwater management (drainage and water quality) issues, strategic planning, budget and finance issues or established professional qualifications in engineering, construction, civil engineering, architectural experience, commercial contractor or similar professions.

(4) Officers.

(a) *Officers.* Selection of officers and their duties as follows:

1. *Chairperson and vice-chair.* At an annual organizational meeting, the members of the SWU board shall elect a chairperson and vice-chairperson from among its members. The chair's and vice-chair's terms shall be for one year with eligibility for reelection. The chair shall be in charge of all procedures before the SWU board, may administer oaths, may compel the attendance of witnesses, and shall take such action as shall be necessary to preserve order and the integrity of all proceedings before the SWU board. In the absence of the chair, the vice-chair shall act as chairperson.

2. *Secretary.* The county professional staff member shall appoint a secretary for the SWU board. The secretary shall keep minutes of all proceedings. The minutes shall contain a summary of all proceedings before the SWU board, which include the vote of all members upon every question, and its recommendations, resolutions, findings and determinations, and shall be attested to by the secretary. The minutes shall be approved by a majority of the SWU board members voting. In addition, the secretary shall maintain a public record of SWU board meetings, hearings, proceedings, and correspondence.

3. *Staff.* The public works director shall be the SWU board's professional staff.

(b) *Quorum and voting.* Four SWU board members shall constitute a quorum of the SWU board necessary to take action and transact business. All actions shall require a simple majority of the number of SWU board members present.

(c) *Removal from office.* The county council, by a simple majority vote, shall terminate the appointment of any member of the SWU board and appoint a new member for the following reasons:

1. Absent from more than one-third of the SWU board meetings per annum, whether excused or unexcused;

2. Is no longer a resident of the county;

3. Is convicted of a felony; or

4. Violated conflict of interest rules.

Moreover, a member shall be removed automatically for failing to attend any three consecutive regular meetings.

(d) *Vacancy.* Whenever a vacancy occurs on the SWU board, the county council shall appoint a new member within 60 days of the vacancy, subject to the provisions of this section. A new member shall serve out the former member's term.

(e) *Compensation.* The SWU board members shall serve without compensation, but may be reimbursed for such travel, mileage and/or per diem expenses as may be authorized by the county council-approved budget.

(5) Responsibilities and duties.

(a) Review and recommend to the county council for approval, a comprehensive Beaufort County Stormwater Management Master Plan and appropriate utility rate study which is in accordance with the South Carolina Stormwater Management and Sediment Reduction Act; and

(b) Review and comment to the county administrator on the annual stormwater management utility enterprise fund budget; and

(c) Cooperate with the South Carolina Department of Health and Environmental Control (DHEC), Office of Coastal Resource Management (OCRM), the Oversight Committee of the Special Area Management Plan (SAMP), the Beaufort County Clean Water Task Force as well as other public and private agencies having programs directed toward stormwater management programs; and

(d) Review and make recommendations concerning development of a multiyear stormwater management capital improvement project (CIP) plan; and

(e) Review and advise on proposed stormwater management plans and procurement procedures; and

(f) Provide review and recommendations on studies conducted and/or funded by the utility; and

(g) Review and advise on actions and programs to comply with regulatory requirements, including permits issued under the State of South Carolina National Pollutant Discharge Elimination System (NPDES) general permit for stormwater discharges from regulated small municipal separate storm sewer systems (MS4).

(6) *Meetings.* Meetings of the SWU board shall be held as established by the SWU board and county staff on a quarterly and an as needed basis and a calendar will be prepared giving the date, time and location of such meetings. Additionally, meetings may be called by the chairperson or at the request of county staff. The location of all SWU board meetings shall be held in a public building in a place accessible to the public. The following shall apply to the conduct of all meetings:

(a) *Meeting records.* The SWU board shall keep a record of meetings, resolutions, findings, and determinations. The SWU board may provide for transcription of such hearings and proceedings, or portions of hearings and proceedings, as may be deemed necessary.

(b) *Open to public.* All meetings and public hearings of the SWU board shall be open to the public.

(c) *Recommendations or decisions.* All recommendations shall be by show of hands of all members present. A tie vote or failure to take action shall constitute a denial recommendation. All recommendations shall be accompanied by a written summary of the action and recommendations.

(d) *Notice and agenda.* The SWU board must give written public notice of regular meetings at the beginning of each calendar year. The SWU board must post regular meeting agendas at the meeting place 24 hours before any meeting. Notices and agenda for call, special or rescheduled meetings must

be posted at least 24 hours before such meetings. The SWU board must notify any persons, organizations and news media that request such notification of meetings.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Secs. 99-117—99-199. Reserved.

ARTICLE III. REGULATORY GENERAL PROVISIONS

Sec. 99-200. Authority.

This article is adopted pursuant to the authority conferred upon the Beaufort County (county) by the South Carolina Constitution, the South Carolina General Assembly and in accordance with Federal Clean Water Act, the South Carolina Pollution Control Act, and regulations promulgated there under.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-201. Findings.

The county council makes the following findings:

(a) Beaufort County's waters contain some of the few remaining pristine shellfish harvesting areas in the southern coastal counties of South Carolina. Many of its waters have been designated by the State of South Carolina as Outstanding Resource Waters. This use has historical and traditional significance to the area. It is in the public interest that the condition of these areas be maintained and preserved for future generations. Uncontrolled stormwater runoff may have significant, adverse impact on the health, safety and general welfare of the county and the quality of life of its citizens by transporting pollutants into receiving waters and by causing erosion and/or flooding. Development and redevelopment may alter the hydrologic response of local watersheds and increases stormwater runoff rates and volumes, flooding, soil erosion, stream channel erosion, non-point pollution, and sediment transport and deposition, as well as reducing groundwater recharge. These changes in stormwater runoff may contribute to increased quantities of water-borne pollutants and alterations in hydrology which are harmful to public health, safety, and welfare, as well as to the natural environment.

(b) Point source pollution may have significant, adverse impact on the health, safety and general welfare of the county and the quality of life of its citizens by transporting pollutants into receiving waters. The allowance of discharge pipes and outfalls for non-stormwater discharges, illegal dumping, and improper handling of accidental spills and intentional disposals increase the quantities of water-borne pollutants which are harmful to public health, safety, and welfare, as well as to the natural environment.

(c) The effects of point and non-point source pollution, such as uncontrolled runoff, have shown evidence of degradation of the county's receiving waters; thereby adversely affecting the unique qualities of the county's receiving waters, its recreational opportunities and commercial, oystering, boating and fishing, the ecosystem's ability to naturally reproduce and thrive, and the general ability of the area to sustain its natural estuarine resources.

(d) These deleterious effects can be managed and minimized by applying proper design and well-planned controls to manage stormwater runoff from development and redevelopment sites, manage existing natural features that maintain hydrology and provide water quality control, and eliminate potential sources of pollution to receiving waters. Public education regarding the cause and effect of these types

of pollutions and the implementation of the controls and management policies is key to fundamentally changing public behavior.

(e) This article is not in conflict with any development agreements to which the county is a party and does not prevent the development set forth in any development agreement unless impairments to the county's receiving waters is linked to this development.

(f) This article is essential to the public health, safety or welfare and shall apply to any development that is subject to a development agreement.

(g) Laws of general application throughout the county necessary to protect health, safety and welfare are anticipated and are provided for in development agreements.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-202. Purpose.

(a) It is the purpose of this article to guide development in Beaufort County to protect, maintain, and enhance the environment of the county and the short- and long-term public health, safety, and general welfare of the citizens of the county by establishing requirements and procedures to control the potential adverse effects of increased stormwater runoff associated with both future development, re-development, and existing developed land. Proper management of stormwater runoff will minimize damage to public and private property, ensure a functional drainage system, reduce the effects of development on land and stream channel erosion, attain and maintain water quality standards, enhance the local environment associated with the drainage system, reduce local flooding, reduce pollutant loading to the maximum extent practicable and maintain to the extent practicable the pre-developed runoff characteristics of the area, and facilitate economic development while minimizing associated pollutant, flooding, and drainage impacts.

(b) This article specifically authorizes and enables the county to:

(1) Prohibit illicit discharges to the stormwater system and receiving waters.

(2) Define procedures for site plan design, review, inspection, and enforcement relative to stormwater management. Establish decision-making processes surrounding land development or redevelopment activities that protect the integrity of local aquatic resources.

(3) Control the discharge of spills, dumping or disposal of materials other than stormwater to the stormwater system and receiving waters.

(4) Address specific categories of non-stormwater discharges and similar other incidental non-stormwater discharges.

(5) Control importation of water that adversely impacts our receiving waters.

(6) Require temporary erosion and sediment controls to protect water quality to the maximum extent practicable during construction activities, in accordance with current state regulations.

(7) Define procedures for receipt and consideration of information submitted by the public.

(8) Address runoff, particularly volume, rate, and quality through the control and treatment of stormwater with stormwater management facilities and/or best management practices (BMPs).

(9) Develop post-construction stormwater quality performance standards, through enforcement of minimum design standards for BMPs.

(10) Ensure effective long-term operation and maintenance of BMPs.

(11) Carry out all inspection, surveillance, monitoring, and enforcement procedures necessary to determine compliance and noncompliance with this article and stormwater permit conditions including the prohibition of illicit discharges to the county's stormwater system and the protection of water quality of the receiving waters.

(12) Development, implement, and enforce regulations any and all other programs or policies to comply with the Municipal Separate Stormsewer System (MS4) permit issued by South Carolina Department of Health and Environmental Control (DHEC).

(13) Establish design criteria in the most current version of the Southern Lowcountry Stormwater Design Manual for structural and nonstructural stormwater management practices that can be used to meet the minimum post-development stormwater management standards and design criteria;

(14) Establish that Better Site Design (BSD) and site planning has been incorporated, documented, and presented in the development/redevelopment design process.

(15) Maintain structural and nonstructural stormwater management practices to ensure that they continue to function as designed and pose no threat to public safety.

(16) Streamline administrative procedures for the submission, review, approval and disapproval of stormwater management plans and for the inspection of approved land development projects.

(17) If any of the stormwater management standards, as defined in this chapter and in the most current version of the Southern Lowcountry Stormwater Design Manual cannot be attained on the site (due to impractical site characteristics or constraints), a maximum extent practicable analysis shall be prepared and submitted by the applicant for review, discussion, and ultimate approval or rejection of the jurisdiction. Any uncontrolled post-development stormwater quantity or quality volume shall be intercepted and treated in one or more off-site stormwater management practices or a fee-in-lieu shall be required.

(18) The stormwater management practices of approved plans shall provide volume control and at least an 80 percent reduction in total suspended solids loads, 30 percent reduction of total nitrogen load, and 60 percent reduction in bacteria load.

(c) The article requires prudent site planning, including special considerations for the purposes of preserving natural drainage ways incorporating on-site stormwater detention and infiltration to minimize runoff from individual sites to receiving waters by use of effective runoff management, structural and non-structural BMPs, drainage structures, and stormwater facilities. Establish that better site design (BSD) and site planning has been incorporated, documented, and presented in the development/redevelopment design process.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-203. Definitions.

The following definitions shall apply in articles III, IV, V, and VI this chapter. Any term not herein defined shall be given the definition, if any, as is found elsewhere in the Code of Ordinances of Beaufort County, including the community development code (CDC) ordinance.

Administrators. The public works director, the stormwater manager and other individuals designated by the county administrator, from time to time, to administer interpret and enforce this article.

Best management practices ("BMP"). Stormwater management practices, either structural, non-structural or natural that has been demonstrated to effectively control movement of stormwater, pollutants, prevent degradation of soil and water resources, and that are compatible with the planned land use.

Clean Water Act. The Federal Water Pollution Control Act, as amended, codified at 33 U.S.C § 1251 et seq.

Community development code ("CDC"). A form based code to regulate zoning and development in Beaufort County.

County. The Beaufort County, South Carolina.

County council. The publicly elected official of Beaufort County, South Carolina.

Department. The stormwater department, or any duly authorized representatives thereof as designated by the county administrator.

Development. All project construction, modification, or use of any lot, parcel, building, or structure on land and on water. Existing dirt roads which are improved and/or paved as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 and existing private dirt roads which are improved or paved and where the project is not related to a pending or proposed development of adjacent land are deemed not to constitute "development".

Disconnected impervious areas or disconnected impervious surfaces. Those non-contiguous impervious areas or impervious surfaces which produce stormwater runoff that discharges through or across a pervious area or surface (i.e. vegetated cover), of sufficient width to reduce or eliminate pollutants associated with stormwater runoff, prior to discharge to the stormwater system.

Environment. The complex of physical, chemical, and biotic factors that act upon an ecological community and ultimately determine its form and survival.

Evapotranspiration. The sum of evaporation and plant transpiration from the earth's land surface to atmosphere.

Excess stormwater volume. The additional volume of stormwater runoff leaving the site over and above the runoff volume which existed pre-development.

Illicit connection. A connection to the county's stormwater system or receiving water which results in a discharge that is not composed entirely of stormwater runoff and has a detrimental effect on the stormwater system or receiving water except, those granted coverage by an active NPDES permit.

Illicit discharge. Any activity, which results in a discharge to the county's stormwater system or receiving waters that is not composed entirely of stormwater except:

(a) Discharge pursuant to an NPDES permit; and

(b) Other allowable discharges as defined and exempted in this article.

Impervious surface. As defined in the county's best management practices (BMP) manual.

Improper disposal. Any disposal through an illicit discharge, including, but not limited to, the disposal of used oil and toxic materials resulting from the improper management of such substances.

Land disturbance or *land disturbing activity.* The use of land by any person that results in a change in the natural vegetated cover or topography, including clearing that may contribute to or alters the quantity and/or quality of stormwater runoff.

Maintenance. Any action necessary to preserve stormwater management facilities in proper working condition, in order to serve the intended purposes set forth in this article and to prevent structural failure of such facilities.

MS4. Municipal separate storm sewer system.

NPDES. National Pollutant Discharge Elimination System (see "Clean Water Act.")

Natural resources. Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources.

Outfall. The point where county's stormwater system discharges to waters of the United States or the State of South Carolina.

Person. Any and all persons, natural or artificial and includes any individual, association, firm, corporation, business trust, estate, trust, partnership, two or more persons having a joint or common interest, or an agent or employee thereof, or any other legal entity.

Pollutant. Those manmade or naturally occurring constituents that when introduced to a specific environment creates a deleterious effect. Typical pollutants found in stormwater include, but are not limited to, sediment (suspended and dissolved), nutrients (nitrogen and phosphorus, etc.), oxygen demanding organic matter, heavy metals (iron, lead, manganese, etc.), bacteria and other pathogens, oil and grease, household hazardous waste (insecticide, pesticide, solvents, paints, etc.) and polycyclic aromatic hydrocarbons (PAHs).

Property owner or *owner.* The legal or equitable owner of land.

Receiving waters. All natural water bodies, including oceans, salt and freshwater marsh areas, lakes, rivers, streams, ponds, wetlands, and groundwater which are located within the jurisdictional boundaries of the county. Stormwater management ponds, manmade wetlands, ditches, and swales constructed for the sole purpose of controlling and treating stormwater are not considered receiving waters.

Record drawings. A set of drawings prepared by and certified by a South Carolina registered professional engineer or landscape architect that accurately represents the actual final configuration of the stormwater and other related infrastructure constructed in a development.

Redevelopment. As defined in the county's best management practices (BMP) manual.

Regulation. Any regulation, rule or requirement and promulgated by the county pursuant to this article.

Southern Lowcountry Stormwater Design Manual. "The Manual for Stormwater Best Management and Design Practices (BMP)" establishes technical standards as referenced and incorporated into the community development code (CDC).

Stormwater. Stormwater runoff, precipitation runoff, and surface runoff.

Stormwater management. The collection, conveyance, storage, treatment and disposal of stormwater in a manner to meet the objectives of this article and its terms, including, but not limited to, measures that control the increased volume and rate of stormwater runoff and water quality impacts caused by manmade changes to the land.

Stormwater management program, services, systems facilities. Those administrative, engineering, operational, regulatory, and capital improvement activities and functions performed in the course of managing the stormwater systems of the county, plus all services. Stormwater management systems and facilities are those natural and manmade channels, swales, ditches, swamps, rivers, streams, creeks, branches, reservoirs, ponds, drainage ways, inlets, catch basins, pipes, head walls, storm sewers, lakes, and other physical works, properties, and improvements which transfer, control, convey or otherwise influence the movement of stormwater runoff and its discharge to and impact upon receiving waters.

Stormwater management plan or *SWMP.* The set of drawings and other documents that comprise all of the information and specifications for the programs, drainage systems, structures, BMPs, concepts, and techniques for the control of stormwater.

Stormwater pollution prevention plan or *SWPPP.* Erosion prevention and sediment control (EPSC). Also see "stormwater management plan".

Stormwater system. The conveyance or system of conveyances (including roads with drainage systems, highways, right-of-way, private streets, catch basins, curbs, gutters, ditches, manmade channels, storm drains, detention ponds, and other stormwater facilities) which is designed or used for collecting or conveying stormwater.

Structural best management practices ("BMP"). A device designed and constructed to trap and filter pollutants from runoff.

Total impervious surface. All impervious surfaces on a site regardless if they are directly connected to another and that is not constructed using permeable pavement technology.

Utility. Beaufort County Stormwater Utility as established by county article chapter 99, article II.

Waiver. The modification of the minimum stormwater management requirements contained in these articles and the most current version of the Southern Lowcountry Stormwater Design Manual for specific circumstances where strict adherence of the requirements would result in unnecessary hardship and not fulfill the intent of this article.

Water quality. Those characteristics of stormwater runoff that relate to the physical, chemical, biological, or radiological integrity of water.

Water quantity. Those characteristics of stormwater runoff that relate to the rate and volume of the stormwater runoff.

Wetlands. As defined by the Army Corps of Engineers and generally means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar type areas.

Working day. Monday through Friday, excluding all county-observed holidays.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2018/6 , 3-12-2018; Ord. No. 2020/18 , 5-26-2020; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-204. Applicability.

Beginning with and subsequent to its effective date, this article shall be applicable to:

(a) All development and redevelopment.

(b) Any illicit discharges.

(c) The provisions of this article shall apply throughout the unincorporated areas of the county.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-205. Regulations.

The county council, may, in its discretion, amend or change this article, or adopt additional regulations to implement this article in order to comply with the state regulations, administer the stormwater management department, or to otherwise further the goal of protecting the quality of the receiving waters into which the stormwater system discharges.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-206. County stormwater management administration.

Stormwater management will be administered by the public works department and the stormwater department to administer and implement the regulations of this article as set forth in the most current version of the Southern Lowcountry Stormwater Design Manual. The manual may include design standards, procedures and

criteria for conducting hydrologic, hydraulic, pollutant load evaluations, and downstream impact for all components of the stormwater management system. It is the intention of the manual to establish uniform design practices; however, it neither replaces the need for engineering judgment nor precludes the use of information not submitted. Other accepted engineering procedures may be used to conduct hydrologic, hydraulic and pollutant load studies if approved by the public works director.

The manual will contain at a minimum the following components:

(a) Construction activity application contents and approval procedures;

(b) Construction completion and closeout processes;

(c) Hydrologic, hydraulic, and water quality design criteria (i.e., design standards) for the purposes of controlling the runoff rate, volume, and pollutant load. Suggested reference material shall be included for guidance in computations needed to meet the design standards;

(d) Information and requirements for new and re-development projects in special protection areas necessary to address TMDLs, known problem areas and other areas necessary to protect, maintain, and enhance water quality and the environment of Beaufort County and the public health, safety, and general welfare of the citizens of Beaufort County.

(e) Construction document requirements;

(f) Long-term maintenance and maintenance plan;

(g) Minimum easement requirements;

(h) Required and recommended inspection schedules and activities for all components of the stormwater management system, including construction related BMPs.

The manual will be updated periodically to reflect the advances in technology and experience.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2020/18 , 5-26-2020; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-207. Administrators of operations, power and duties.

(a) The administrators, or designee, shall administer, implement, and enforce provisions of this article on behalf of the county.

(b) In addition to the powers and duties that may be conferred by other provisions of the county and other laws, the administrators shall have the following powers and duties under this article:

(1) To create the Southern Lowcountry Stormwater Design Manual. The manual may be used to convey design and engineering standards, construction management processes and procedures, and other aspects necessary for compliance with this chapter;

(2) To review and approve, approve with conditions, or disapprove applications for approval of a stormwater management plan pursuant to this article;

(3) To make determinations and render interpretations of this article;

(4) To establish application requirements, schedules and fees for submittal and review of applications, receipt of appeals, in accordance with the standards for county development permits and stormwater permits under the county's CDC ordinance and this article;

(5) To review and make recommendations to the applications for development or redevelopment approvals;

(6) To enforce the provisions of this article in accordance with its enforcement provisions;

(7) To maintain records, maps, and official materials related enforcement, or administration of this article;

(8) To provide expertise and technical assistance;

(9) To take any other action necessary to administer the provisions of this article.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-208. Coordination with other agencies.

The administrators will coordinate the county's activities with other federal, state, and local agencies, which manage and perform functions relating to the protection of receiving waters.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-209. Cooperation with other governments.

The county may enter into agreements with other governmental and private entities to carry out the purposes of this article. These agreements may include, but are not limited to, enforcement, resolution of disputes, cooperative monitoring, and cooperative management of stormwater systems and cooperative implementation of stormwater management programs.

Nothing in this article or in this section shall be construed as limitation or repeal of any ordinances of these local governments or of the powers granted to these local governments by the South Carolina Constitution or statues, including, without limitation, the power to require additional or more stringent stormwater management requirements within their jurisdictional boundaries.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-210. Stormwater management standards.

(a) Reference to best management practices can be found in the most current version of the Southern Lowcountry Stormwater Design Manual. The administrators shall use the policy, criteria, and information, including technical specifications and standards, in the most current version of the Southern Lowcountry Stormwater Design Manual as the basis for decisions about stormwater plans and about the design, implementation and performance of structural and non-structural stormwater systems. The stormwater management standards shall describe in detail how post-development stormwater runoff will be controlled and managed, the design of all stormwater facilities and practices, and how the proposed project will meet the requirements of this article. The most current version of the Southern Lowcountry Stormwater Design Manual includes a list of acceptable stormwater treatment practices, including the specific design criteria for each stormwater practice. These standards will be updated as technology improves.

(b) Relationship of stormwater management standards to other laws and regulations. If the specifications or guidelines of the standards are more restrictive or apply a higher standard than other laws or regulations, that fact shall not prevent application of the specifications or guidelines in the standards.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-211. Review of stormwater management plans.

Stormwater management plans shall be reviewed as a component of the development plan review process by the administrators. They will be reviewed for compliance with standards in this article and requirements in the

CDC and the most current version of the Southern Lowcountry Stormwater Design Manual Procedures are outlined in the most current version of the Southern Lowcountry Stormwater Design Manual. Requests for meetings and submission of plans will be submitted to stormwater department. The expected process will be in accordance with the standard procedures for applications described in the community development code.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-212. Approvals.

(a) *Effect of approval.* Approval authorizes the applicant to go forward with only the specific plans and activity authorized in the plan. The approval shall not be construed to exempt the applicant from obtaining other applicable approvals from local, state, and federal authorities.

(b) *Time limit/expiration.* Time limit, expiration and extensions shall be in accordance with the county's community development code.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-213. Appeals.

(a) *Scope of appeal.* Any person aggrieved by a decision of the administrators may appeal the same by filing an interim written notice of appeal, with the administrators within 30 days of the issuance of said decision or notice of violation. The interim notice of appeal must specify with reasonable practicality the grounds of the appeal and relief sought. The stormwater management utility board (SWUB) will review and provide a decision within 15 days after the next scheduled board meeting following the appeal. The decision of the SWUB shall be final. Appeals to SWUB's decision shall be processed in accordance with state law.

(b) Standards.

(1) The SWUB is limited to the following determinations for an administrative appeal:

a. The administrators made an error in reviewing whether a standard was met. The record must indicate that an error in judgment occurred or facts, plans, or regulations were misread in determining whether the particular standard was met.

b. Where conflicting evidence exists, the appeal is limited to determining what evidence or testimony bears the greatest credibility in terms of documentation and qualifications of those making the determination.

c. The administrators made the decision on standards not contained in this chapter or other county ordinances, regulations, or state law, or a standard more strict or broad was applied. This chapter does not permit administrators to consider or create standards not officially adopted.

d. An error in applying a standard or measuring a standard was made.

(2) The board, on an appeal, shall not hear any evidence or make any decision based on financial hardships.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-214—99-299. Reserved.

ARTICLE IV. STORMWATER MANAGEMENT STANDARDS TO BE APPLIED

Sec. 99-300. General requirements.

(a) All development and redevelopment, including highways, shall use site planning, design, construction. and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume and duration of flow.

(b) All development shall connect impervious surfaces to vegetative surfaces to the maximum extent practicable.

(c) Stormwater runoff shall be controlled in a manner that:

(1) Promotes positive drainage from structures resulting from development.

(2) Includes the use of vegetated conveyances, such as swales and existing natural channels to promote infiltration and evapotranspiration.

(3) Reduces runoff velocities and maintains sheet flow condition to prevent erosion and promote infiltration.

(4) Limits its interaction with potential pollutant sources that may become water-borne and create non-point source pollution.

(5) Promotes reuse of excess stormwater volume to increase evapotranspiration.

(d) Natural vegetative buffers play an integral part in minimizing the volume of stormwater runoff by promoting infiltration and increasing evaportranspiration to reduce stormwater volume to receiving waters and acting as a first line of treatment of water quality pollution. Development shall observe the buffer requirements of the county's CDC ordinance or if applicable the relevant development agreement, concept plan, and/or approved master plan.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-301. Stormwater design requirements for development.

Developments which incorporates engineered stormwater collection, conveyance, and storage systems shall be designed to the criteria established in the ~~latest~~ most current version of county's Southern Lowcountry Stormwater Design Manual.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-302. BMP requirements.

(a) Effectiveness of infiltration practices is dependent on the site conditions. The most current version of the Southern Lowcountry Stormwater Design Manual outlines guidance for properly siting infiltration practices and shall be reviewed prior to the design phase.

(b) The owners of all new developments that receive a stormwater permit from the county shall be required to perform stormwater quantity monitoring at their expense to ensure compliance with the provisions of this article and ensure that volume reduction plans are operated as intended.

(c) All construction and implementation of erosion and sediment control BMPs shall comply with the requirements of the South Carolina Stormwater Management and Sediment Reduction Act and submit reports in accordance with the most current version of the Southern Lowcountry Stormwater Design Manual.

(d) The county reserves the right to perform other monitoring as it deems appropriate to determine compliance with the State Sediment and Erosion Control Act.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-303. Reserved.

(Ord. No. 2016/38 , 10-24-2016)

Sec. 99-304. Waiver.

Individuals seeking a waiver in connection with a stormwater plan may submit to the public works director a request for a waiver from the requirements of this article if exceptional circumstances applicable to a site exist, such that the applicant can provide rational documentation and justification to support a waiver.

Waivers may be granted for water quantity control only and best management practices to achieve water quality goals will still be required.

(a) *Request of waiver at staff level.* A written request for a waiver is required and shall state the specific waiver sought and the reasons, with supporting data, a waiver should be granted. The request shall include all information necessary to evaluate the proposed waiver. Requests must outline the need for such a waiver, such as site constraints, soil characteristics, or similar engineering limitations. Cost shall not be considered cause for a waiver. The applicant will address the four areas of consideration for waiver approval as follows:

(1) What exceptional circumstances to the site are evident?

(2) What unnecessary hardship is being caused?

(3) How will denial of the waiver be inconsistent with the intent of the ordinance?

(4) How will granting waiver comply with intent of ordinance?

(b) *Review of waivers.* The administrators will conduct a review of the request and will issue a decision within 15 working days of receiving the request.

(c) *Appeal of decision.* Any person aggrieved by the decision of the administrators concerning a waiver request may appeal such decision in accordance with section 99-213 above.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-305. Maintenance; general requirements.

(a) *Function of BMPs as intended.* The owner of each structural BMP installed pursuant to this article shall maintain and operate it to preserve and continue its function in controlling stormwater quality and quantity at the degree or amount of function for which the structural BMP was designed.

(b) *Right of county to inspection.* Every structural BMP installed pursuant to this article shall be made accessible for adequate inspection by the county.

(c) *Annual maintenance inspection and report.* The person responsible for maintenance of any structural BMP installed pursuant to this article shall submit to the administrator(s) an inspection report from a qualified inspector or registered South Carolina Professional Engineer. The inspection report, at a minimum, shall contain all of the following:

(1) The name and address of the land owner;

(2) The recorded book and page number of the lot of each structural BMP or a digital representation of the geographic location of each structural BMP;

(3) A statement that an inspection was made of all structural BMPs;

(4) The date the inspection was made;

(5) A statement that all inspected structural BMPs are performing properly and comply with the terms and conditions of the approved maintenance agreement required by this article;

(6) The original signature and seal of the engineer inspecting the structural BMPs; and

(7) Digital photographs of the structural BMPs and pertinent components integral to its operation, including, but not limited to, inlet/outlet control structures, downstream receiving channel/area, embankments and spillways, safety features, and vegetation.

An original inspection report shall be provided to the administrators beginning one year from the date of final inspection of the completed structural BMP and each year thereafter on or before the date of the record drawings certification.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-306. Operation and maintenance agreement.

(a) Prior to the conveyance or transfer of any lot or building site requiring a structural BMP pursuant to this article, the applicant or owner of the site must execute an operation and maintenance agreement (see the most current version of the Southern Lowcountry Stormwater Design Manual for form) that shall be binding on all subsequent owners of the site, portions of the site, and lots or parcels served by the structural BMP. Until the transference of all property, sites, or lots served by the structural BMP, the original owner or applicant shall have primary responsibility for carrying out the provisions of the maintenance agreement.

(b) The operation and maintenance agreement must be approved by the administrators prior to plan approval, and it shall be referenced on the final plat and shall be recorded with the county register of deeds upon final plat approval. If no subdivision plat is recorded for the site, then the operations and maintenance agreement shall be recorded upon the approval of a certificate of completion with the county register of deeds to appear in the chain of title of all subsequent purchasers under generally accepted searching principles. A copy of the recorded maintenance agreement shall be given to the administrators within 14 days following its recordation.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-307. Deed recordation and indications on plat.

The applicable operations and maintenance agreement pertaining to every structural BMP shall be referenced on the final plat and in covenants and shall be recorded with the county register of deeds upon final plat approval.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-308. Records of installation and maintenance activities.

The owner of each structural BMP shall keep records of inspections, maintenance, and repairs for at least five years from the date of the record and shall submit the same upon reasonable request to the administrator(s).

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-309. Nuisance.

The owner of each stormwater BMP shall maintain it so as not to create or result in a nuisance condition, such as, but not limited to, flooding, erosion, excessive algal growth, overgrown vegetation, mosquito breeding habitat, existence of unsightly debris, or impairments to public safety and health. Maintenance practices must not lead to discharges of harmful pollutants.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-310—99-399. Reserved.

ARTICLE V. ILLICIT DISCHARGES AND CONNECTIONS TO THE STORMWATER SYSTEM

Sec. 99-400. Illicit discharges.

No person shall cause or allow the discharge, emission, disposal, pouring, or pumping directly or indirectly to any stormwater conveyance, receiving water, or upon the land in manner and amount that the substance is likely to reach a stormwater conveyance or the receiving waters, any liquid, solid, gas, or other substance (including animal waste), other than stormwater.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-401. Non-stormwater discharges.

(a) Non-stormwater discharges associated with the following activities are allowed provided that acceptable BMPs are followed:

(1) Water line and hydrant flushing;

(2) Landscape irrigation, unless it leads to excess SW volume discharge;

(3) Diverted stream flows;

(4) Rising ground waters;

(5) Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));

(6) Uncontaminated pumped ground water;

(7) Discharges from potable water sources (with dechlorination BMP utilized);

(8) Foundation drains;

(9) Air conditioning condensation;

(10) Reuse water;

(11) Springs;

(12) Water from crawl space pumps;

(13) Footing drains;

(14) Individual residential car washing;

(15) Flows from riparian habitats and wetlands;

(16) Dechlorinated swimming pool discharges: typically less than one part per million;

(17) Street wash water;

(18) Other non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under EPA authority, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the storm drain system;

(19) Discharges specified in writing by the authorized agency/entity, as being necessary to protect public health and safety;

(20) Dye testing is an allowable discharge, but requires a verbal notification to the authorized enforcement agency prior to the test; and

(21) Firefighting.

(22) The public works director may develop procedures for allowing other non-stormwater discharges.

(b) Prohibited substances include, but are not limited to: Oil, anti-freeze, chemicals, animal waste, paints, garbage, and litter.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-402. Illicit connections.

(a) Connections to a receiving water and/or stormwater conveyance system that allow the discharge of non-stormwater, other than the exclusions described in subsection 99-401(a) above are unlawful. Prohibited connections include, but are not limited to, floor drains, waste water from washing machines or sanitary sewers, wash water from commercial vehicle washing or steam cleaning, and waste water from septic systems.

(b) Where such connections exist in violation of this section and said connections were made prior to the adoption of this article or any other article prohibiting such connections, the property owner or the person using said connection shall remove or correct the connection immediately upon notice.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-403. Spills.

(a) Spills or leaks of polluting substances released, discharged to, or having the potential to released or discharged to a receiving water or the stormwater conveyance system, shall be immediately contained, controlled, collected, and properly disposed. All affected areas shall be restored to their preexisting condition.

(b) Persons in control of the polluting substances shall immediately report the release or discharge to persons owning the property on which the substances were released or discharged, shall within two hours of such an event notify the nearest fire department (which will also notify the administrators), and all required federal and state agencies of the release or discharge. Notification shall not relieve any person of any expenses related to the restoration, loss, damage, or any other liability which may be incurred as a result of said spill or leak, nor shall such notification relieve any person from other liability which may be imposed by state or other law.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-404. Nuisance.

Illicit discharges and illicit connections which exist within the unincorporated county are hereby found, deemed, and declared to be dangerous and prejudicial to the public health, and welfare, and are found, deemed, and declared to be public nuisances. Such public nuisances shall be abated in accordance with the procedures set forth in subsection 99-503(c) and (d).

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-405. Suspension of a MS4 discharge due to an illicit discharge.

(a) Any person discharging to the MS4 in violation of this article may have their MS4 access terminated if such termination would abate or reduce an illicit discharge. The authorized administrators notify a violator of the proposed termination of its MS4 access. The violator may petition the authorized enforcement agency for a reconsideration and hearing.

(b) A person commits a violation if the person reinstates MS4 access to premises terminated pursuant to this section, without the prior approval of the authorized administrators.

(c) The Beaufort County, South Carolina administrators may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge that presents or may present imminent and substantial danger to the environment, or to the health or welfare of persons, or to the MS4 or waters of the United States. If the violator fails to comply with a suspension order issued in an emergency, the authorized enforcement agency may take such steps as deemed necessary to prevent or minimize damage to the MS4 or waters of the United States, or to minimize danger to persons.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-406—99-499. Reserved.

ARTICLE VI. INSPECTION, ENFORCEMENT, AND CORRECTION

Sec. 99-500. Inspections.

The county administrators will maintain the right to inspect any and all stormwater systems within its jurisdiction as outlined below:

(a) An inspector designated by the administrators, bearing proper credentials and identification, may enter and inspect all properties for regular inspections, periodic investigations, monitoring, observation

measurement, enforcement, sampling and testing, to ensure compliance with the provisions of this article.

(b) Upon refusal by any property owner to permit an inspector to enter or continue an inspection, the inspector may terminate the inspection or confine the inspection to areas concerning which no objection is raised. The inspector shall immediately report the refusal and the grounds to the administrators. The administrators will promptly seek the appropriate compulsory process.

(c) In the event that the administrators or inspector reasonably believes that discharges from the property into the county's stormwater system or receiving waters may cause an imminent and substantial threat to human health or the environment, the inspection may take place at any time after an initial attempt to notify the owner of the property or a representative on site. The inspector shall present proper credentials upon reasonable request by the owner or representative.

(d) The Beaufort County, South Carolina, administrators shall have the right to set up on any permitted facility such devices as are necessary in the opinion of the authorized enforcement agency to conduct monitoring and/or sampling of the facility's stormwater discharge.

(e) The Beaufort County, South Carolina, administrators have the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure stormwater flow and quality shall be calibrated to ensure their accuracy.

(f) Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the authorized administrators and shall not be replaced. The costs of clearing such access shall be borne by the operator.

(g) Unreasonable delays in allowing the Beaufort County, South Carolina, administrators access to a permitted facility is a violation of a stormwater discharge permit and of this article. A person who is the operator of a facility with a NPDES permit to discharge stormwater associated with industrial activity commits an offense if the person denies the authorized enforcement agency reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this article.

(h) Inspection reports will be maintained in a permanent file at the offices of the administrators.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-501. Notice and warning.

(a) Upon the county's attention to a violation of this article, the administrators shall investigate the violation and prepare a report concerning the violation. If a violation exists, a notice of violation shall be delivered within five working days to any person occupying the property or linked to a discharge, whether the person is the owner, renter, or lessee. If the nature of the violation is not correctable, a stop work order shall be issued immediately. If no one is present or refuses to accept the notice, the administrators shall post the notice of violation on the residence or building entrance.

(b) The notice of violation shall contain the following:

(1) The address and tax ID number of the property.

(2) The section of this chapter being violated.

(3) The nature and location of the violation and the date by which such violation shall be removed or abated.

(4) A notice of the penalty for failing to remove or abate the violation, stating that if the nuisance recurs by the same apparent occupant, owner, or person in charge, a notice of violation, stop work order, or notice to appear will be issued without further notice.

(5) The notice shall specify the number of days in which the violation shall be removed or abated, which time shall be not less than three days nor more than ten days, except in emergency cases.

(c) If the violation occurs where the residence or building is unoccupied, the property may be posted as provided in this section. If the property is unimproved, the notice may be placed on a tree, a stake, or other such object as available.

(d) A written notice containing the same information as the notice of violation shall be sent to the owner or any other person having control of the property at the last known address of the owner, or at the address of the person having control, by U.S. mail or email.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-502. Recurring violations.

Once a notice has been delivered pursuant to this article and the same violation recurs on the same lot or tract of land by the same person previously responsible, no further notice of violation need be given. Each day a violation continues after the expiration of the warning period to abate such a violation shall constitute a separate offence. Thereafter, the county may issue a stop work order, or such person deemed responsible may be notified to appear in court to answer to the charge against such person.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-503. Failure to act upon notice of violation.

Upon neglect or failure to act upon the notice of violation, and/or stop work order given as provided in sections 99-501 and 99-502, the county shall issue a notice to appear and shall follow the procedures as follows:

(a) *Service of notice to appear.* If a stop work order is given and, after the time for removal or abatement has lapsed, the property is reinspected and the administrator or designee finds and determines the violation has not been removed or abated, the administrator or designee shall fill out and sign, as the complainant, a complaint and information form or a notice to appear. The notice to appear shall include the following:

(1) Name of the occupant, owner, or person in charge of the property.

(2) The address or tax ID number of the property on which the violation is occurring.

(3) This chapter section or other reference the action or condition violates.

(4) The date on which the case will be on the court docket for hearing.

(5) Any other information deemed pertinent by the county official.

The original copy of the notice to appear shall be forwarded to the clerk of the court for inclusion on the court's docket for the date indicated on the notice to appear.

(b) *Notice to appear; delivery by mail.* If no one is found at the property to accept a notice to appear for failure to remove or abate a violation, the administrator or designee shall fill out and sign the notice to appear as the complainant and deliver the original plus one copy to the clerk of the court. The clerk shall verify or insert the date the case has been set for hearing before the court. The clerk shall mail the copy by certified mail to the person named in the notice to appear at that person's last known address.

(c) *Abatement by county; costs assessed to person responsible.* If the occupant, owner, or person in charge of the property for which a warning notice has been given fails to remove or abate the violation in the time specified in the notice, whether on public or private property, the administrator or designee may, if severe conditions exist that affect health, welfare, safety or severe environmental degradation, remove the violation and thereby abate the violation. If such conditions exist, the administrator or designee may lawfully enter upon the property on which the violation remains unabated to remove or abate such violation at the cost of the person responsible for creating or maintaining the violation. The violation will be subject to civil fines reflecting the cost to the county, as prosecuted by the county attorney.

(d) *Payment of costs; special tax bill or judgment.* All costs and expenses incurred by the county in removing or abating any violation on any private property may be assessed against the property as a lien on the property. Alternatively, the cost of removing or abating the violation may be made part of the judgment by the judge, in addition to any other penalties and costs imposed if the person charged either pleads or is found guilty of causing, creating, or maintaining a violation.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-504. Penalty for violation.

(a) Enforcement of this article shall fall under the jurisdiction of both the Beaufort County Public Works Department and Beaufort County Codes Enforcement. Officers and inspectors shall have the authority to exercise full discretion in deciding whether to issue a notice of violation, stop work order, or fine when investigating complains that arise under this article.

(b) Any person, group, firm, association, or corporation violating any section of this chapter, or the requirements of an approved Beaufort County Stormwater Permit, shall be guilty of a misdemeanor and, upon conviction thereof, shall pay such penalties as the court may decide, as prescribed by state law, not to exceed $1000.00 or 30 days' imprisonment for each violation. Each day during which such conduct shall continue shall subject the offender to the liability prescribed in this article.

(c) In addition to the penalties established and authorized in subsection (a) of this section, the county attorney may take other actions at law or in equity as may be required to halt, terminate, remove, or otherwise eliminate any violations of this chapter.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-505. Interpretation.

(a) *Meaning and intent.* All provisions, terms, phrases, and expressions contained in this article shall be construed according to the general and specific purposes set forth in section 99-202, purpose. If a different or more specific meaning is given for a term defined elsewhere in county's Code of Ordinances or in an existing development agreement, the meaning and application of the term in this article shall control for purposes of application of this article.

(b) *Text controls in event of conflict.* In the event of a conflict or inconsistency between the text of this article and any heading, caption, figure, illustration, table, or map, the text shall control.

(c) *Authority for interpretation.* The administrators have, after consultation with county attorney, authority to determine the interpretation of this article. Any person may request an interpretation by submitting a written request to the administrators who shall respond in writing within 30 days. The administrators shall keep on file a record of all written interpretations of this article.

(d) *References to statutes, regulations, and documents.* Whenever reference is made to a resolution, article, statute, regulation, manual (including the most current version of the Southern Lowcountry Stormwater Design Manual), or document, it shall be construed as a reference to the most recent edition of such that has been finalized and published with due provision for notice and comment, unless otherwise specifically stated.

(e) *Delegation of authority.* Any act authorized by this article to be carried out by the county administrator may be carried out by his or her designee.

(f) *Usage.*

(1) *Mandatory and discretionary terms.* The words "shall," "must," and "will" are mandatory in nature, establishing an obligation or duty to comply with the particular provision. The words "may" and "should" are permissive in nature.

(2) *Conjunctions.* Unless the context clearly indicates the contrary, conjunctions shall be interpreted as follows: The word "and" indicates that all connected items, conditions, provisions or events apply. The word "or" indicates that one or more of the connected items, conditions, provisions or events apply.

(3) *Tense, plurals, and gender words used in the present tense include the future tense.* Words used in the singular number include the plural number and the plural number includes the singular number, unless the context of the particular usage clearly indicates otherwise. Words used in the masculine gender include the feminine gender, and vice versa.

(g) *Measurement and computation.* Lot area refers to the amount of horizontal land area contained inside the lot lines of a lot or site.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-506. Conflict of laws.

This article is not intended to modify or repeal any other ordinance, rule, regulation or other provision of law. The requirements of this article are in addition to the requirements of any other ordinance, rule, regulation or other provision of law, and where any provision of this article imposes restrictions different from those imposed by any other ordinance, rule, regulation or other provision of law, whichever provision is more restrictive or imposes higher protective standards for human or environmental health, safety, and welfare, shall control.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-507. Severability.

If the provisions of any section, subsection, paragraph, subdivision or clause of this article shall be adjudged invalid by a court of competent jurisdiction, such judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision or clause of this article.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Appendix B: Infiltration Testing and Geotechnical Requirements

Table of Contents

B.1 General Notes Pertinent to All Geotechnical Testing

A geotechnical report may be required for all underground stormwater best management practices (BMPs), including infiltration-based practices, filtering systems, and storage practices, as well as stormwater ponds and wetlands. The following must be taken into account when producing this report.

- Testing is to be conducted at the direction of a qualified professional. This professional shall either be a registered professional engineer, soils scientist, or geologist and must be licensed in the State.
- Soil boring or test pit information is to be obtained from at least one location on the site. Additional borings or test pits are required within the proposed BMP facility under three conditions: (1) when the soils or slopes vary appreciably from the findings in the initial boring or test pit, (2) when the groundwater level is found to be significantly higher than the initial boring or test pit indicated, and (3) when the groundwater level may adversely affect the performance of the proposed BMP facilities. However, the location, number, and depth of borings or test pits shall be determined by a qualified professional, and be sufficient to accurately characterize the site soil conditions.
- Log any indications of water saturation to include both perched and groundwater table levels; include descriptions of soils that are mottled or gleyed. Depth to the groundwater table (with 24-hour readings) must be included in the boring logs/geotechnical report.
- Laboratory testing must include grain size analysis. Additional tests such as liquid limit and plastic limit tests, consolidation tests, shear tests and permeability tests may be necessary where foundation soils or slopes are potentially unstable based on the discretion of the qualified professional.
- The geotechnical report must include soil descriptions from each boring or test pit, and the laboratory test results for grain size. Based upon the proposed development, the geotechnical report may also include evaluation of settlement, bearing capacity and slope stability of soils supporting the proposed structures.
- All soil profile descriptions should provide enough detail to identify the boundary and elevations of any problem (boundary/restrictions) conditions such as fills and seepage zones, type and depth of rock, etc.

In addition to the testing requirements described above, infiltration tests must be performed for all BMPs in which infiltration will be relied upon, including permeable pavement systems, bioretention, infiltration, and dry swales. Specific requirements for infiltration testing are discussed below.

B.2 Initial Feasibility Assessment

The feasibility assessment is conducted to determine whether full-scale infiltration testing is necessary, screen unsuitable sites, and reduce testing costs. However, a designer or landowner may opt to skip the initial feasibility assessment at his or her discretion and begin with soil borings.

The initial feasibility assessment typically involves existing data, such as the following:

- On-site septic percolation testing, which can establish historic percolation rates, water table, and/or depth to bedrock. Percolation tests are different than tests for coefficient of permeability or infiltration rate;
- Previous geotechnical reports prepared for the site or adjacent properties; or
- Natural Resources Conservation Service (NRCS) Soil Mapping.

If the results of initial feasibility assessment show that a suitable infiltration rate (typically greater than 0.5 inches per hour) is possible or probable, then test pits must be dug or soil borings drilled to determine the saturated hydraulic conductivity (K_{sat}).

B.3 Test Pit/Boring Requirements for Infiltration Tests

- Excavate a test pit or drill a standard soil boring to a depth of 2 feet below the proposed BMP bottom.
- Do not construct, maintain or abandon a well in a manner that may create a point source or non-point source of pollutants to waters of the State, impair the beneficial uses of waters of the State, or pose a hazard to public health and safety or the environment.
- Determine depth to groundwater table if within 2 feet of proposed bottom.
- Determine Unified Soil Classification System (USCS) and/or United Sates Department of Agriculture (USDA) textures at the proposed bottom to 2 feet below the bottom of the BMP.
- Determine depth to bedrock (if within 2 feet of proposed bottom).
- Include the soil description in all soil horizons. Perform the infiltration test at the proposed bottom of the practice. If any of the soil horizons below the proposed bottom of the infiltration practice (within 2 feet) appear to be a confining layer, additional infiltration tests must be performed on this layer (or layers), following the procedure described below.
- The location of the test pits or borings shall correspond to the BMP locations; a map or plan that clearly and accurately indicates the locations(s) of the test pits or soil borings must be provided with the geotechnical report.

Table 1 indicates the number of test pits or soil borings and subsequent infiltration tests that must be performed per BMP. In cases where multiple BMPs are proposed in 1 area with generally uniform conditions, a circular shape that fully encompasses all of the BMPs may be substituted for the “area of practice” that determines the number of required infiltration tests.

Table 1. Number of Infiltration Tests Required per BMP.

Area of Practice (ft^2)	Minimum Number of Test Pits/Soil Borings
< 1,000	1
1,000–1,999	2
2,000–9,999	3
≥ 10,000	Add 1 test pit/soil boring for each additional 10,000 ft^2 of BMP.

When one test pit or boring is required, it must be located as near to the testing area as possible. When more than one test pit or boring is necessary for a single BMP or area, the pit or boring locations must be equally spaced throughout the proposed area, as directed by the qualified professional. The reported saturated hydraulic conductivity for a BMP shall be the median or geometric mean (area-weighted average) of the observed results from the soil boring/test pit locations.

B.4 Infiltration Testing Requirements

The following tests are acceptable for use in determining soil infiltration rates. The geotechnical report shall include a detailed description of the test method and published source references:

1) Constant Head Bore-Hole Infiltration Tests (also referred to as bore-hole permeameter tests and constant-head well permeameter tests). These types of tests determine saturated hydraulic conductivity (coefficient of permeability) by measuring the rate of water flow to a borehole. Analytical solutions utilize principles of Darcy's Law, borehole geometry, and head (or multiple heads) of water in determining saturated hydraulic characteristics. Where the soil characteristics meet all of the above described requirements for infiltration BMPs, the hydraulic gradient element of Darcy's Law is often estimated as 1 for determining infiltration rate.

   One published standard developed by the United States Bureau of Reclamation for this method is USBR 7300-89. Some of the commercially available equipment is listed below:

   - Aardvark Permeameter
   - Amoozemeter
   - Guelph Permeameter
   - Johnson Permeameter

2) Testing Requirements for Infiltration, Bioretention, and Sand Filer Subsoils, as modified below. The data obtained from this infiltration testing procedure shall be used to calculate the saturated hydraulic conductivity (see Section B.5 Saturated Hydraulic Conductivity Calculations).
   a. Install solid casing in the boring or test pit to the proposed BMP bottom or other required test depth (i.e. confining layer encountered within 2 feet below the BMP bottom). When installing casing, drive the casing between 3 to 5 inches below the test surface to promote a good casing-to-soil seal.
   b. Remove any smeared, soiled surfaces, and provide a natural soil interface into which water may infiltrate. Remove all loose material from the casing. At the tester's/registered professional's discretion, a 2-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scouring and sediment. Fill the casing with clean, potable water 24 inches above the test surface (24 inches of head), and allow to presoak for 24 hours.

c. Protect the open borehole with suitable cover such as a sanitary well cap and steel plate with surrounding sandbags to prevent the introduction of surface water runoff, trash, debris, and other pollutants.

d. Twenty-four hours later, refill the casing with approximately 24 inches of clean water (24 inches of head), and monitor the water level for 1 hour, recording the depth of water at the beginning and end of the test.

e. Repeat step 4 (filling the casing each time) three additional times, for a total of four observations. At the registered professional's discretion, the saturated hydraulic conductivity calculations may be performed based on the values recorded during the average of the four readings or the last observation. The testing interval can be increased at the discretion of the registered professional.

All soil borings and test pits shall be properly backfilled after conclusion of the tests. A person shall not construct, maintain or abandon a well in a manner that may create a point source or non-point source of pollutants to waters of the State, impair the beneficial uses of waters of the State, or pose a hazard to public health and safety or the environment. To prevent a soil boring from becoming a conduit for stormwater or other contaminants to enter groundwater and create a low-permeability seal against vertical fluid migration, follow these steps:

1) Use a positive displacement technique, inject a sodium-based bentonite slurry through a tremie pipe at least 1 inch in diameter starting at the bottom of the borehole. The slurry shall be composed of 2 pounds of sodium-based bentonite powder to 1 gallon of water.
2) If the borehole is too narrow to accommodate a tremie pipe or the borehole is less than 10 feet deep, slowly place uncoated, medium-sized, sodium-based bentonite chips in the borehole to create a 2-foot lift of chips measured from the bottom of the borehole.
3) Tamp down the bentonite chips to prevent bridging.
4) Using a ratio of 1 gallon of water to 12.5 pounds of bentonite chips, add potable water to the borehole and allow 15 to 30 minutes to elapse to ensure proper hydration of the bentonite chips.
5) Adjust these instructions as necessary in accordance with the manufacturer's instructions, providing that the resulting seal will have an effective hydraulic conductivity of no more than 1 × 10-7 cm/s.
6) The process should be repeated until the boring is filled 1 to 2 feet from the ground surface.
7) The remainder of the borehole should be backfilled with material to match the surrounding cover and must not include the use of a coal-tar product.

Further details are provided in SCDHEC Regulations R.61-71, Well Standards.

Note: If the infiltration testing procedure reveals smells or visual indications of soil or groundwater contamination then the boring or test hole must be filled in accordance with wellhead protection best practices, unless laboratory analysis determines groundwater or soil is not contaminated.

B.5 Saturated Hydraulic Conductivity Calculations

To convert the field infiltration measurements to a saturated hydraulic conductivity value (K_{sat}), the following calculations must be performed.

$$K_{sat} = \frac{\pi D}{11(t_2 - t_1)} \times \ln\left(\frac{H_1}{H_2}\right)$$

where:

K_{sat} = saturated hydraulic conductivity (in/hr)
D = casing diameter (in) (minimum 4 inches)
t_2 = recorded end time of test (hr)
t_1 = recorded beginning time of test (hr)
H_1 = head in casing measured at time t_1 (ft)
H_2 = head in casing measured at time t_2 (ft)

This equation was adapted by the U.S. Bureau of Reclamation in 1975 from Lambe and Whitman, 1969.

B.6 Infiltration Restrictions

If a Phase I Environmental Site Assessment identifies a Recognized Environmental Concern at a site indicating that site contamination is likely or present; or if DHEC is aware of upgradient or downgradient contaminant plumes, the presence of a brownfield or historic hotspot use, such as any of the following current or previous uses, then an impermeable liner must be used for BMPs, and infiltration is prohibited.

- Leaking underground storage tank (LUST),
- Above ground storage tanks (AST),
- Gas stations,
- Vehicle maintenance or repair facility,
- Dry cleaner,
- Transformer sub-station,
- Waste transfer or holding facility,
- Print shop,
- Chemical storage warehouse,
- Illicit hazardous wastes generator,
- Greenhouse with unlined floor,
- Septic system,
- Cement or asphalt plant, or
- Dump or landfill.

If an ASTM Phase II Environmental Site Assessment is performed based on a DHEC-approved workplan and DHEC reviews the results and determines that stormwater infiltration BMPs may impact on-site contamination by the following means, then an impermeable liner must be used for BMPs, and infiltration is prohibited.

- Spreading of contamination vertically or horizontally at the site,
- Increasing on-site groundwater contamination by leaching contaminants from the soil,

- Causing or enhancing contaminant migration to go offsite,
- Interfering with contaminant remedial activities,
- Decreasing or reversing the natural degradation of contaminants, or
- Causing a pollutant discharge to a surface water body.

If DHEC concludes there is no evidence of a Recognized Environmental Concern based on ASTM Phase I and II Environmental Site, and there is no current site use that could result in the foreseeable creation of a Recognized Environmental Concern, then impermeable liners are not required, and infiltration is not restricted.

Appendix C: Soil Compost Amendment Requirements

Table of Contents

C.1 Introduction

Soil amendment (also called soil restoration) is a technique applied after construction to deeply till compacted soils and restore their porosity by amending them with compost. These soil amendments can be used to enhance the performance of impervious cover disconnections and grass channels.

C.2 Physical Feasibility and Design Applications

Amended soils are suitable for any pervious area where soils have been or will be compacted by the grading and construction process. They are particularly well suited when existing soils have low infiltration rates (HSG C and D) and when the pervious area will be used to filter runoff (downspout disconnections and grass channels). The area or strip of amended soils should be hydraulically connected to the stormwater conveyance system. Soil restoration is recommended for sites that will experience mass grading of more than a foot of cut and fill across the site.

Compost amendments are not recommended where any of the following exists:

- Existing soils have high infiltration rates (e.g., HSG A and B), although compost amendments may be needed at mass-graded B soils in order to maintain infiltration rates.
- The water table or bedrock is located within 1.5 feet of the soil surface.
- Slopes exceed 10% (compost can be used on slopes exceeding 10% as long as proper soil erosion and sediment control measures are included in the plan).
- Existing soils are saturated or seasonally wet.
- They would harm roots of existing trees (keep amendments outside the tree drip line).
- The downhill slope runs toward an existing or proposed building foundation.

- Areas that will be used for snow storage.

C.3 Design Criteria

C.3.1 Performance

When Used in Conjunction with Other Practices. As referenced in several of the Chapter 4 Stormwater Best Management Practices (BMPs) specifications, soil compost amendments can be used to enhance the performance of allied practices by improving runoff infiltration. The specifications for each of these practices contain design criteria for how compost amendments can be incorporated into those designs:

- Impermeable Surface Disconnection – See Section 4.6 Impervious Surface Disconnection.
- Grass Channels – See Section 4.7 Open Channel Systems.

C.3.2 Soil Testing

Soil tests are required during two stages of the compost amendment process. The first testing is done to ascertain preconstruction soil properties at proposed amendment areas. The initial testing is used to determine soil properties to a depth 1 foot below the proposed amendment area, with respect to bulk density, pH, salts, and soil nutrients. These tests should be conducted every 5,000 square feet and are used to characterize potential drainage problems and determine what, if any, further soil amendments are needed.

The second soil test is taken at least 1 week after the compost has been incorporated into the soils. This soil analysis should be conducted by a reputable laboratory to determine whether any further nutritional requirements, pH adjustment, and organic matter adjustments are necessary for plant growth. This soil analysis must be done in conjunction with the final construction inspection to ensure tilling or subsoiling has achieved design depths.

C.3.3 Determining Depth of Compost Incorporation

The depth of compost amendment is based on the relationship of the surface area of the soil amendment to the contributing area of impervious cover that it receives. Table C.1 presents some general guidance derived from soil modeling by Holman-Dodds (2004) that evaluates the required depth to which compost must be incorporated. Some adjustments to the recommended incorporation depth were made to reflect alternative recommendations of Roa Espinosa (2006), Balousek (2003), Chollak and Rosenfeld (1998), and others.

Table 1 indicates the number of test pits or soil borings and subsequent infiltration tests that must be performed per BMP. In cases where multiple BMPs are proposed in 1 area with generally uniform conditions, a circular shape that fully encompasses all of the BMPs may be substituted for the “area of practice” that determines the number of required infiltration tests.

Table 1. Method to Determine Compost and Incorporation Depths.

Ratio of Area of Contributing Impervious Cover to Soil Amendment[a] (IC/SA)	Compost Depth[b] (in.)	Incorporation Depth (in.)	Incorporation Method
0.5	3[c]	12[c]	Tiller
0.75	4[c]	18[c]	Subsoiler
1.0[d]	6[c]	24[c]	Subsoiler

[a] IC = contrib. impervious cover (ft^2) and SA = surface area of compost amendment (ft^2)

[b] Average depth of compost added
[c] Lower end for B soils, higher end for C/D soils
[d] In general, IC/SA ratios greater than 1 should be avoided

Once the area and depth of the compost amendments are known, the designer can estimate the total amount of compost needed, using an estimator developed by TCC, (1997):

$$CC = AA \times DD \times 0.0031$$

where:

C	= compost needed (yd^3)
A	= area of soil amended (ft^2)
D	= depth of compost added (in)

C.3.4 Compost Specifications

The basic material specifications for compost amendments are outlined below:

- Compost shall be derived from plant material and provided by a member of the U.S. Composting Seal of Testing Assurance (STA) program. See https://compostingcouncil.org/ for a list of local providers.
- Alternative specifications and/or certifications, such as Clemson University or the US Department of Agriculture, may be substituted, as authorized by *<local jurisdiction>*. In all cases, compost material must meet standards for chemical contamination and pathogen limits pertaining to source materials, as well as reasonable limits on phosphorus and nitrogen content to avoid excessive leaching of nutrients.
- The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions that promote anaerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have a moisture content that has no visible free water or dust produced when handling the material. It shall meet the following criteria, as reported by the U.S. Composting Council STA Compost Technical Data Sheet provided by the vendor:

    a. 100% of the material must pass through a half-inch screen
    b. The pH of the material shall be between 6 and 8
    c. Manufactured inlet material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight
    d. The organic matter shall be between 35%–65%
    e. Soluble salt content shall be less than 6.0 mmhos/cm
    f. Maturity must be greater than 80%
    g. Stability shall be 7 or less
    h. Carbon/nitrogen ratio shall be less than 25:1
    i. Trace metal test result must equal “pass”
    j. The compost must have a dry bulk density ranging from 40–50 lb/ft^3

C.4 Construction Sequence

The construction sequence for compost amendments differs depending whether the practice will be applied to a large area or a narrow filter strip, such as in a rooftop disconnection or grass channel. For larger areas, a typical construction sequence is as follows:

1) **Soil Erosion and Sediment Control.** When areas of compost amendments exceed 2,500 square feet install soil erosion and sediment control measures, such as silt fences, are required to secure the area until the surface is stabilized by vegetation.
2) **Deep Till.** Deep till to a depth of 12 to 18 inches after the final building lots have been graded prior to the addition of compost.
3) **Dry Conditions.** Wait for dry conditions at the site prior to incorporating compost.
4) **Compost.** Incorporate the required compost depth (as indicated in Table 1) into the tilled soil using the appropriate equipment. Level the site. Seeds or sod are required to establish a vigorous grass cover. To help the grass grow quickly, lime or irrigation is recommended.
5) **Vegetation.** Ensure surface area is stabilized with vegetation.
6) **Construction Inspection.** Construction inspection by a qualified professional involves digging a test pit to verify the depth of amended soil and scarification. A rod penetrometer should be used to establish the depth of uncompacted soil at a minimum of 1 location per 10,000 square feet.

C.5 Maintenance

C.5.1 First-Year Maintenance Operations

In order to ensure the success of soil compost amendments, the following tasks must be undertaken in the first year following soil restoration:

- **Initial inspections.** For the first 6 months following the incorporation of soil amendments, the site should be inspected by a qualified professional at least once after each storm event that exceeds 1/2-inch of rainfall.
- **Spot Reseeding.** Inspectors should look for bare or eroding areas in the contributing drainage area (CDA) or around the soil restoration area and make sure they are immediately stabilized with grass cover.
- **Fertilization.** Depending on the amended soils test, a one-time, spot fertilization may be needed in the fall after the first growing season to increase plant vigor.
- **Watering.** Water once every 3 days for the first month, and then weekly during the first year (April through October), depending on rainfall.

C.5.2 Ongoing Maintenance

There are no major ongoing maintenance needs associated with soil compost amendments, although the owners may want to de-thatch the turf every few years to increase permeability. The owner should also be aware that there are maintenance tasks needed for filter strips, grass channels, and reforestation areas. The maintenance inspection checklist for an area of Soil Compost Amendments can be accessed in Appendix F Maintenance Inspection Forms.

C.5.3 Maintenance Agreement

A Maintenance Agreement that includes all maintenance responsibilities to ensure the continued stormwater performance for the BMP is required. The Maintenance Agreement specifies the property owner's primary maintenance responsibilities and authorizes the Beaufort County Public Works staff to access the property for inspection or corrective action in the event the proper maintenance is not performed. The Maintenance Agreement is attached to the deed of the property as attached to the land. It is to be recorded in the Register of Deeds in the County office. Maintenance responsibilities on government properties must be defined through a partnership agreement or a memorandum of understanding.

Appendix D: Conceptual Design Checklist

D.1 Design Checklist

This checklist serves as a guide for the consultant in the preparation and for the reviewer in the evaluation of a Stormwater Management Plan (SWMP). Any questions regarding items contained herein should be referred to the *Beaufort County Public Works Department.* Applicable page number or section in the Southern Lowcountry Stormwater Design Manual is included for reference.

NOTE: PLANS SUBMITTED WITHOUT A COMPLTED CHECKLIST MAY BE RETURNED WITHOUT REVIEW

Site/Project Name:	______________	Date:	______________
Consultant:	______________	Applicant:	______________
Phone Number:	______________	Phone Number:	______________
Email Address:	______________	Email Address:	______________

☐**Conceptual Plan** or ☐**Final Plan**

Consultant: Please complete the checklist below. A box in the Conceptual or Final checklist columns indicates the item is required for a complete application submittal.

	Conceptual	Final
A. Narrative Information		
1. Cover Sheet with Project Name, Engineer's Contact Information, Developer's Contact Information, Contractors Contact Information. Information required: Name, mailing address, telephone, email.	Δ	Δ
2. Site development plan and stormwater management narrative	Δ	Δ
3. Assess potential application of green infrastructure practices in the form of better site planning and design techniques. Low impact development practice should be used to the maximum extent practicable during the creation of a stormwater management concept plan. A demonstration of better site planning is required. The following site information and practices shall be considered: a. Soil type (from Soil Study); b. Depth of ground water on site; c. Whether the type of development proposed is a hotspot as defined by the Ordinance and Design Manual and address how this influences the concept proposal; d. Protection of primary and secondary conservation areas; e. Reduced clearing and grading limits; f. Reduced roadway lengths and widths; g. Reduced parking lot and building footprints to minimize impervious surface; h. Soil restoration; i. Site reforestation/revegetation; j. Impervious area disconnection;	Δ	

k. Green roof; and l. Permeable pavement		
4. Stormwater Pollution Prevention Plan (SWPPP) or Erosion and Sediment Control narrative (for projects disturbing over an acre)	Δ	Δ
5. Information regarding the mitigation of any off-site impacts anticipated as a result of the proposed development. Not applicable for all projects.		Δ
6. Construction specifications	Δ	Δ
B. Site Plan		
1. Standard drawing size (24 x 36 inches)	Δ	Δ
2. A plan showing property boundaries and the complete address of the property	Δ	Δ
3. Lot number or property identification number designation (if applicable)	Δ	Δ
4. Property lines (include longitude and latitude)	Δ	Δ
5. Location of easements (if applicable)		Δ
6. A legend identifying all symbols used on the plan	Δ	Δ
7. Location and size of existing and proposed utilities (including gas lines, sanitary lines, telephone lines or poles, electric utilities and water mains), structures, roads, and other paved areas		Δ
8. Existing and proposed topographic contours	Δ	Δ
9. Show drainage patterns, property ridge line(s) and building finish elevation on the grading plan.		Δ
10. Material and equipment staging areas	Δ	Δ
11. Clearly note on plans: - A right-of-way permit shall be obtained prior to performing construction activity in the right-of-way - Chlorinated disinfected water shall not be discharged into the stormwater system - Call before you dig note and number		Δ
12. Soil information for design purposes	Δ	Δ
13. Area(s) of soil disturbance	Δ	Δ
14. Site drainage area(s) (SDAs) within the limits of disturbance (LOD) and contributing to the LOD		Δ
15. Contributing drainage area (CDA) to each BMP		Δ
16. Location(s) of BMPs, marked with the BMP ID Numbers to agree with the BMP design summary list		Δ
17. Delineation of existing and proposed land covers including natural cover, compacted cover, and impervious surfaces.	Δ	Δ

18. Site fingerprint map of the location of existing stream(s), wetlands, or other natural features within the project area; tree and vegetation survey; and preservation area(s)	Δ	Δ
19. All plans and profiles must be drawn at a scale of 1 in. = 10 ft, 1 in. = 20 ft, 1 in. = 30 ft, 1 in. = 40 ft, 1 in. = 50 ft, or 1 in. = 100 ft. Although, 1 in. = 10 ft, 1 in = 20 ft, and 1 in. = 30 ft, are the most commonly used scales. Vertical scale for profiles must be 1 in. = 2 ft, 1 in. = 4 ft, 1 in. = 5 ft, or 1 in. = 10 ft	Δ	Δ
20. Drafting media that yield first- or second-generation, reproducible drawings with a minimum letter size of No. 4 (1/8 inch)	Δ	Δ
21. Applicable flood boundaries and FEMA map identification number for sites lying wholly or partially within the 100-year floodplain (if applicable)	Δ	Δ
C. Design and As-Built Certification		
1. Statement and seal by a registered professional engineer licensed in the State of South Carolina that the site design, land covers, and design of the BMPs conform to engineering principles applicable to the treatment and disposal of stormwater pollutants		Δ
2. Submission one set of the As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina within 21 days after completion of construction of the site, all BMPs, land covers, and stormwater conveyances. *Comes at close out*		Δ
3. For a project consisting entirely of work in the public right-of-way (PROW), the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMP and related stormwater infrastructure.		Δ
D. Maintenance of Stormwater BMPs		
1. BMP maintenance access easements shall not be located on pipe easements.		Δ
2. A minimum 20’ wide maintenance access easement is provided around stormwater detention ponds and from publicly accessible road has been provided.		Δ
3. A maintenance plan that identifies routine and long-term maintenance needs and a maintenance schedule		Δ
4. For regulated projects, a maintenance agreement stating the owner’s specific maintenance responsibilities identified in the maintenance plan and maintenance schedule. These must be exhibits recorded with the property deed at the Recorder of Deeds.		Δ
5. For applicants using Rainwater Harvesting, submission of third-party testing of end-use water quality may be required at equipment commissioning.		Δ
E. Stormwater Retention Volume Computations		

1. Calculation(s) of the required SWRv for the entire site within the LOD and each SDA within the LOD		Δ
2. Calculation(s) for each proposed BMP demonstrating retention value towards SWRv in accordance with Chapters 2 and 4 Stormwater Best Management Practices (BMPs)		Δ
3. For Rainwater Harvesting BMP, calculations demonstrating the annual water balance as determined using the Rainwater Harvesting Retention Calculator		Δ
4. For proprietary and non-proprietary BMPs outside Chapter 4, complete documentation defined in Chapter 4.15		Δ
5. Document off-site stormwater volume where required.		Δ
6. Document the 8-steps of the MEP process in Chapter 3.8.		Δ
7. Compliance Calculator sheets identifying that proposed BMP(s) meet standards for water quality		Δ
F. Pre/Post-Development Hydrologic Computations		
1. A summary of soil conditions and field data		Δ
2. Pre- and post-project curve number summary table		Δ
3. Pre and post construction peak flow summary table for the 2, 10, 25, 50 and the 100-year 24-hour storm events for each SDA within the project's LOD		Δ
4. Flow control structure elevations		Δ
G. Hydraulic Computations		
1. Existing and proposed SDA must be delineated on separate plans with the flow paths used for calculation of the times of concentration		Δ
2. Hydraulic capacity and flow velocity for drainage conveyances, including ditches, swales, pipes, inlets.		Δ
3. Plan profiles for all open conveyances and pipelines, with energy (kinetic) and hydraulic gradients for the 25-year and 100-year, 24-hour storms		Δ
4. The proposed development layout including the following:		Δ
a) Location and design of BMP(s) on site, marked with the BMP ID Numbers		Δ
b) A list of design assumptions (e.g., design basis, 2 through 25-year return periods)		Δ
c) The boundary of the CDA to the BMP		Δ
d) Schedule of structures (a listing of the structures, details, or elevations including inverts)		Δ
e) Manhole to manhole listing of pipe size, pipe type, slope, computed velocity, and computed flow rate (i.e., a storm drain pipe schedule		Δ
5. Demonstrate downstream conveyance system capacity for the development.		Δ

H. Erosion and Sediment Control Plans		
1. Provide erosion and sediment control drawings and detail sheets required by the CSWPPP	Δ	Δ
2. Show dewatering setup to ensure no negative off-site impacts result from the discharge	Δ	Δ
3. Provide erosion and sediment control inspection forms required by the CSWPPP		Δ
I. Supporting Documentation (written report)		
1. Pre- and Post-development curve number selection		Δ
2. Time of concentration calculation		Δ
3. Travel time calculation		Δ
4. Hydrologic computations supporting peak discharges assumed for each SDA within the project's LOD for the 2-, 10-, 25-, and 50-year, 24-hour storm events		Δ
5. Provide downstream and surrounding neighborhood area analysis to identify any existing capacity shortfalls or flooding based on the 10% rule.		Δ
6. SCDHEC's Construction Stormwater Pollution Prevention Plan (C-SWPPP)		Δ

The engineering features of all stormwater best management practices (BMPs), stormwater infrastructure, and land covers (collectively the "Facility") have been designed/examined by me and found to be in conformity with the standard of care applicable to the treatment and disposal of stormwater pollutants. The Facility has been designed in accordance with the specification required under Chapter 99 of the Beaufort County Ordinance.

Seal Signed Date

License Number:		Expiration Date:	

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s):____ **Mailing Address:** __________

____

Date:__________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of practice (check all that apply)		
a. Bioretention		
b. Dry Swale		
d. Residential Rain Garden		
e. Infiltration Practice		
f. Filtration Practice		
2. For Bioretention		
a. Standard Design		
b. Enhanced Design		
3. Practice Location		
a. Open to Surface		
b. Underground		
4. Filtration Media		
a. No filtration media (e.g., stone reservoir only)		
b. Sand		
c. Bioretention Soil Mix		
d. Peat		
e. Other		
5. Hydraulic configuration		
a. On-line		
b. Off-line		
6. Type of pretreatment		
a. Separate pretreatment cell		
b. Sedimentation chamber/manhole		
c. Grass channel		
d. Grass filter strip		
e. Gravel or stone flow spreader		
f. Gravel diaphragm		
g. Other		Type of pretreatment:
7. If designed for infiltration (i.e., no underdrain OR infiltration sump below underdrain):		
a. Soil boring logs and infiltration testing report provided		
b. Field-measured infiltration rate of at least 0.5 in/hr (preferred 1-4 in/hr)		Field-measured rate:

A. Contributing Drainage Area
0 = Good condition. Well maintained, no action required.

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Excessive trash/debris	0	1	2	3	N/A	
2. Bare/exposed soil	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A	

B. Pretreatment

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Maintenance access to pretreatment facility	0	1	2	3	N/A	
2. Excessive trash/debris/sediment	0	1	2	3	N/A	
3. Evidence of standing water	0	1	2	3	N/A	
a. Ponding	☐					
b. Noticeable odors	☐					
c. Water stains	☐					
d. Presence of algae or floating aquatic vegetation	☐					
4. Evidence of clogging	0	1	2	3	N/A	
5. Dead vegetation/exposed soil	0	1	2	3	N/A	
6. Evidence of erosion	0	1	2	3	N/A	

C. Inlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Inlets provide stable conveyance into practice	0	1	2	3	N/A	
2. Excessive trash/debris/sediment accumulation at inlet	0	1	2	3	N/A	
3. Evidence of erosion at/around inlet	0	1	2	3	N/A	

D. Practice

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		Rating	Comments
1.	Maintenance access	0 1 2 3 N/A	
2.	Condition of structural components	0 1 2 3 N/A	
3.	Condition of hydraulic control components	0 1 2 3 N/A	
4.	Excessive trash/debris/sediment	0 1 2 3 N/A	
5.	Evidence of erosion	0 1 2 3 N/A	
6.	Evidence of oil/chemical accumulation	0 1 2 3 N/A	
7.	Evidence of standing water:	0 1 2 3 N/A	
	a. Ponding	☐	
	b. Noticeable odors	☐	
	c. Water stains	☐	
	d. Presence of algae or floating aquatic vegetation	☐	
8.	Underdrain system (if equipped)	0 1 2 3 N/A	
	a. Broken	☐	
	b. Clogged	☐	
9.	Vegetation	0 1 2 3 N/A	
	a. Plant composition consistent with approved plans	☐	
	b. Presence of invasive species/weeds	☐	
	c. Dead vegetation/exposed soil	☐	

E. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		Rating	Comments
1.	Outlets provide stable conveyance out of practice	0 1 2 3 N/A	
2.	Excessive trash/debris/sediment accumulation at outlet	0 1 2 3 N/A	
3.	Evidence of erosion at/around outlet	0 1 2 3 N/A	

☐ Inspected
☐ Not Inspected

F. Miscellaneous

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

Item		Comments
1. Complaints from local residents	0 1 2 3 N/A	
2. Mosquito proliferation	0 1 2 3 N/A	
3. Encroachment on practice or easement by buildings or other structures	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
2.	
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Sketch of Practice

(note problem areas)

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

Permeable Pavement
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates:
____

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of practice (check all that apply)		
a. Standard design		
b. Infiltration design		
c. Infiltration sump design		
2. Pavement Type		
a. Pervious concrete		
b. Porous asphalt		
c. Concrete grid pavers		
d. Permeable interlocking concrete pavers		
e. Other:		
3. External drainage area?		
a. Yes		Ratio:
b. No		
4. Pretreatment (if landscaped/turf areas in drainage area)		
a. Yes		Type:
b. No		
5. If designed for infiltration (e.g., no underdrain OR infiltration sump below underdrain):		
b. Soil boring logs and infiltration testing report provided		
c. Field-measured infiltration rate indicated		Field-measured rate:

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Excessive trash/debris	0	1	2	3	N/A	
2. Bare/exposed soil	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A	

Permeable Pavement

Maintenance Inspection Checklist

5	Excessive grit, sand, or other clogging agents on upgradient pavement that drains onto permeable pavement	0	1	2	3	N/A	

B. Pretreatment (if applicable to landscaped/turf drainage area)

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Maintenance access to pretreatment facility	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment	0	1	2	3	N/A	
3.	Evidence of standing water						
	a. Ponding	0	1	2	3	N/A	
	b. Noticeable odors	0	1	2	3	N/A	
	c. Water stains	0	1	2	3	N/A	
	d. Presence of algae or floating aquatic vegetation	0	1	2	3	N/A	
4.	Evidence of clogging	0	1	2	3	N/A	
5.	Dead vegetation/exposed soil	0	1	2	3	N/A	
6.	Evidence of erosion	0	1	2	3	N/A	

C. Evidence of Materials Storage or Resurfacing of Permeable Pavement

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Evidence of storage of sand, mulch, soil, construction staging, power washing, or other activities that can clog pavement	0	1	2	3	N/A	
2.	Evidence of resealing or resurfacing of permeable pavement surface	0	1	2	3	N/A	

D. Practice

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Maintenance access to practice	0	1	2	3	N/A	
2.	Condition of structural components	0	1	2	3	N/A	

Permeable Pavement

Maintenance Inspection Checklist

3.	Condition of hydraulic control components	0	1	2	3	N/A
4.	Excessive trash/debris/sediment on pavement surface	0	1	2	3	N/A
5.	Evidence of damaged pavers and/or cracked/broken surface	0	1	2	3	N/A
6.	Evidence of oil/chemical accumulation	0	1	2	3	N/A
7.	Evidence of clogging:					
	a. Ponding/water standing in observation wells	0	1	2	3	N/A
	b. Noticeable odors	0	1	2	3	N/A
	c. Water stains	0	1	2	3	N/A
8.	Underdrain system (if equipped)	0	1	2	3	N/A
	a. Broken	0	1	2	3	N/A
	b. Clogged	0	1	2	3	N/A
9.	Vegetation (e.g., grass in grid pavers) if present	0	1	2	3	N/A
	a. Grass or vegetation needs mowing or maintenance	0	1	2	3	N/A
	b. Excessive growth of weeds	0	1	2	3	N/A
	c. Dead vegetation	0	1	2	3	N/A

E. Miscellaneous

0 = Good condition. Well maintained, no action required.

1 = Moderate condition. Adequately maintained, routine maintenance needed.

2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.

3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected

☐ Not Inspected

	Item						Comments
1.	Complaints from local residents	0	1	2	3	N/A	
2.	Spring clean-up conducted?	0	1	2	3	N/A	
3.	Vacuum sweeping without water spray (2 -- 4 time annually)	0	1	2	3	N/A	
4.	Encroachment on practice or easement by buildings or other structures	0	1	2	3	N/A	

Inspector's Summary:

Permeable Pavement
Maintenance Inspection Checklist

Photographs	
Photo ID	**Description**
1.	
2.	
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Sketch of Practice
(note problem areas)

Green Roof
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________________

Contact: ______________________________

Phone Number: ______________________________

E-mail: ______________________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of vegetated roof (check all that apply)		
a. Extensive - shallow soil		
b. Intensive - deep soil		
c. Other		Type:
2. Type of plant cover (check all that apply)		
a. Sedums		
b. Shrubs		
c. Trees		
d. Other		Type:

A. Practice

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item	Rating	Comments
1. Maintenance access to practice	0 1 2 3 N/A	
2. Condition of structural components	0 1 2 3 N/A	
3. Condition of hydraulic control components	0 1 2 3 N/A	
4. Excessive trash/debris/sediment	0 1 2 3 N/A	
5. Evidence of leaking in waterproof	0 1 2 3 N/A	
6. Evidence of perforated root barrier	0 1 2 3 N/A	
7. Evidence of standing water:	0 1 2 3 N/A	
a. Ponding	☐	
b. Noticeable odors	☐	
c. Water stains	☐	
d. Presence of algae	☐	
8. Roof drain system	0 1 2 3 N/A	
a. Broken	☐	
b. Clogged	☐	
9. Vegetation	0 1 2 3 N/A	
a. Plant composition consistent with approved plans	☐	
b. Presence of invasive species/weeds	☐	
c. Plants appear nutrient deficient	☐	
d. Evidence of birds/pests removing plants	☐	
e. Dead/sparse vegetation soil	☐	

Green Roof
Maintenance Inspection Checklist

B.	***Outlets***		
	0 = Good condition. Well maintained, no action required.		
	1 = Moderate condition. Adequately maintained, routine maintenance needed.		
	2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.		
	3 = Serious condition. Immediate need for repair or replacement.		
	Inspected		
	Not Inspected		
	Item		**Comments**
1.	Roof drain conveyance is clogged	0 1 2 3 N/A	
2.	Excessive trash/debris/sediment accumulation at roof drain outlets	0 1 2 3 N/A	
3.	Evidence of erosion at/around outlet	0 1 2 3 N/A	

C.	***Miscellaneous***		
	0 = Good condition. Well maintained, no action required.		
	1 = Moderate condition. Adequately maintained, routine maintenance needed.		
	2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.		
	3 = Serious condition. Immediate need for repair or replacement.		
	Inspected		
	Not Inspected		
	Item		**Comments**
1.	Complaints from local residents	0 1 2 3 N/A	
2.	Mosquito proliferation	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Photo ID	**Description**
1.	
2.	
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Sketch of Practice

(note problem areas)

Rainwater Harvesting
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Practice ID: ______________________

Location: ______________________

Contact: ______________________

GPS Coordinates: ______________________

Phone Number: ______________________

E-mail: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: ___________ **Time:** ______________

A.	***Contributing Drainage Area (Roof Area)*** 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐	Inspected						
☐	Not Inspected						
	Item						**Comments**
1.	Excessive leaves and debris in gutters/downspouts	0	1	2	3	N/A	
2.	Other materials/debris on roof surface (e.g., excessive bird droppings)	0	1	2	3	N/A	
3.	Clear overhanging trees/vegetation over roof surface	0	1	2	3	N/A	

B.	***Pretreatment*** 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐	Inspected						
☐	Not Inspected						
	Item						**Comments**
1.	Maintenance access to pretreatment facility	0	1	2	3	N/A	
2.	Check first flush diverters/filters for proper functioning (e.g., not bypassing too much water). Clean debris from filter screens.	0	1	2	3	N/A	Sediment marker reading:

C.	***Inlets*** 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐	Inspected						
☐	Not Inspected						
	Item						**Comments**
1.	Check all conveyances into tank; remove debris; check for clogging	0	1	2	3	N/A	

2. Patch any holes or gaps.	0	1	2	3	N/A		

D. Tank or Cistern

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item							Comments
1. Maintenance access to practice	0	1	2	3	N/A		
2. Check storage tank lids	0	1	2	3	N/A		
a. Vents and screens on inflow/outflow spigots	0	1	2	3	N/A		
b. Lids in place, properly secured	0	1	2	3	N/A		
3. Overflow pipes & downstream flow path	0	1	2	3	N/A	Cause:	
a. Debris/clogging in overflow pipes	0	1	2	3	N/A	Cause:	
b. Erosion, excessive debris, clogging of flow path	0	1	2	3	N/A	Cause:	
c. Condition of downstream secondary runoff reduction practice (see applicable checklist)	0	1	2	3	N/A	Cause:	
4. Sediment build-up in tank	0	1	2	3	N/A		
5. Backflow preventer	0	1	2	3	N/A		
6. Structural integrity	0	1	2	3	N/A		
a. Tank and foundation	0	1	2	3	N/A		
b. Pump and pump housing	0	1	2	3	N/A		
c. Pipes	0	1	2	3	N/A		
d. Electrical system and housing	0	1	2	3	N/A		
7. Water Quality Devices	0	1	2	3	N/A		
8. Mosquitos	0	1	2	3	N/A		
a. Mosquito screens; check gaps and holes	0	1	2	3	N/A		
b. Evidence of mosquito larvae in tank or manholes	0	1	2	3	N/A		

E. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Complaints from local residents	0	1	2	3	N/A	
2. Mosquito proliferation	0	1	2	3	N/A	
3. Encroachment on practice or easement by buildings or other structures	0	1	2	3	N/A	
4. Adequate safety signage	0	1	2	3	N/A	

Inspector's Summary:

Photographs	
Photo ID	Description
1.	
2.	
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Sketch of Practice

(note problem areas)

Impervious Surface Disconnection
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s):____ **Mailing Address:** __________

____

Date:__________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of impervious area disconnected		
a. Rooftop		
b. Parking		
c. Other		
2. Type of disconnection surface		
a. Managed turf areas		
b. Forest cover or preserved open space		
c. Soil compost amended filter path		
3. Type of forest cover or open space (if applicable)		
a. Forest		
b. Meadow/Brush		
c. Other		
4. Vegetative Cover Condition		
a. Good		
b. Average		
c. Poor		
5. Meets width/length requirement		

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		**Comments**
1. Excessive trash/debris	0 1 2 3 N/A	
2. Excessive landscape waste/yard clippings	0 1 2 3 N/A	

B . Inflow Points

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected

Impervious Surface Disconnection
Maintenance Inspection Checklist

	Not Inspected		
	Item		**Comments**
1.	Inflow points (e.g. downspouts, curb cuts, edge of pavement, level spreader) provide stable conveyance into practice	0 1 2 3 N/A	
2.	Runoff enters pervious area as sheet flow	0 1 2 3 N/A	
3.	Excessive trash/debris/sediment	0 1 2 3 N/A	
4.	Evidence of erosion at/around inflow points	0 1 2 3 N/A	
5.	Level spreader functional, if applicable	0 1 2 3 N/A	

C .	***Practice (Pervious Area Receiving Runoff)*** 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.		
	Inspected		
	Not Inspected		
	Item		**Comments**
1.	Maintenance access to area	0 1 2 3 N/A	
2.	Downspouts or surface impervious area drains to the receiving pervious area (doesn't bypass)	0 1 2 3 N/A	
3.	Receiving pervious areas retain dimensions as shown on plans and are in good	0 1 2 3 N/A	
4.	Excessive trash/debris/sediment	0 1 2 3 N/A	
5.	Evidence of standing water:	0 1 2 3 N/A	
	a. Ponding		
	b. Noticeable odors		
	c. Water stains		
	d. Presence of algae or floating aquatic vegetation		
6.	Evidence of erosion	0 1 2 3 N/A	
7	Evidence of oil/chemical accumulation	0 1 2 3 N/A	
8.	Vegetation	0 1 2 3 N/A	
	a. Plant composition consistent with approved plans	0 1 2 3 N/A	
	b. Presence of invasive species/weeds	0 1 2 3 N/A	
	c. Dead vegetation/exposed soil	0 1 2 3 N/A	
	d. Disturbance to natural vegetation or excessive maintenance (e.g. mowing, tree cutting)	0 1 2 3 N/A	
	e. Restoration planting survival, if	0 1 2 3 N/A	
9.	Conservation area signs (if applicable)	0 1 2 3 N/A	
10.	Level spreader (if applicable)	0 1 2 3 N/A	

D .	***Miscellaneous*** 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed.

Impervious Surface Disconnection
Maintenance Inspection Checklist

2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

	Inspected
	Not Inspected

	Item		Comments
1.	Complaints from local residents	0 1 2 3 N/A	
2.	Mosquito proliferation	0 1 2 3 N/A	
3.	Encroachment on pervious area or easement by buildings or other structures	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
2.	
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Sketch of Practice

(note problem areas)

Dry Detention Practices
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** ______________________

Date: __________ **Time:** __________

Key Questions		
Item	**X**	**Comments**
1. Type of detention practice		
a. Dry Pond		
b. Underground Detetention Vault and/or Tank		
c. Other		Type:

A. Contributing Drainage Area						
0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐ Inspected						
☐ Not Inspected						
Item						**Comments**
1. Excessive trash/debris	0	1	2	3	N/A	
2. Bare/exposed soil	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A	
5. Oils, greases, paints and other harmful substances disposed of in drainage area.	0	1	2	3	N/A	

B. Forebay/Pretreatment						
0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐ Inspected						
☐ Not Inspected						
Item						**Comments**
1. Maintenance access to pretreatment facility	0	1	2	3	N/A	
2. Excessive trash/debris accumulation	0	1	2	3	N/A	
3. Excessive sediment accumulation	0	1	2	3	N/A	Sediment marker reading:
4. Evidence of clogging	0	1	2	3	N/A	
5. Dead vegetation/exposed soil	0	1	2	3	N/A	
6. Evidence of erosion	0	1	2	3	N/A	

Dry Detention Practices
MaintenanceInspection Checklist

C.	***Inlets***						
	0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐	Inspected						
☐	Not Inspected						
	Item						**Comments**
1.	Inlets provide stable conveyance into	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment accumulation at inlet	0	1	2	3	N/A	
3.	Evidence of erosion at/around inlet	0	1	2	3	N/A	
4.	Damaged pipes or components	0	1	2	3	N/A	
5.	Inflow hindered by soil height, build up of sediment and/or grass	0	1	2	3	N/A	

D.	***Practice***						
	0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐	Inspected						
☐	Not Inspected						
	Item						**Comments**
1.	Maintenance access to practice	0	1	2	3	N/A	
2.	Sediment accumulation	0	1	2	3	N/A	
3.	Abnormally high or low water levels	0	1	2	3	N/A	Cause:
4.	Evidence of pollution/hotspot runoff	0	1	2	3	N/A	Cause:
5.	Berm(s)/embankment(s)	0	1	2	3	N/A	
	a. Cracking, bulging, or sloughing	0	1	2	3	N/A	
	b. Soft spots or sinkholes	0	1	2	3	N/A	
	c. Evidence of erosion/bare spots	0	1	2	3	N/A	
	d. Evidence of animal burrows	0	1	2	3	N/A	
	e. Presence of woody vegetation	0	1	2	3	N/A	
6.	Riser/outlet	0	1	2	3	N/A	Type of riser:
	a. Maintenance access to riser	0	1	2	3	N/A	
	b. Structural condition of riser	0	1	2	3	N/A	
	c. Condition of joints	0	1	2	3	N/A	
	d. Trash/debris accumulation	0	1	2	3	N/A	
	e. Woody growth within 5 ft. of outlet	0	1	2	3	N/A	
	f. Emergency spillway eroding or failing	0	1	2	3	N/A	
7.	Low flow orifice	0	1	2	3	N/A	
	a. Trash/debris accumulation	0	1	2	3	N/A	
	b. Adjustable control valve accessible and operational	0	1	2	3	N/A	
9.	Vegetation	0	1	2	3	N/A	
	a. Plant composition consistent with approved plans	0	1	2	3	N/A	
	b. Presence of invasive species/weeds	0	1	2	3	N/A	
	c. Dead vegetation/exposed soil	0	1	2	3	N/A	

d. Reinforcement planting recommended ☐

E. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Outlets provide stable conveyance out of practice	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment accumulation at outlet	0	1	2	3	N/A	
3.	Evidence of erosion at/around outlet/outfall	0	1	2	3	N/A	
4.	Evidence of leaking/clogging of trash racks or reversed slope pipes	0	1	2	3	N/A	

F. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Complaints from local residents	0	1	2	3	N/A	
2.	Mosquito proliferation	0	1	2	3	N/A	
3.	Encroachment on practice or easement by buildings or other structures	0	1	2	3	N/A	
4.	Adequate safety signage	0	1	2	3	N/A	

Inspector's Summary:

Photographs

Dry Detention Practices
MaintenanceInspection Checklist

Photo ID	Description
1.	
2.	
3.	
4.	
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10.	

Sketch of practice
(note problem areas)

Created: 2021-07-22 09:11:36 [EST]

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________________

Practice ID: ______________________

Location: ______________________

Contact: ______________________________

GPS Coordinates: ______________________

Phone Number: ______________________________

E-mail: ______________________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of stormwater practice (check all that apply)		
a. Stormwater wetland basin		
b. Stormwater multi-cell wetland or pond/wetland combination		
c. Subsurface gravel wetland		
d. Wet pond		
d. Other		Type:
2. Type of pretreatment facility (check all that apply)		*Pretreatment must be provided*
a. Sediment forebay		
b. Other		Type:

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		Comments
1. Excessive trash/debris	0 1 2 3 N/A	
2. Bare/exposed soil	0 1 2 3 N/A	
3. Evidence of erosion	0 1 2 3 N/A	
4. Excessive landscape waste/yard clippings	0 1 2 3 N/A	
5. Oils, greases, paints and other harmful substances disposed of in drainage area.	0 1 2 3 N/A	

B. Pretreatment

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item	Comments

Stormwater Wet Pond/Wetland

Maintenance Inspection Checklist

1.	Maintenance access to pretreatment facility	0	1	2	3	N/A	
2.	Excessive trash/debris accumulation	0	1	2	3	N/A	
3.	Excessive sediment accumulation	0	1	2	3	N/A	Sediment marker reading:
4.	Evidence of clogging	0	1	2	3	N/A	
5.	Dead vegetation/exposed soil	0	1	2	3	N/A	
6.	Evidence of erosion	0	1	2	3	N/A	

C. Inlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Inlets provide stable conveyance into	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment accumulation at inlet	0	1	2	3	N/A	
3.	Evidence of erosion at/around inlet	0	1	2	3	N/A	
4.	Damaged pipes or components	0	1	2	3	N/A	
5.	Inflow hindered by soil height, build up of sediment and/or grass	0	1	2	3	N/A	
6.	Asphalt/concrete crumbling at inlets	0	1	2	3	N/A	

D. Practice

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Maintenance access to practice	0	1	2	3	N/A	
2.	Sediment accumulation	0	1	2	3	N/A	
	Bathymetric study recommended						
3.	Abnormally high or low water levels	0	1	2	3	N/A	Cause:
4.	Evidence of pollution/hotspot runoff	0	1	2	3	N/A	Cause:
5.	Berm(s)/embankment(s)	0	1	2	3	N/A	
	a. Cracking, bulging, or sloughing	0	1	2	3	N/A	
	b. Soft spots or sinkholes	0	1	2	3	N/A	
	c. Evidence of erosion/bare spots	0	1	2	3	N/A	
	d. Evidence of animal burrows	0	1	2	3	N/A	
	e. Presence of woody vegetation	0	1	2	3	N/A	

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

6. Riser/outlet	0	1	2	3	N/A	Type of riser:
a. Maintenance access to riser	0	1	2	3	N/A	
b. Structural condition of riser	0	1	2	3	N/A	
c. Condition of joints	0	1	2	3	N/A	
d. Trash/debris accumulation	0	1	2	3	N/A	
e. Woody growth within 5 ft. of outlet	0	1	2	3	N/A	
f. Emergency spillway eroding, or failing	0	1	2	3	N/A	
7. Low flow orifice	0	1	2	3	N/A	
a. Trash/debris accumulation	0	1	2	3	N/A	
b. Adjustable control valve accessible and operational	0	1	2	3	N/A	
8. Pond drain (underdrain) system (if applicable)	0	1	2	3	N/A	
a. Broken	0	1	2	3	N/A	
b. Clogged	0	1	2	3	N/A	
c. Adjustable control valve accessible and operational	0	1	2	3	N/A	
9. Vegetation	0	1	2	3	N/A	
a. Plant composition consistent with approved plans	0	1	2	3	N/A	
b. Presence of invasive species/weeds	0	1	2	3	N/A	
c. Dead vegetation/exposed soil	0	1	2	3	N/A	
d. Reinforcement planting recommended	☐					

E. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Outlets provide stable conveyance out of practice	0	1	2	3	N/A	
2. Excessive trash/debris/sediment accumulation at outlet	0	1	2	3	N/A	
3. Evidence of erosion at/around outlet/outfall	0	1	2	3	N/A	
4. Evidence of polluted water being released – discoloration, odor, staining, etc.	0	1	2	3	N/A	

F. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

☐	Inspected
☐	Not Inspected

Item		Comments
1. Complaints from local residents	0 1 2 3 N/A	
2. Mosquito proliferation	0 1 2 3 N/A	
3. Encroachment on practice or easement by buildings or other structures	0 1 2 3 N/A	
4. Adequate safety signage	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Sketch of practice

(note problem areas)

Grass Swale
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Practice ID: ______________________

Location: ______________________

Contact: ______________________

GPS Coordinates: ______________________

Phone Number: ______________________

E-mail: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

A. *Contributing Drainage Area*						
0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐ Inspected						
☐ Not Inspected						
Item						**Comments**
1. Excessive trash/debris	0	1	2	3	N/A	
2. Bare/exposed soil	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A	
5. Impervious area added	0	1	2	3	N/A	

B. *Inflow Points*						
0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐ Inspected						
☐ Not Inspected						
Item						**Comments**
1. Inflow points (e.g. curb cuts, edge of pavement, pipes) provide stable conveyance into the channel	0	1	2	3	N/A	
2. Excessive trash/debris/sediment accumulation at inflow points	0	1	2	3	N/A	
3. Evidence of erosion at/around inflow points	0	1	2	3	N/A	

C. *Practice (Grass Swale)*
0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.
☐ Inspected

Grass Swale

Maintenance Inspection Checklist

☐ Not Inspected

Item						Comments
1. Swale remains vegetated; no concrete, rip-rap, or other lining has been added	0	1	2	3	N/A	
2. Grade ensures positive flow	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Sediment accumulation	0	1	2	3	N/A	
5. Excessive trash/debris accumulation	0	1	2	3	N/A	
6. Evidence of oil/chemical accumulation	0	1	2	3	N/A	
7. Vegetation condition	0	1	2	3	N/A	
a. Mowing as needed to maintain 4"-6" grass height.	0	1	2	3	N/A	
b. 90% turf cover in practice.	0	1	2	3	N/A	
8. Check dams in place	0	1	2	3	N/A	
9. Signs of erosion around or under check dams	0	1	2	3	N/A	

D. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Complaints from local residents	0	1	2	3	N/A	
2. Mosquito breeding	0	1	2	3	N/A	
3. Encroachments (e.g. filling, fences, obstructions, etc.)	0	1	2	3	N/A	

Inspector's Summary:

Created: 2021-07-22 09:11:36 [EST]

Grass Swale
Maintenance Inspection Checklist

Photographs	
Photo ID	**Description**
1.	
2.	
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8.	
9.	
10.	

Sketch of Practice

(note problem areas)

Grass Swale

Maintenance Inspection Checklist

Appendix G: Compliance Calculator Spreadsheet Instructions

Table of Contents

G.1 Introduction

The compliance calculator spreadsheet (Appendix H) was created to allow a designer to quickly analyze multiple LID options and check them against the watershed area's water quality design requirements. As is clear from the specifications, each LID BMP has different design requirements, equations, and standards that determine its effectiveness. Depending upon the site, it can become difficult to determine which BMP(s) best meets the requirements. With the compliance calculator, it is easier to examine different combinations of BMPs in order to find the best option or set of options. The compliance calculator is also to be used by the plan reviewer to quickly verify the compliance status of a plan.

It is important to note that the compliance calculator is not a model, and while it can be used as a design tool, it does not replace the needed efforts of a competent designer. The numbers in the spreadsheet don't guarantee that a BMP meets the specifications, is appropriate for its location, or is generally well-designed.

G.2 Compliance Calculator Spreadsheet Guidance

The following guidance explains how to use each of the worksheets in the compliance calculator spreadsheet (Appendix H).

Note: All cells highlighted in blue are user input cells. Cells highlighted in gray are calculation cells, and cells highlighted in yellow are constant values that generally should not be changed.

Site Data Sheet

1. Enter the name of the proposed project on **line 9**.
2. Enter the pre-development land cover areas (in acres) of forest/open space cover, turf cover, impervious cover and BMP cover for the site for Natural Resource Conservation Service (NRCS) soil types A, B, C, and D in cells C24-C27, E24-E27, G24-G27, and I24-I27, respectively.
3. Verify/enter the NRCS runoff curve numbers for each land use/soil type combination in cells D24-D27, F24-F27, H24-H27, and J24-J27. Default values have already been included in these cells, but they can be changed if necessary.
4. Enter the post-development land cover areas (in acres) of forest cover/open space, turf cover, impervious cover and BMP cover on the site for Natural Resource Conservation Service (NRCS) soil types A, B, C, and D in cells C34-C37, E34-E37, G34-G37, and I34-I37, respectively.
5. Verify/enter the NRCS runoff curve numbers for each land use/soil type combination in cells D34-D37, F34-F37, H34-H37, and J34-J37. As with the pre-development entries, default values have already been included in these cells, but they can be changed if necessary.

BMP Sheet

1. Apply BMPs to the drainage area to address the required water quality volume by indicating the area in square feet (sf) of forest cover, turf cover, and impervious cover to be treated by a given BMP in **Columns B, C, and D**. This will likely be an iterative process. The available BMPs include the following:
   - Bioretention – No Underdrain
   - Bioretention - IWS
   - Bioretention - Standard
   - Permeable Pavement - Enhanced
   - Permeable Pavement - Standard
   - Infiltration
   - Green Roof
   - Green Roof – Irrigated
   - Rainwater Harvesting
   - Impervious Surface Disconnection
   - Grass Channel
   - Grass Channel – Amended Soils
   - Dry Swale
   - Wet Swale
   - Regenerative Stormwater Conveyance (RSC)
   - Filtering Systems
   - Storage Practices
   - Stormwater Ponds
   - Stormwater Wetlands
   - Proprietary Practice
   - Planted Tree
   - Preserved Tree
2. Enter the BMP's surface area (sf) in Column E and storage volume (cf) in Column F.
3. If a Stormwater Pond is used for irrigation the contributing drainage area and storage volume (determined from the Rainwater Harvesting Calculator) are entered in the Rainwater Harvesting cells B24, C24, D24, E24 and F24, respectively. The Stormwater Pond row remains empty unless there are other ponds used that are not used for irrigation.
4. If other Rainwater Harvesting BMPs are used, the Rainwater Harvesting Calculator is used to determine the contributing drainage area and storage volume inputs to the BMP worksheet.
5. The volume from direct drainage to the BMP is calculated and reported in **Column E**. Note that the total disturbed area is reflected as the sum of impervious cover (**Column D**), turf cover (**Column C**) and forest/open space cover (**Column B**) draining to the practice.
6. If more than one BMP will be employed in series, any overflow from upstream BMPs will be accounted for in **Column M**.

7. The total volume captured by the practice (V_{CAP}) is reported in **Column N** and is equal to the following:

$$W_{CCCCCC} = MMMMMMMMMMMMMM(SSSS, W_{UUUU} + W_{DDDD})$$

Where:

WQv_{CAP} = Water Quality Volume captured by the practice (cf) (**Column N)**
Sv = Storage Volume (cf) (**Column F)**
V_{US} = Volume of runoff from upstream practice (cf) (**Column M)**
V_{DD} = Volume of runoff from direct discharge (cf) (**Column L)**

8. The Runoff Reduction or Pollutant Removal Efficiency (%) for each BMP (from Table 2.3) is reported in **Columns H-K**.

9. The Water Quality Volume Credited is calculated in **Column O**, and is equal to the following:

$$WWWWSS_{CCCC} = MMMMMMMMMMMMMM\ oooo\ (SSSS \times CCCC, VV_{CCCCCC})$$

Where:

WQv_{CR} = Water Quality Volume Credited (cf)
Sv = Storage Volume (cf) **(Column F)**
CR = Credit (fraction)
V_{CAP}= Volume Captured by the Practice (cf) **(Column N)**

10. The Remaining Water Quality Volume **(Column P)** is calculated as:

$$WWWWSS_{CC} = VV_{UUUU} + VV_{DDDD} - WWWWSS_{CCCC}$$

Where:

WQv_R = Water Quality Volume Remaining (cf) **(Column O)**
V_{US} = Volume from Upstream Practices (cf) **(Column M)**
V_{DD} = Volume from Direct Drainage (cf) **(Column L)**

11. Any runoff volume remaining can be directed to a downstream BMP by selecting a practice from the pull-down menu in **Column G**. Selecting a BMP from the menu will automatically direct the runoff volume remaining to **Column M (volume from upstream practices)** for the appropriate BMP.

12. Planted Trees. Input the number of planted and preserved trees of each size class in cells F38-F42 (retention values correspond to Table 4.62 and 4.63 in design manual).

13. The Target Retention Volume (WQv_T) is reported in **Cell B49**, from corresponding **Cell C42** on the **Site Data Tab**.

14. The Water Quality Volume Provided (WQv_P), is calculated in **Cell C49** as a combination of the retention values for all BMPs and trees (Cells O17-O42)

15. The fraction of target achieved (either by practice or by the entire site as appropriate) is calculated in **Cells F31-F35).** The % of target achieved is calculated as follows:

$$TT = MMMMMMMMMMMMMM\ oooo\left(\frac{WWWWSS_{CC}}{WWWWSS_{TT}}, 1\right)$$

Where:

T = Treatment (fraction)

WQv_P = Water Quality Volume Provided (cf)
WQv_T = Water Quality Volume Target (cf)

16. **Cells D49, 52, 54, 58, and 61** determine if the site target has been reached as follows:
- Overall Retention Goal
  - Target Retention Volume
- General Stormwater Management Watershed Area Minimum Requirements
  - Target Retention Volume (1.16 in storm)
  - Target TSS Removal
  - Target Nitrogen Removal
  - Target Bacteria Removal
- Savannah River Special Watershed Protection Area Minimum Requirements
  - Target Retention Volume (1.16 in storm)
  - Target TSS Removal
  - Target Nitrogen Removal
  - Target Bacteria Removal

Channel and Flood Protection

This sheet assists with calculation of Adjusted Curve Numbers that can be used to calculate peak flows associated with the 2- to 100-year storm events.

17. Enter the appropriate depths for the 2-year, 10-year, 25-year and 100-year 24-hour storms (as provided in Table 2.4) on **Line 5**.
18. The Total Site Area (from the **Site Data** Tab), is reported in **Cell C7**.
19. Detention Storage Volume (cf) is calculated in **Cell C8**, and refers to the total storage provided in all LID practices using the following equation:

$$VV_{DDUU} = \sum_{LLLLDD\ BBBBCCBB} SSSS_{BBBBCC} \cdot IICCII_{BBBBCC}$$

Where:
V_{DS} = Volume in Site Detention Storage (cf)
Sv_{BMP} = Storage Volume Provided in Each BMP (cf) (from **Column F** of the **BMPs** Tab)
IRD_{BMP} = Infiltration, Retention or Detention Credit for Each BMP (from **Column J** of the **BMPs** Tab)

Note that, while other practices such as ponds provide detention, it is assumed that design engineers will explicitly account for this detention in a Pond Routing program.

20. As indicated in the Site Data sheet, each cover type is associated with a NRCS curve number. **Cells D15–G22** show the pre-development land cover areas and curve numbers that were indicated on the Site Data Sheet. Using these curve numbers, a weighted curve number is calculated in **cell G24**.

21. **Cells D29–G36** show the post-development land cover areas and curve numbers that were indicated on the Site Data Sheet. Using these curve numbers, a weighted curve number is calculated in **cell G38**.

22. Using NRCS methodology, **Line 42** calculates the pre-development runoff volume (inches) for the various storm events.

Potential Abstraction

$$SS = \frac{1000}{(CCCC - 10)}$$

Where:

S = potential abstraction (in.)
CN = weighted curve number

Runoff Volume

$$WW = \frac{(PP - 0.2 \cdot SS)^2}{(PP + 0.8 \cdot SS)}$$

Where:

Q = runoff volume (in.)
P = precipitation depth for a given 24-hour storm (in.)
S = potential abstraction (in.)

23. **Line 43** calculates the post-development runoff volume based solely on land cover (without regard to the BMPs selected on the BMP sheet). **Line 44** then subtracts the runoff reduction volume provided by BMPs, from **Cell C8**.

24. Based upon the reduced runoff volumes calculated in line 44, the spreadsheet then calculates corresponding reduced curve numbers for each storm event. This Adjusted Curve Number is reported on **Line 45**.

25. **Line 46** compares the pre-development runoff volume in line 42 with the post-development (with BMPs) runoff volume in line 44. If the post-development volume (with BMPs) is less than or equal to the pre-development volume for a given storm event, then it is assumed that detention will not be required. If the post-development volume (with BMPs) is greater than the pre-development volume for a given storm event, then detention will be necessary, and the Adjusted Curve Numbers form line 45 should be used to calculate the post-development peak runoff rates.

Southern Low Country Stormwater Compliance Calculator - Updated 8/20/20

(cyan)	data input cells
(gray)	calculation cells
(yellow)	constant values

Site Data

Site Name:

Watershed Protection Area

Design Storm (in.)	#N/A

	Runoff Coefficients			
	Soil Type A	Soil Type B	Soil Type C	Soil Type D
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95
BMP	0.95	0.95	0.95	0.95

Indicate Pre-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

	Area (square feet)										
Cover Type	Soil Type A	CN	Soil Type B	CN	Soil Type C	CN	Soil Type D	CN	Total	**% Cover**	Rv
Forest Cover/Open Space		30		55		70		77	0	0%	0
Turf Cover		39		61		74		80	0	0%	0
Impervious Cover		98		98		98		98	0	0%	0
BMP		98		98		98		98	0	0%	0
Total	0		0		0		0		0	0%	0.00

Indicate Post-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

	Area (square feet)										
Cover Type	Soil Type A	CN	Soil Type B	CN	Soil Type C	CN	Soil Type D	CN	Total	**% Cover**	Rv
Forest Cover/Open Space		30		55		70		77	0	0%	0
Turf Cover		39		61		74		80	0	0%	0
Impervious Cover		98		98		98		98	0	0%	0
BMP		98		98		98		98	0	0%	0
Total	0		0		0		0		0	0%	0.0000

Stormwater Retention Volume (cf)	**No SWMP Required**

Southern Low Country Stormwater Compliance Calculator - Updated 8/20/20

Site Drainage Area 1

Indicate Post-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

	Area (square feet)						
Cover Type	Soil Type A	Soil Type B	Soil Type C	Soil Type D	Total	% Cover	Rv
Forest Cover/Open Space					0	0%	0
Turf Cover					0	0%	0
Impervious Cover					0	0%	0.95
BMP					0	0%	0.95
Total	0	0	0	0	0	0%	0

BMPs

	Contributing Drainage Area				Storage Volume Provided by BMP (cubic feet)	Downstream BMP	Water Quality Credits				Retention (cf)			
	Forest Cover Draining to BMP	Turf Cover Draining to BMP	Impervious Cover Draining to BMP	BMP Surface Area										
	Area (square feet)	Area (square feet)	Area (square feet)	Area (square feet)			Runoff Reduction	TSS % Removal	Total N % Removal	Bacteria % Removal	Volume from Direct Drainage	Volume from Upstream Practices	Total Volume Captured by BMP	Volume Credited
Bioretention - No Underdrain							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Bioretention - IWS							75%	85%	85%	80%	#N/A	0	#N/A	#N/A
Bioretention - Standard							60%	85%	75%	80%	#N/A	0	#N/A	#N/A
Permeable Pavement - Enhanced							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Permeable Pavement - Standard							30%	80%	45%	30%	#N/A	0	#N/A	#N/A
Infiltration							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Green Roof							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Rainwater Harvesting							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Impervious Surface Disconnection							40%	80%	40%	40%	#N/A	0	#N/A	#N/A
Grass Channel							10%	50%	25%	30%	#N/A	0	#N/A	#N/A
Grass Channel - Amended Soils							20%	50%	35%	30%	#N/A	0	#N/A	#N/A
Dry Swale							60%	85%	70%	80%	#N/A	0	#N/A	#N/A
Wet Swale							0%	80%	25%	60%	#N/A	0	#N/A	#N/A
RSC							0%	80%	40%	80%	#N/A	0	#N/A	#N/A
Filtering Systems							0%	80%	30%	80%	#N/A	0	#N/A	#N/A
Storage Practices							0%	60%	10%	60%	#N/A	0	#N/A	#N/A
Stormwater Ponds							0%	80%	30%	60%	#N/A	0	#N/A	#N/A
Stormwater Wetlands							0%	80%	25%	60%	#N/A	0	#N/A	#N/A
Proprietary Practice											#N/A	0	#N/A	#N/A
					Input Number of Trees									
Planted Tree - Small							5 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Planted Tree - Large							10 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Preserved Tree - Small							10 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Preserved Tree - Large							20 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Preserved Tree - Special							30 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Totals	0.00	0.00	0.00		0.00									

Southern Low Country Stormwater Compliance Calculator - Updated 8/20/20

Detention Calculations

Site Area (square feet)

Storage Volume Provided by BMPs 0

Land Area		A Soils	B Soils	C Soils	D Soils
Forest Cover	CN	30	55	70	77
Turf Cover	CN	39	61	74	80
Impervious Cover	CN	98	98	98	98
BMP	CN	98	98	98	98

Land Area		A Soils	B Soils	C Soils	D Soils
Forest Cover	CN	30	55	70	77
Turf Cover	CN	39	61	74	80
Impervious Cover	CN	98	98	98	98
BMP	CN	98	98	98	98

Pre-Development Runoff Volume (in)

Post Development Runoff Volume (in) with no BMPs

Post-Development Runoff Volume (in) with BMPs

2-year storm	10-year storm	25-year storm	100-year storm		
v (in)	v (in)	v (in)	v (in)	CN	S
0.00	0.01	0.10	0.49	25	30.00
0.00	0.01	0.12	0.54	25.5	29.22
0.00	0.02	0.15	0.60	26.1	28.31
0.00	0.02	0.16	0.62	26.3	28.02
0.00	0.02	0.17	0.64	26.5	27.74
0.00	0.03	0.18	0.66	26.7	27.45
0.00	0.03	0.19	0.68	26.9	27.17
0.00	0.04	0.21	0.73	27.3	26.63
0.00	0.05	0.22	0.75	27.5	26.36
0.00	0.05	0.23	0.77	27.7	26.10
0.00	0.06	0.24	0.79	27.9	25.84
0.00	0.06	0.25	0.81	28.1	25.59
0.00	0.07	0.26	0.83	28.3	25.34
0.00	0.26	0.62	1.45	33.5	19.85
0.00	0.28	0.64	1.48	33.8	19.59
0.00	0.28	0.65	1.50	33.9	19.50
0.01	0.32	0.70	1.58	34.6	18.90
0.04	0.47	0.93	1.94	37.4	16.74
0.06	0.54	1.04	2.11	38.7	15.84
0.07	0.58	1.09	2.18	39.2	15.51
0.11	0.68	1.23	2.39	40.8	14.51
0.12	0.71	1.28	2.45	41.3	14.21
0.12	0.72	1.29	2.47	41.4	14.15
0.12	0.72	1.30	2.48	41.5	14.10
0.12	0.73	1.31	2.49	41.6	14.04
0.13	0.73	1.31	2.51	41.7	13.98
0.13	0.74	1.32	2.52	41.8	13.92
0.13	0.75	1.33	2.53	41.9	13.87
0.13	0.75	1.34	2.55	42	13.81
0.14	0.76	1.35	2.56	42.1	13.75
0.14	0.77	1.36	2.57	42.2	13.70
0.14	0.77	1.37	2.59	42.3	13.64
0.14	0.78	1.38	2.60	42.4	13.58
0.15	0.79	1.39	2.61	42.5	13.53
0.15	0.80	1.40	2.63	42.6	13.47
0.19	0.88	1.52	2.80	43.9	12.78
0.19	0.89	1.53	2.81	44	12.73
0.19	0.90	1.54	2.83	44.1	12.68
0.19	0.91	1.55	2.84	44.2	12.62
0.20	0.91	1.56	2.85	44.3	12.57

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Watershed Protection Area	Design Storm
General Stormwater Management Watershed Area	1.16
Savannah River Special Watershed Protection Area	1.16
Bacteria and Shellfish Special Watershed Protection Area	1.95

0%
100%

0%
80%

Appendix I: General Design Criteria and Guidelines

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I.1 Hydrology and Runoff Determination

I.1.1 Acceptable Hydrologic Methods and Models

The following are the acceptable methodologies and computer models for estimating runoff hydrographs before and after development. These methods are used to predict the runoff response from given rainfall information and site surface characteristic conditions. The design storm frequencies used in all of the hydrologic engineering calculations will be based on design storms required in this guidebook unless circumstances make consideration of another storm intensity criterion appropriate:

- Rational Method (limited to sites under 10 acres)
- Urban Hydrology for Small Watersheds TR-55 (TR-55)
- Storage-Indication Routing
- HEC-1, WinTR-55, TR-20, and SWMM Computer Models

These methods are given as valid in principle and are applicable to most stormwater management design situations in the Southern Lowcountry. Other methods may be used when the Southern Lowcountry reviewing authority approves their application.

Note: Of the above methods, TR-55 and SWMM allow for the easiest correlation of the benefits of retention BMPs used to meet the stormwater retention volume (SWRv) with peak flow detention requirements and are therefore strongly recommended.

The following conditions shall be assumed when developing predevelopment, pre-project, and post-development hydrology, as applicable:

- For new development sites the runoff conditions shall be computed independent of existing developed land uses and conditions and shall be based on “Meadow in good condition” or better, assuming good hydrologic conditions and land with grass cover (NEH, 2004).
- For infill and redevelopment sites the predeveloped condition is the condition at the time of project submittal.
- Post-development conditions shall be computed for future land use assuming good hydrologic and appropriate land use conditions. If an NRCS CN Method-based approach, such as TR-55, is used, this curve number (CN) may be reduced based upon the application of retention BMPs, as indicated in the General Retention Compliance Calculator (Appendix H). This CN reduction will reduce the required detention volume for a site, but it should not be used to reduce the size of conveyance infrastructure.
- The rainfall intensity - duration - frequency curve should be determined from the most recent version of the Hydrometeorological Design Studies Center’s Precipitation Frequency Data Server (NOAA Atlas 14, Volume 2).
- Predevelopment Time of Concentration (Tc) shall be based on the sum total of computed or estimated overland flow time and travel in natural swales, streams, creeks and rivers, but never less than 6 minutes.
- Post-development Time of Concentration shall be based on the sum total of the inlet time and travel time in improved channels or storm drains but shall not be less than 6 minutes.
- Site drainage areas exceeding 10 acres that are heterogeneous with respect to land use, soils, RCN or Time of Concentration (Tc) shall require a separate hydrologic analysis for each sub-area.
- Hydrologic soil groups (HSGs) approved for use in the <local jurisdiction> are contained in the US Department of Agriculture Web Soil Survey. Where the HSG is not available through the Soil Survey due to the listed soil type being “Urban Soils” or similar, an HSG of C shall be used.

I.1.1.1 Urban Hydrology for Small Watersheds TR-55

Chapter 6 of Urban Hydrology for Small Watersheds TR-55, Storage Volume for Detention Basins, or TR-55 shortcut procedure, is based on average storage and routing effects for many structures and can be used for multistage outflow devices. Refer to TR-55 for more detailed discussions and limitations.

Information Needed

To calculate the required storage volume using TR-55, the predevelopment hydrology, along with the post-development hydrology for the 2, 10 and 25-year, 24-hour storm events are needed. The predevelopment hydrology is based on natural conditions (meadow) and will determine the site’s predevelopment peak rate of discharge, or allowable release rate, *qo*.

The post-development hydrology may be determined using the reduced CNs calculated in the General Retention Compliance Calculator or more detailed routing calculations. This will determine the site’s post-development peak rate of discharge, or inflow for the 2, 10 and 25-year, 24-hour storm events, and the site’s post-developed runoff in inches. Note that this method does not require a hydrograph. Once the above parameters are known, the TR-55 Manual can be used to approximate the storage volume required for each design storm.

Procedure

1) Determine the peak development inflows, q_i, and the allowable release rates, q_o, from the hydrology for the appropriate design storm.

Using the ratio of the allowable release rate (q_O) to the peak developed inflow (q_i)—or q_O/q_i—for the design storms, use Figure 1 to obtain the ratio of storage volume (V_S) to runoff volume (V_R)—for Type III storms.

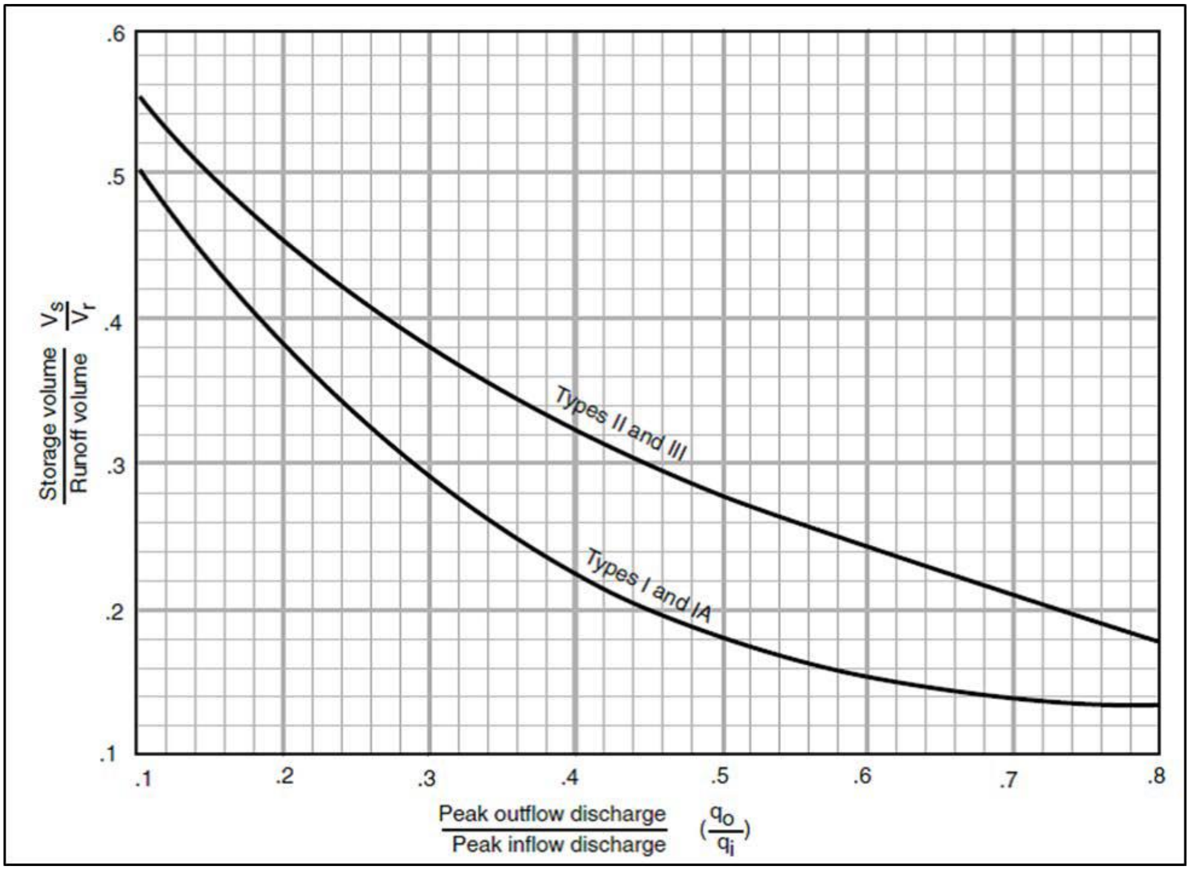

Figure 1. Approximate detention basin routing for rainfall Types I, IA, II, and III.

2) Determine the runoff volume V_R.

$$W_R = \frac{QQ}{12} \times SSSSSS$$

where:

V_R	= post-development runoff for the design storm (ft^3)
Q	= post-development runoff for the design storm (in)
12	= conversion factor (inches to feet)
SDA	= site drainage area (ft^2)

3) Multiply the V_S/V_R ratios from Step 1 by the runoff volume (V_R) from Step 2 to determine the required storage volumes (V_S) in acre-feet.

$$\frac{VV_{SS}}{VV_{RR}} VV_{RR} = VV_{SS}$$

The design procedure presented above may be used with Urban Hydrology for Small Watersheds TR-55 Worksheet 6a. The worksheet includes an area to plot the stage-storage curve, from which actual elevations corresponding to the required storage volumes can be derived. The characteristics of the stage-storage curve are dependent upon the topography of the proposed storage practice and the outlet structure, and it may be best developed using a spreadsheet or appropriate hydraulics software.

Limitations

This routing method is less accurate as the q_O/q_i ratio approaches the limits shown in Figure 1. The curves in Figure 1 depend on the relationship between available storage, outflow device, inflow volume, and shape of the inflow hydrograph. When storage volume (V_S) required is small, the shape of the outflow hydrograph is sensitive to the rate of the inflow hydrograph. Conversely, when V_S is large, the inflow hydrograph shape has little effect on the outflow hydrograph. In such instances, the outflow hydrograph is controlled by the hydraulics of the outflow device and the procedure therefore yields consistent results. When the peak outflow discharge (q_O) approaches the peak inflow discharge (q_i) parameters that affect the rate of rise of a hydrograph, such as rainfall volume, CN, and Time of Concentration, become especially significant.

The procedure should not be used to perform final design if an error in storage of 25% cannot be tolerated. Figure 1 is biased to prevent under-sizing of outflow devices, but it may significantly overestimate the required storage capacity. More detailed hydrograph development and storage indication routing will often pay for itself through reduced construction costs.

I.1.1.2 Storage-Indication Routing

Storage-Indication Routing may be used to analyze storage detention practices. This approach requires that the inflow hydrograph be developed through one of the methods listed in this appendix (TR-55, WinTR-55, SWMM, etc.), as well as the required maximum outflow, q_o. Using the stage-discharge relationship for a given combination outlet devices, the detention volume necessary to achieve the maximum outflows can be determined.

I.1.1.3 HEC-1, WinTR-55, TR-20, ICPR and SWMM Computer Models

If the application of the above computer models is needed, the complete input data file and print-out will be submitted with the Stormwater Management Plans (SWMPs). Submission of SWMPs shall include the following computer model documentation:

- For all computer models, supporting computations prepared for the data input file shall be submitted with the SWMPs.
- Inflow-outflow hydrographs shall be computed for each design storm presented graphically and submitted for all plans.
- Schematic (node) diagrams must be provided for all routings.

I.1.2 Stormwater Volume Peak Discharge

The peak rate of discharge for individual design storms may be required for several different components of water quality BMP design. While the primary design and sizing factor for most stormwater retention BMPs is the design Stormwater Retention Volume (SWRv), several design elements will require a peak rate of discharge for specified design storms. The design and sizing of pretreatment cells, level spreaders, by-pass diversion structures, overflow riser structures, grass swales, and water quality swale geometry, etc. all require a peak rate of discharge in order to ensure non-erosive conditions and flow capacity.

The peak rate of discharge from an SDA can be calculated from any one of several calculation methods discussed in this appendix. The two most commonly used methods of computing peak discharges for peak runoff calculations and drainage system design are NRCS TR-55 CN methods (NRCS TR-55, 1986) and the Rational Formula. The Rational Formula is limited to 10 acre drainage areas. It is highly sensitive to the Time of Concentration and rainfall intensity, and therefore should only be used with reliable Intensity-Duration-Frequency (IDF) curves or tables for the rainfall depth and region of interest (Claytor & Schueler, 1996).

The NRCS CN methods are very useful for characterizing complex sub-watersheds and SDAs and estimating the peak discharge from large storms (greater than 2 inches), but it can significantly underestimate the discharge from small storm events (Claytor and Schueler, 1996). Since the SWRv is based on smaller storm events, this underestimation of peak discharge can lead to undersized diversion and overflow structures, potentially bypassing a significant volume of the design SWRv around the retention practice. Undersized overflow structures and outlet channels can cause erosion of the BMP conveyance features that can lead to costly and frequent maintenance.

In order to maintain consistency and accuracy, the following Modified CN Method is recommended to calculate the peak discharge for the SWRv rain event. The method utilizes the Small Storm Hydrology Method (Pitt, 1994) and NRCS Graphical Peak Discharge Method (USDA, 1986) to provide an adjusted CN that is more reflective of the runoff volume from impervious areas within the SDA. The design rainfall is a NRCS Type III distribution, so the method incorporates the peak rainfall intensities common in the eastern United States, and the time of concentration is computed using the method outlined in TR-55.

The following steps describe how to calculate the SWRv peak rate of discharge (q_{pSWRv}) for the 85th percentile rain (1.16-inch) event.

1) Calculate the adjusted CN for the site or contributing drainage area (CDA).
The following equation is derived from the NRCS CN Method and is described in detail in the National Engineering Handbook Part 630 Chapter 10: Estimation of Direct Runoff from Storm Rainfall and NRCS TR-55 Chapter 2: Estimating Runoff:

$$CN = \frac{1{,}000}{10 + 5P + 10Q_a - 10(Q_a^2 + 1.25Q_aP)^{0.5}}$$

where:

CN = adjusted curve number

P = rainfall (in, 1.16 or 1.95 in)

Q_a = runoff volume (watershed inches), equal to SWRv/SDA

Note: When using hydraulic/hydrologic model for sizing a retention BMP or calculating the SWRv peak discharge, designers must use this modified CN for the CDA to generate runoff equal to the SWRv for the design rainfall event.

2) Compute the site drainage area's time of concentration (*Tc*).
TR-55 Chapter 3: Time of Concentration and Travel Time provides a detailed procedure for computing the Tc.

3) **Calculate the stormwater retention volume peak discharge (q_{pSWRv}).**
The q_{pSWRv} is computed using the following equation and the procedures outlined in TR-55, Chapter 4: Graphical Peak Discharge Method. Designers can also use WinTR-55 or an equivalent TR-55 spreadsheet to compute q_{pSWRv}:

- Read initial abstraction (I_a) from TR-55 Table 4.1 or calculate using I_a = 200/CN – 2
- Compute I_a/P (P = 1.16)
- Read the Unit Peak Discharge (q_u) from Exhibit 4-II using Tc and I_a/P
- Compute the q_{pSWRv} peak discharge:

$$qqqq_{SSSSRRSS} = qq_{uu} \times SS \times QQ_{aa}$$

where:

q_{pSWRv}	= stormwater retention volume peak discharge (ft^3/sec)
q_u	= unit peak discharge (ft^3/sec/mi^2/in)
A	= site drainage area (mi^2)
Q_a	= runoff volume (watershed inches), equal to SWRv/SDA

This procedure is for computing the peak flow rate for the 85th and 95th percentile rainfall events. Calculations of peak discharge from larger storm events for the design of drainage systems, culverts, etc., should use published CNs and computational procedures.

I.2 Storm Sewer Collection System

I.2.1 Introduction

The focus of *the Southern Lowcountry Stormwater Design Manual* is to define standards and specifications for design, construction and maintenance of BMPs required to meet post construction stormwater performance objectives. Design of the conveyance of stormwater runoff within the public right-of-way (PROW) must follow the current requirements in SCDOT's Requirements for Hydraulic Studies, Part 2 Requirements for Roadway Drainage (SCDOT, 2009). These are incorporated by reference with the following notes pertinent to the *<local jurisdiction>*.

I.2.2 Clearance with Other Utilities

- All proposed and existing utilities crossing or parallel to designed storm sewer systems must be shown on the plan and profile.
- Storm drain and utility crossings must not have less than a 45-degree angle between them.
- Minimum vertical and horizontal clearances, wall to wall, must be provided between storm drainage lines and other utilities as defined by the Beaufort-Jasper Water & Sewer Authority.

I.2.3 Pipe Systems

- The pipe sizes used for any part of the storm drainage system within the PROW must be designed in accordance with the current requirements in SCDOT's Requirements for Hydraulic Studies, Part 2 Requirements for Roadway Drainage. (SCDOT, 2009)

- The material and installation of the storm drain for any part of public storm sewer must be designed in accordance with the current requirements in SCDOT's Requirements for Hydraulic Studies, Part 2 Requirements for Roadway Drainage (SCDOT, 2009). An exception to the SCDOT list is spiral ribbed aluminum pipe (SRAP), which is not an acceptable pipe material for brackish waters. Materials shall be RCP, CAAP, HDPE or HP Storm per AASHTO standards for H20/H25 loading and installation per ASTM/AASHTO standards. Durability must be 100 years or greater per SCDOT standards.
- An alternative overflow path for the 100-year storm is to be shown on the plan view if the path is not directly over the pipe. Where applicable, proposed grading must ensure that overflow will be into attenuation facilities designed to control the 100-year storm.
- A pipe schedule tabulating pipe length by diameter and class is to be included on the drawings. Public and private systems must be shown separately.
- Profiles of the proposed storm drains must be shown on the drawings and indicate size, type, and class of pipe, percent grade, existing ground and proposed ground over the proposed system, and invert elevations at both ends of each pipe run. Pipe elevations and grades must be set to avoid hydrostatic surcharge during design conditions. Where hydrostatic surcharge greater than 1-foot of head cannot be avoided, a rubber gasket pipe is to be specified.

I.2.4 Hydraulic Grade Line

The existing grade line and proposed 25- and 100-year hydraulic grade lines (HGL) must be clearly indicated on the system profiles and identified with the initials HGL on the line and identified in the legend key. This grade line must take into consideration pipe and channel friction losses, computing structures losses, tailwater conditions and entrance losses. All pipe systems must be designed so that they will operate without building up a surcharged hydrostatic head under design flow conditions. It is recommended that the HGL be no more than 1 foot above the pipe crown. If pipes have a HGL more than 1 foot above the pipe crown, rubber gaskets are required. The 100-year HGL must not overtop the 6” curb of ingress/egress routes that would isolate interior parcels in the extreme flood event.

If the structural stormwater BMP discharges into a storm sewer, a detailed HGL analysis of the system including the receiving system must be submitted with the final Stormwater Management Plans (SWMPs) for 100-year storm event. Provide documentation supporting safe passage of the 100-yr post-development flow downstream and an analysis of the surrounding neighborhood area to identify any existing capacity shortfalls or drainage blockages based on the 10% rule in Section 3.8.

I.3 Open Channels

- Calculations must be provided for all channels, streams, ditches, swales, etc., including a typical section of each reach and a plan view with reach locations. In the case of existing natural streams/swales, a field survey of the stream (swale) cross sections may be required prior to the final approval.
- The final designed channel must safely pass the 100-yr storm event.
- If the base flow exists for a long period of time or velocities are more than 5 feet per second in earth and sodded channel linings, gabion or riprap protection must be provided at the intersection of the inverts and side slopes of the channels unless it can be demonstrated that the final bank and vegetation are sufficiently erosion-resistant to withstand the designed flows, and the channel will stay within the floodplain easement throughout the project life.

- Channel inverts and tops of bank are to be shown in plan and profile views.
- For a designed channel, a cross section view of each configuration must be shown.
- For proposed channels, a final grading plan must be provided.
- The limits of a recorded 100-year floodplain easement or surface water easement sufficient to convey the 100-year flow must be shown.
- The minimum 25-foot horizontal clearance between a residential structure and 100-year floodplain must be indicated in the plan.
- For designed channels, transition at the entrance and outfall is to be clearly shown on the site

Appendix J: Rainwater Harvesting Treatment and Management Requirements

This Appendix is provided as an example of requirements necessary for approval of use of reclaimed rainwater in non-potable water systems. It is not intended to regulate water retained by another BMP for use in irrigation and to meet stormwater retention volume requirements.

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J.1 Rainwater Harvesting Treatment and Management Requirements

J.1.1 Introduction

The majority of the information and requirements provided herein are excerpted from the 2017 Water Environment and Reuse Foundation Report: Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems (DNWS Report), and much of the text is directly quoted. In some cases, text from this report has been modified to conform to the Stormwater Design Manual and <*local jurisdiction*> review and inspection procedures.

The purpose of this appendix is to provide information and guidance through a risk-based framework to help designers and <*local jurisdiction*> ensure that all rainwater harvesting systems are adequately protective of public health. This appendix identifies pathogen reduction targets that must be met and various treatment systems that can be used to meet the targets, as well as volatile organic compound (VOC) limits that must be achieved storage and distribution management considerations, operation and maintenance as well as long-term monitoring and reporting requirements are also discussed.

J.1.2 Pathogen Reduction Targets

Risk-based pathogen reduction targets have been developed based on analysis of potential human health risks associated with exposure to microbial hazards, and are based on a "10^{-4} Per Person per Year Benchmark." This means that the agreed-upon "tolerable" risk level is a probability of infection of 1 in 10,000 people per year. Pathogen reduction targets are expressed in terms of the 95th percentile Log_{10} Reduction Target (LRT). LRTs were developed for each source water and end use addressed in this appendix based on attaining the "tolerable" infection risk. If a system can maintain this level of treatment performance at all times, then the predicted probability of infection across the population will be less than the 1 in 10,000 benchmark for each pathogen 95% of the time.

The LRT for each non-potable use scenario is presented in Table 1 for healthy adults (values are based on the DNWS Report, although additional uses have been added). A rainwater harvesting system must maintain this level of treatment performance at all times for all three pathogen types: viruses, protozoa, and bacteria. When both general runoff and roof runoff (as defined below in Table 1) are combined, the reduction targets for general runoff shall apply. Similarly, when multiple uses are proposed, the highest reduction targets shall apply.

Table 1. Ninety-fifth percentile log10 pathogen reduction targets (LRT) to meet infection ppy benchmarks for healthy adults.

Water Source and Use	**Log_{10} Reduction Targets for 10^{-4} Per Person Per Year Benchmarks**		
	Enteric Viruses	**Parasitic Protozoa**	**Enteric Bacteria**
General Runoff[a]			
Cooling Towers[b]	–	–	–
Irrigation	5.0	4.5	4.0
Indoor Use	5.5	5.5	5.0
Roof Runoff[c]			
Cooling Towers[b]	–	–	–
Irrigation	N/A	Limited data available	3.5
Indoor Use	N/A	Limited data available	3.5

a. For the purposes of this appendix, general runoff means precipitation runoff from rain or snowmelt events that flows over land and/or impervious surfaces (e.g., streets, sidewalks, and parking lots). It also includes runoff from roofs or parking garages with frequent public access.

b. The pathogen risks associated with cooling towers and other uses in which there is no public exposure can be controlled by post-treatment management practices rather than initial treatment. The reason is that greater microbial risks from this use is likely to result from not controlling the growth of water-based pathogens (e.g., Legionella pneumophila, Pseudomonas aeruginosa, and non-tuberculous mycobacteria) that may proliferate in stagnant piped water. Management practices are discussed in Section J.1.7 Storage and Distribution Management Practices.

c. Roof runoff means precipitation from a rain event that is collected directly from a roof surface not subject to frequent public access.

The non-potable uses and LRTs included in Table 1 assume that human contact with the harvested water will be infrequent, and ingestion unintentional. Uses where frequent human contact with the harvested water is intended, like fountains or splash pads, will be considered similar to swimming pools, and must meet the standards defined by the *<local jurisdiction>*. The remaining sections in this appendix only cover non-potable uses with infrequent human contact. Treatment and monitoring procedures for frequent contact uses will be reviewed on a case-by-case basis.

Treatment Process

A well-established and accepted concept in modern drinking water and water reuse practices is to attribute the log10 reduction of pathogen groups to specific technologies that are operated within defined limits, coupled with appropriate control points to demonstrate the proper performance of the technology. This is referred to as the log10 reduction value (LRV) and can be compared directly to the LRTs described in Section J.1.2 above. Various treatment processes and treatment trains can be used to obtain the LRT for each pathogen for a given combination of source water and end use. Sections J.1.5 and J.1.6 discuss a range of treatment processes and provide LRVs for each process.

J.1.3 Filtration

The removal of particulate matter, including pathogens, by size exclusion is of interest because filters can serve as a barrier to pathogens in water. Filtration is especially important because pathogens can be shielded by or embedded in particulate matter, reducing the effectiveness of subsequent disinfection processes. Typical values for pathogen group log10 reduction by filtration processes are summarized in Table 2.

Table 2. Typical values for pathogen reduction using filtration processes.

Barrier	Typical Log_{10} Reduction Values		
	Virus	Protozoa	Bacteria
Slow sand filter	2	4	2
Dual media filter with coagulant	1	2	1
Cartridge/bag filter (5-10 microns)	0	0	0
Cartridge/bag filter (3 microns or less)	0	3	0
Cartridge/bag filter (1 micron)	0	4	0
Diatomaceous earth	1	4	2
Microfilter	1	6	6
Ultrafilter or Nanofilter	6	6	6
Reverse osmosis	6	6	6

J.1.4 Disinfection

Processes for pathogen inactivation include disinfection by chlorine, peracetic acid, ozone, ultraviolet (UV) radiation, advanced oxidation, and pasteurization. Particles in water can inhibit effective disinfection through shading (in the case of UV) and shielding embedded pathogens. Larger particles may require more time for a disinfecting agent to penetrate the particle and reach an embedded pathogen; therefore, for any disinfectant to be effective, particles larger than 10 microns must be removed.

Typical values for the inactivation of pathogens for disinfection processes in filtered water are given in Table *3*, Table 4, and

Table 5. These values serve as a guide to the relative effectiveness of different disinfection technologies and are not for a specific microorganism.

Table 3. Typical values for various levels of the inactivation of enteric virus in filtered secondary effluent with selected disinfection processes.

Disinfectant	Unit[b]	Dose for Corresponding Log_{10} Reduction Value			
		1 Log_{10}	2 Log_{10}	3 Log_{10}	4 Log_{10}
Free chlorine	mg•min/L	–	1.5–1.8	2.2–2.6	3.0–3.5
Chloramine[a]	mg•min/L	–	370–400	550–600	750–800
Peracetic acid	mg•min/L	NA	NA	NA	NA
Ozone	mg•min/L	–	0.25–0.30	0.35–0.45	0.50–0.60
Ultraviolet radiation	mJ/cm^2	50–60	90–110	140–150	180–200
Advanced oxidation	mJ/cm^2	10–20	50–60	70–80	110–130
Pasteurization (60°C)	Second	140	280	420	560
a. Due to interferences with chloro-organic compounds, when chloramine is used as a disinfectant, log10 reductions can only be used if the actual dosage of monochloramine is known, not just the amount of combined chlorine.					
b. mg•min/L = Milligram-minutes per liter					
c. mJ/cm2 = Millijoules per square centimeter.					

Table 4. Typical values for various levels of the inactivation of parasitic protozoa in filtered secondary effluent with selected disinfection processes.

Disinfectant	Unit[b]	Dose for Corresponding Log_{10} Reduction Value			
		1 Log_{10}	2 Log_{10}	3 Log_{10}	4 Log_{10}
Free chlorine	mg•min/L	2,000–2,600	NA	NA	NA
Chloramine[a]	mg•min/L	NA	NA	NA	NA
Peracetic acid	mg•min/L	NA	NA	NA	NA
Ozone	mg•min/L	4.0–4.5	8.0–8.5	12–13	NA
Ultraviolet radiation	mJ/cm^2	2–3	5–6	11–12	20–25
Advanced oxidation	mJ/cm^2	2–3	5–6	10–12	20–25
Pasteurization (60°C)	Second	30	60	90	120
a. Due to interferences with chloro-organic compounds, when chloramine is used as a disinfectant, log10 reductions can only be used if the actual dosage of monochloramine is known, not just the amount of combined chlorine.					
b. mg•min/L = Milligram-minutes per liter.					
c. mJ/cm2 = Millijoules per square centimeter.					

Table 5. Typical values for various levels of the inactivation of enteric bacteria in filtered secondary effluent with selected disinfection processes.

Disinfectant	Unit[b]	Dose for Corresponding Log_{10} Reduction Value			
		1 Log_{10}	**2 Log_{10}**	**3 Log_{10}**	**4 Log_{10}**
Free chlorine	mg•min/L	0.4–0.6	0.8–1.2	1.2–1.8	1.6–2.4
Chloramine[a]	mg•min/L	50–70	95–150	140–220	200–300
Peracetic acid	mg•min/L	10–25	40–60	75–125	150–200
Ozone	mg•min/L	0.005–0.01	0.01–0.02	0.02–0.03	0.03–0.04
Ultraviolet radiation	mJ/cm^2	10–15	20–30	30–45	40–60
Advanced oxidation	mJ/cm^2	4–6	6–8	8–10	10–12
Pasteurization (60°C)	Second	50	100	150	200
a. Due to interferences with chloro-organic compounds, when chloramine is used as a disinfectant, log10 reductions can only be used if the actual dosage of monochloramine is known, not just the amount of combined chlorine.					
b. mg•min/L = Milligram-minutes per liter.					
c. mJ/cm2 = Millijoules per square centimeter.					

J.1.5 Treatment Trains

Most non-potable water systems use a number of unit processes in series to accomplish treatment, known commonly as the “multiple barrier” approach. Multiple barriers are used to improve the reliability of a treatment approach through process redundancy, robustness, and resiliency. When multiple treatment barriers are used to achieve the pathogen LRT, the contribution from each barrier is cumulative; therefore, a reduction in performance by one process is mitigated by other processes in the treatment train.

In addition to these treatment barriers, operational and management barriers are used to ensure that systems are in place to respond to non-routine operation. Treatment barriers can be monitored using sensors and instrumentation for continuous process monitoring. An important ability is to take the treatment train offline automatically in the event of process malfunction.

If each barrier in a treatment train is independent, the LRVs for each process in the treatment train can be added together to obtain the overall treatment train LRV.

J.1.6 Volatile Organic Compounds

For rainwater harvesting systems that use general runoff from vehicular access areas as a source and will have some level of public exposure risk, the treated water must be tested for the presence of volatile organic compounds (VOCs); however, this does not apply when the water will be used for cooling towers or other “no public exposure” uses. The test must be performed by the system operator prior to commissioning of the system (see Commissioning) and prior to subsequent *<local jurisdiction>* maintenance inspections (see Operational Monitoring and Reporting). VOC levels must be below the maximums indicated in Table 6. If any VOC levels exceed these limits, the rainwater harvesting system must not be utilized until the problem is satisfactorily addressed, and a successful test has been performed. VOC limit exceedances may be addressed through source controls or through provision of additional treatment devices.

Table 6. Volatile organic compound maximum concentrations.

VOC	Maximum Concentration (mg/L)[a]
Benzene	0.1
Carbon Tetrachloride	0.5
1,2-Dichlorobenzene	5.4
1,4-Dichlorobenzene	5.4
1,1 Dichloroethane	14.4
1,2 Dichloroethane	0.1
1,1-Dichloroethylene	0.1
cis-1,2-Dichloroethylene	28.4
trans-1,2-Dichloroethylene	28.4
Dichloromethane	3.1
1,2-Dichloropropane	12.6
1,3-Dichloropropene	0.2
Ethylbenzene	15.6
Methyl-tert-butyl ether	5.2
Monochlorobenzene	1.7
Styrene	7.7
1,1,2,2-Tetrachloroethane	0.3
Tetrachloroethylene	6.1
Toluene	6.8
1,2,4-Trichlorobenzene	1.4
1,1,1-Trichloroethane	68.2
1,1,2-Trichloroethane	1.6
Trichloroethylene	4.8
Trichlorofluoromethane	201.1
1,1,2-Trichloro-1,2,2-Trifluoroethane	272.9
Vinyl Chloride	0.1
Xylenes	15.6

a. Values determined by the San Francisco Department of Public Health based on U.S. Occupational Safety and Health Administration Permissible Exposure Limits for 8-hour inhalation exposures to selected VOCs.

J.1.7 Storage and Distribution Management Practices

To achieve the desired objectives of public health protection, treated water must be properly stored and distributed to prevent compromising the quality of water after treatment. For example, opportunistic pathogens like Legionella could grow in the distribution system, sewage could contaminate treated water, or lead and copper (which cause toxicity) could leach from piping. Producing adequate quality non-potable water that meets all the pathogen control criteria set forth in this appendix is the first step in ensuring proper public health protection. The final step in quality control is to manage properly 1) storage and distribution systems and 2) the uses of non-potable water.

In rainwater harvesting systems, neither significant/routine ingestion nor direct contact with the treated water product is typically anticipated due to limited exposures to non-potable water. Nevertheless, the occurrence of aerosol inhalation and indirect contact requires the careful management of DNW system storage and distribution systems to control exposures to non-tuberculous mycobacterial and Legionella pathogens. For example, even clean drinking water may allow biofilm growth of Legionella (aerosol pathogen risk) if the water temperature is between 25°C and 45°C and stagnates, resulting in the presence of minimal residual chlorine.

A number of approaches are available to control microbial regrowth in distribution systems, each with varying benefits and drawbacks that depend on the characteristics and use of the system. Below are some recommended approaches for controlling microbial growth in distribution systems:

- **Producing non-potable water low in carbonaceous material and nutrient content**
  The primary energy source for pathogen regrowth is organic carbon measured as assimilable organic carbon, biodegradable dissolved organic carbon, total organic carbon, and other essential nutrients, including nitrogen (N), phosphorous (P), and iron (Fe); therefore, the primary means to reduce the regrowth potential of pathogens is to provide highly treated water. Reducing the potential for regrowth is more important in large-scale buildings or neighborhood/district-scale projects where there will be more residence time (creating more opportunities for regrowth) in distribution systems that supply non-potable water.
- **Producing highly disinfected non-potable water**
  Low concentrations of microbes resulting from filtration and advanced means of disinfection have a reduced potential for regrowth if organic carbon levels are low. Otherwise, there may be a need for a residual disinfectant to manage growth in larger community systems that produce aerosols. Post-treatment disinfection with UV radiation is a recommended means of disinfection that does not increase levels of assimilable organic carbon or biodegradable dissolved organic carbon.
- **Using non-reactive, biologically stable materials of construction**
  Avoid the use of corrosive materials or organic materials that tend to protect microorganisms from disinfection and enhance the regrowth environment by the adsorption of organic compounds.
- **Maintaining a residual disinfectant**
  Different disinfectants offer advantages and disadvantages to overall water quality and system management. In general, a higher disinfectant residual provides lower regrowth. Many design and operation considerations are available for each specific system. It is recommended that a free chlorine residual of 0.2 milligrams per liter (mg/L) or monochloramine residual of 2 to 3 mg/L be maintained at or near the point of use to control microbial growth. Chloramine provides a better residual duration as compared to chlorine. Various combinations of UV,

chlorine, chloramine, ozone, and hydrogen peroxide are beneficial for specific disinfection goals. Periodic shock treatments with disinfectants and continuous disinfection looping of reservoirs help reduce the potential for regrowth and manage issues with biofilms. Stagnation resulting from dead zones or prolonged periods of zero-flow or low flow that create long residence times and allow disinfectants to dissipate and sediments to deposit result in improved conditions for regrowth and should be avoided.

- **Cleaning storage tanks**
  The required frequency of storage tank cleaning varies depending upon the quality of water stored, detention time in storage, temperature of the water, and nature of the tank. Tanks that are open to the atmosphere require more frequent cleaning.
- **Flushing the distribution system**
  The required frequency of distribution system flushing varies depending upon the quality of water transmitted, detention time in the distribution system, temperature of the water, and nature of the distribution system components. Periodic flushing is a good means of both removing sediments and scouring pipe walls. System design must include means for easily flushing pipes as part of routine maintenance.
- **Controlling temperature**
  Avoid the storage and distribution of non-potable water within 20°C to 45°C to reduce the potential for pathogen regrowth. Otherwise, consider a disinfection residual or point-of-use system, particularly if aerosols are generated.

The rainwater harvesting system designer and Person Responsible for Maintenance each should review published guidelines for the management of Legionella in distribution systems and implement as appropriate for each specific system. In particular, ANSI/ASHRAE Standard 188-2015 Legionellosis: Risk Management for Building Water Systems (2015) provides guidance on stormwater best management practices (BMPs) for both potable and non-potable water systems. It addresses management program responsibilities, system design, risk analysis, control mechanisms, monitoring, confirmation, and documentation. Although the ASHRAE Standard targets legionellosis, its rationales and approaches are applicable to all pathogens and health risks identified in this appendix.

J.1.8 Commissioning

In the process of initializing a rainwater harvesting system, the system must be evaluated for leaks in the storage unit and the performance of the components of the treatment and distribution system. A commissioning report of the evaluation is required at the initial startup of the system and anytime the system is brought back online after cleaning, flushing, and/or a hiatus of use (e.g., winter shutdown).

J.1.9 Operational Monitoring and Reporting

The Person Responsible for Maintenance, as identified in the Stormwater Management Plan (SWMP), must maintain the rainwater harvesting system in good working condition and assure adequate treatment of the harvested rainwater. All systems, with the exception of those installed in single-family homes, shall include continuous monitoring systems that are capable of determining if the rainwater harvesting system is operating within the design specification, and if all system components of the rainwater harvesting system are functional.

Data logs from continuous monitoring systems must be kept on file and produced upon request from <*local jurisdiction*>. In addition, annual reports must be generated that identify the following:

- Significant maintenance activities;
- Treatment modifications;
- Outages and malfunctions (including reasons and durations); and
- Steps taken to mitigate or eliminate recurrence of outages and malfunctions.

If there is a change of personnel—Person Responsible for Maintenance—it is the responsibility, within 15 business days, of the owner of the rainwater harvesting system or her/his agent to update the <*local jurisdiction*> with the name and contact information of the new personnel.

An operation and maintenance manual that includes a schematic drawing of the system, standard operating procedures for the system, and maintenance schedule(s), as well as commissioning reports, field verification reports, and annual reports must be on site and produced upon request from <*local jurisdiction*>.

J.1.10 Field Verification

Field verification is a performance confirmation of a rainwater harvesting system. It can be accomplished by physically observing the collection, storage, and distribution system, and the treatment process components. It can also be conducted using challenge testing, including surrogate microorganisms and/or other non-biological surrogates and typically involves manual collection of water samples for microbial analysis to check system performance in achieving LRTs. While not specifically required, <*local jurisdiction*> construction or maintenance inspections may include field verification testing to ensure that the rainwater harvesting system is achieving its LRTs, and that operational monitoring and control systems are functional.

J.1.11 Design Report

A design report must be submitted with each rainwater harvesting system that includes, at a minimum, the following:

- Pathogen $\log_{10}$ reduction target
- Proposed treatment process and associated $\log_{10}$ reduction value
- Proposed storage and distribution management practices
- Identification of the Person Responsible for Maintenance
    - Operation and Maintenance Manual
- Reliability analysis that identifies the following:
    - How the equipment used to monitor treatment, operations, and water quality enables determination of whether the system is working as planned.
    - How the monitoring and controls of the system will enable the operator or automatic controls to intervene in the event of the production of off-specification water.
    - Remedies and provisions for operation disruption (e.g., power failures, vandalism, and excessive source contamination)
    - Unauthorized access limitations for the rainwater harvesting and distribution system.

J.1.12 Treatment Design Examples

Example 1: Rooftop Runoff for Landscape Irrigation

1) **Identify the $\log_{10}$ reduction targets for the reference pathogen groups.**
Since the roof will not allow frequent public access, the water source qualifies as roof runoff rather than general runoff. No LRT is provided for enteric bacteria or parasitic protozoa, but an LRT of 3.5 is defined for enteric bacteria.

2) **Select a treatment process to achieve the $\log_{10}$ reduction target.**
An ozone system with a CT value (the product of concentration and contact time) of 0.04 mg • min/L can achieve 4-$\log_{10}$ reduction of enteric bacteria. However, as all disinfection processes require removal of particles 10 microns or larger, a 10-micron cartridge filter or similar device will also be necessary (see Figure 1).

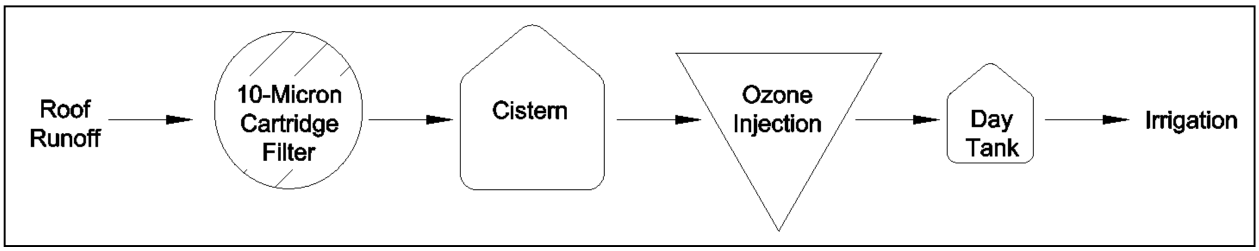


Figure 1. Example 1 treatment schematic.

Alternative treatment trains that also could meet the required LRT include the following:

- Microfiltration (i.e., 6-$\log_{10}$ reduction of bacteria).
- Sand filter with an equivalent effluent particle size distribution of 10 microns, followed by UV radiation with a dose of 40 to 60 mJ/cm2 (i.e., 4-$\log_{10}$ inactivation of bacteria).
- Cartridge filtration (10 microns), followed by chlorination with free chlorine with a CT value of 1.6 to 2.4 mg•min/L (i.e., 4-$\log_{10}$ inactivation of bacteria).

3) **Determine storage and distribution management practices.**
For non-potable water systems, consider the chemical characteristics of roof runoff and storage conditions, as follows:

- Due to its high purity, roof runoff may result in the corrosion of components and fixtures of the metallic distribution system. If any metallic pipe, fittings, solder, or fixtures are used that may be subject to corrosion from contact with aggressive water, then modify the water system or add a corrosion inhibitor to the non-potable water supply.
- If the temperature of water in the non-potable water distribution system exceeds 25°C (which is a condition that could promote the growth of opportunistic pathogens like Legionella), then maintain a free chlorine residual of 0.2 milligrams per liter (mg/L) or chloramine residual of 0.5 mg/L at or near the point of use.

4) **Identify maintenance and monitoring requirements and schedule of activities.**
These will vary based on the specific equipment and devices included in each design.

5) **Submit design report and SWMP.**

Example 2: General Runoff for Indoor Use

1) **Identify the $\log_{10}$ reduction targets for the reference pathogen groups.**
The proposed rainwater harvesting system will capture runoff from two different areas on a rooftop. The first area will have no public access, but the second area includes a patio area that is designed for public access. The combined water from the two areas is therefore considered "general runoff," and will need to be treated accordingly. The LRT for both enteric viruses and protozoa is 5.5, and the LRT for enteric bacteria is 5.0.

2) **Select a treatment process to achieve the $\log_{10}$ reduction target.**
An ultrafiltration system can achieve 6-$\log_{10}$ reduction of viruses, protozoa, and bacteria (see Figure 2).

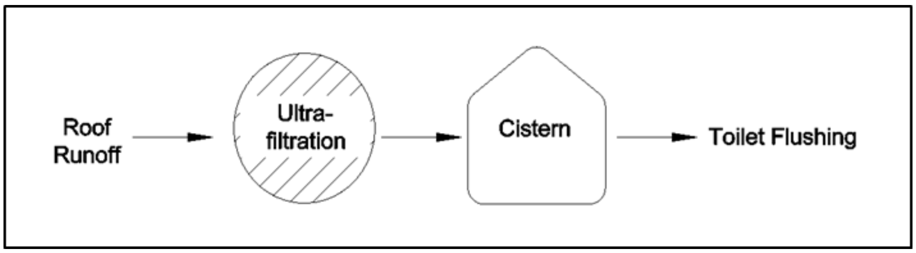


Figure 2. Example 2 treatment schematic.

The only alternative processes that can also meet the required LRTs are nanofiltration and reverse osmosis.

3) **Determine storage and distribution management practices.**
For non-potable water systems, consider the chemical characteristics of roof runoff and storage conditions, as follows:

- Due to its high purity, roof runoff may result in the corrosion of components and fixtures of the metallic distribution system. If any metallic pipe, fittings, solder, or fixtures are used that may be subject to corrosion from contact with aggressive water, then modify the water system or add a corrosion inhibitor to the non-potable water supply.
- If the temperature of water in the non-potable water distribution system exceeds 25°C (which is a condition that could promote the growth of opportunistic pathogens like Legionella), then maintain a free chlorine residual of 0.2 milligrams per liter (mg/L) or chloramine residual of 0.5 mg/L at or near the point of use.

4) **Identify maintenance and monitoring requirements and schedule of activities.**
These will vary based on the specific equipment and devices included in each design.

5) **Submit design report and SWMP.**

Example 3: Roof Runoff for Cooling Towers

1) **Identify the $\log_{10}$ reduction targets for the reference pathogen groups.**
   As there is not public exposure to the harvested rainwater, there are not initial treatment requirements. Chlorination may still be required to control the growth of opportunistic pathogens however (see Step 2).

2) **Determine storage and distribution management practices.**
   For non-potable water systems, consider the chemical characteristics of roof runoff and storage conditions, as follows:

   - Due to its high purity, roof runoff may result in the corrosion of components and fixtures of the metallic distribution system. If any metallic pipe, fittings, solder, or fixtures are used that may be subject to corrosion from contact with aggressive water, then modify the water system or add a corrosion inhibitor to the non-potable water supply.
   - If the temperature of water in the non-potable water distribution system exceeds 25°C (which is a condition that could promote the growth of opportunistic pathogens like Legionella), then maintain a free chlorine residual of 0.2 milligrams per liter (mg/L) or chloramine residual of 0.5 mg/L at or near the point of use.

3) **Identify maintenance and monitoring requirements and schedule of activities.**
   These will vary based on the specific equipment and devices included in each design.

4) **Submit design report and SWMP.**

J.2 Rainwater Harvesting Storage Volume Calculator Instructions

Input Sheet

The cells of the spreadsheet are color coded as follows:

Color Code

(orange)	Title/New Category
(light green)	Required Entry value
(bright green)	Alternate Category Entry (if selected, do not enter value into "Required Entry value")
(yellow)	Final Category Value

Design Storm (inches)

Cell L4	Choose either 1.16 inches or 1.95 inches depending on the Watershed Protection Area in which the project is located.

CONTRIBUTING DRAINAGE AREA (CDA)

Cell L7, L9, L11	Indicate the impervious CDA, the turf cover CDA, and the runoff coefficient (Rv) for the turf cover. The turf cover Rv should range between 0.15 and 0.25. The CDA is assumed to convey 95 percent of the rainfall that lands on its impervious surface and 15 - 25 percent of the rainfall that lands on its turf cover area.

CONTRIBUTING BMPS	
Cell L17	Enter the retention volume as well as the overflow from the Design Storm for any BMPs that drain to the cistern. Both of these values can be found in the SoLoCo Compliance Calculator. The retention volume is in the "Volume Credited" column, and the overflow volume is in the "Remaining Volume" column.
The following instructions identify how the collected rainwater will be used. Only fill in the sections that are applicable to the site.	
IRRIGATION	
Cells L23, L25	Indicate the area to be irrigated in square feet and if the irrigation system as smart controls.
Row A31-L31	The spreadsheet allows for irrigation to be used in certain months. Indicate, for each month, the average weekly irrigation application rate in either inches per week or gallons per month.
	The EPA WaterSense Water Budget Tool can be used to calculate Monthly Landscape Water Requirement (based on the site's peak watering month). The output for this calculation is found on the Part 2-LWA sheet, which can be found at the following link: https://www.epa.gov/watersense/water-budget-tool
INDOOR DEMAND - FLUSHING TOILETS/URINALS	
Cell L35	Indicate the number of people using the building.
Cells L35, L37	The values in **lines 35 and 37** can be altered depending on how much water is used when flushing urinals or toilets. The default values are 0.80 gallons/flush and 1.60 gallons/flush for urinals and toilets, respectively.
Cell L39	If the user knows the daily toilet and urinal demand, that value can be input into **line 39** and the information in the rows above will not be used.
Cells L44, L46, L48	Indicate the first and last day of the week that the building will be in use and the number of hours each day the building will be occupied.
INDOOR DEMAND - LAUNDRY	
Cell L54	Indicate the number of loads of laundry done each day.
Cell L54	The value in **line 54** can be altered depending on how much water is used for each load of laundry. The default value is 42 gallons per load.
Cell L56	If the user knows the daily laundry demand, the value can be input into **line 56** and the information in the rows above will not be used.
Cells L60, L62	Indicate the first and last day of the week when the water will be used.
ADDITIONAL DAILY USE	
Row A71-L71	If there is any other additional daily use not covered in the spreadsheet, **line 69** can accommodate additional demand. Indicate, for each month, the average daily demand in gallons per day.
Cells L73, L75	Indicate the first and last day of the week when the water will be used.

COOLING TOWERS	
Row A79-L79	If the rainwater collected is to be used for cooling towers, indicate in **line 79** the average daily demand in gallons per day for each month the cooling towers use the collected rainwater.
The following section allows for additional contribution to the cistern from sources other than rainwater.	
CONTRIBUTION FROM OTHER SOURCES	
Row A88-L88	If there are other sources of water that contribute to the cistern, indicate the average daily contribution in gallons per day for each month
Cells L90, L92	Indicate the first and last day of the week when the water will be input.
FIRST FLUSH FILTER DIVERSION AND EFFICIENCY	
This section accounts for the filter efficiency of the cistern. It is assumed that, after the first flush diversion and loss of water due to filter inefficiencies, the remainder of the SWRv storm will be successfully captured. These minimum values can be altered if appropriate.	
Cell L98	**Line 98** indicates that for the 1.16-inch storm, a minimum of 95 percent of the runoff should be conveyed into the cistern.
Cell L100	**Line 100** indicates that for the 4.19-inch storm, a minimum of 90 percent of the runoff should be conveyed.

Storage Volume Results Sheets

These sheets give a range of possible cistern sizes and the corresponding storage volume available. Once a cistern size is chosen, the corresponding storage volume may be used in the Stormwater Database.

The table on this sheet has the following information.

- **Cistern Volume** (gallons) – This row gives a range of cistern sizes in gallons based on the CDA size.

- **Daily Average Available Storage Volume** (gallons or cubic feet) – This row shows the average available storage capacity of a given cistern (Sv). Use the Sv that corresponds to the cistern size selected for the site for the General Retention Calculator.

- **Overflow Volume (Sv)** (gallons or cubic feet) – This row shows the average overflow created by a 1.7" storm for various cistern sizes, based on average available storage volumes.

The graph shows a trade-off curve, which allows for a comparison of the retention achieved versus cistern size. While larger cisterns yield more retention, they are more costly. The curve helps the user to choose the appropriate cistern size, based on the design objectives and site needs. The overflow volume is also plotted to illustrate the effects of cistern size on overflow volume.

Southern Low Country -- RAINWATER HARVESTING STORAGE VOLUME CALCULATOR v1.1, August 26, 2020

Input Sheet

The cells of the spreadsheet are color coded as follows:

Color Code

Color	Meaning
(orange)	Title/New Category
(light green)	Required Entry value
(bright green)	Alternate Category Entry (if selected, do not enter value into "Required Entry value")
(yellow)	Final Category Value

Design Storm (inches)

Choose either 1.16 inches or 1.95 inches depending on the Watershed Protection Area in which the project is located.

CONTRIBUTING DRAINAGE AREA (CDA)

Indicate the impervious CDA, the turf cover CDA, and the runoff coefficient (Rv) for the turf cover. The turf cover Rv should range between 0.15 and 0.25. The CDA is assumed to convey 95 percent of the rainfall that lands on its impervious surface and 15 - 25 percent of the rainfall that lands on its turf cover area.

CONTRIBUTING BMPS

Enter the retention volume as well as the overflow from the Design Storm for any BMPs that drain to the cistern. Both of these values can be found in the SoLoCo Compliance Calculator. The retention volume is in the "Volume Credited" column, and the overflow volume is in the "Remaining Volume" column.

The following instructions identify how the collected rainwater will be used. Only fill in the sections that are applicable to the site.

IRRIGATION

Indicate the area to be irrigated in square feet and if the irrigation system as smart controls.

The spreadsheet allows for irrigation to be used in certain months. Indicate, for each month, the average weekely irrigation application rate in either inches per week or gallons per month.

The EPA WaterSense Water Budget Tool can be used to calculate Monthly Landscape Water Requirement (based on the site's peak watering month). The output for this calculation is found on the Part 2-LWA sheet, which can be found at the following link:
https://www.epa.gov/watersense/water-budget-tool

INDOOR DEMAND - FLUSHING TOILETS/URINALS

Indicate the number of people using the building.

The values in **lines 35 and 37** can be altered depending on how much water is used when flushing urinals or toilets. The default values are 0.80 gallons/flush and 1.60 gallons/flush for urinals and toilets, respectively.

If the user knows the daily toilet and urinal demand, that value can be input into **line 39** and the information in the rows above will not be used.

Indicate the first and last day of the week that the building will be in use and the number of hours each day the building will be occupied.

INDOOR DEMAND - LAUNDRY

Indicate the number of loads of laundry done each day.

The value in **line 54** can be altered depending on how much water is used for each load of laundry. The default value is 42 gallons per load. If the user knows the daily laundry demand, the value can be input into **line 56** and the information in the rows above will not be used.

Indicate the first and last day of the week when the water will be used.

ADDITIONAL DAILY USE

If there is any other additional daily use not covered in the spreadsheet, **line 69** can accommodate additional demand. Indicate, for each month, the average daily demand in gallons per day.

Indicate the first and last day of the week when the water will be used.

COOLING TOWERS

If the rainwater collected is to be used for cooling towers, indicate in **line 79** the average daily demand in gallons per day for each month the cooling towers use the collected rainwater.

The following section allows for additional contribution to the cistern from sources other than rainwater.

CONTRIBUTION FROM OTHER SOURCES

If there are other sources of water that contribute to the cistern, indicate the average daily contribution in gallons per day for each month

Indicate the first and last day of the week when the water will be input.

FIRST FLUSH FILTER DIVERSION AND EFFICIENCY

This section accounts for the filter efficiency of the cistern. It is assumed that, after the first flush diversion and loss of water due to filter inefficiencies, the remainder of the SWRv storm will be successfully captured. These minimum values can be altered if appropriate.

Line 96 indicates that for the 1.16-inch storm, a minimum of 95 percent of the runoff should be conveyed into the cistern.

Line 98 indicates that for the 4.19-inch storm, a minimum of 90 percent of the runoff should be conveyed.

Storage Volume Results Sheets

These sheets give a range of possible cistern sizes and the corresponding storage volume available. Once a cistern size is chosen, the corresponding storage volume may be used in the Stormwater Database.

The table on this sheet has the following information.

- **Cistern Volume** (gallons) – This row gives a range of cistern sizes in gallons based on the CDA size.
- **Daily Average Available Storage Volume** (gallons or cubic feet) – This row shows the average available storage capacity of a given cistern (Sv). Use the Sv that corresponds to the cistern size selected for the site for the General Retention Calculator.
- **Overflow Volume (Sv)** (gallons or cubic feet) – This row shows the average overflow created by a 1.7" storm for various cistern sizes, based on average available storage volumes.

The graph shows a trade-off curve, which allows for a comparison of the retention achieved versus cistern size. While larger cisterns yield more retention, they are more costly. The curve helps the user to choose the appropriate cistern size, based on the design objectives and site needs. The overflow volume is also plotted to illustrate the effects of cistern size on overflow volume.

Southern Low Country -- RAINWATER HARVESTING STORAGE VOLUME CALCULATOR v1.1, August 26, 2020

Input

Color Code	
	Title/New Category
	Required Entry value
	Alternate Category Entry (if selected, do not enter value into "Required Entry value")
	Final Category Value

Design Storm

Design Storm (inches)	1.16

CONTRIBUTING DRAINAGE AREA (CDA)

What is the area of impervious cover in the CDA (SF)?	
What is the area of compacted cover in the CDA (SF)?	
What is the Runoff Coefficient (Rv) of the compacted cover?	
Total CDA (SF)	0

CONTRIBUTING BMPS

Retention Volume for the Upstream BMP(s) (cubic feet)	
Overflow volume from Design Storm from BMP(s) (cubic feet)	

IRRIGATION

How big is the area to irrigate? (SF)	
Does the irrigation system have smart controls (e.g. soil moisture sensor shutoff)? If no, leave unchecked.	
Enter monthly irrigation needs for site. Select units (Inches/Week or Gallons/Month)	Inches/Week

If using EPA WaterSense Water Budget Tool (link below), select Gallons/Month.

https://www.epa.gov/watersense/water-budget-tool

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00

INDOOR DEMAND - FLUSHING TOILETS/URINALS

Toilet and urinal use (if only toilets are used, set urinals = 0)

How many people will use the building? (# people)	
How much water will each urinal use? (gallons/flush) Set to 0, if no urinal.	0.80
How much water will each toilet use? (gallons/flush)	1.60
Calculated daily toilet and urinal demand. (gallons/day) Use this cell if value has already been calculated, instead of the rows above.	0
Select the first day of the week this water will typically be used (e.g. Monday).	
Select the last day of the week this water will typically be used (e.g. Friday).	
Hours per day the building is used (e.g. 8 for a 9-5 office building; 24 for a shift-work factory).	
Total daily toilet and urinal demand (gallons/day).	0.0

INDOOR DEMAND - LAUNDRY

Laundry use (use either loads per day, pounds per day or calculated demand)

How many loads of laundry are done each day? (# loads/day)	
How much water does each load of laundry use in gallons? (gallons/load)	42
Calculated daily laundry demand. (gallons/day)	0
Select the first day of the week this water will typically be used (e.g. Monday).	
Select the last day of the week this water will typically be used (e.g. Friday).	
Total daily laundry demand. (gallons/day)	0

ADDITIONAL DAILY USE

Additional daily use (bus wash, street sweepers, etc)

This value is user defined and is provided to allow for any other demand value.

Enter the average daily demand for each month throughout the year. (gallons/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

Select the first day of the week this water will typically be used (e.g. Monday).	
Select the last day of the week this water will typically be used (e.g. Friday).	

COOLING TOWERS

If water is to be used for cooling towers (for large scale projects)

Enter the average daily demand for each month throughout the year. (gallons/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

CONTRIBUTION FROM OTHER SOURCES

If any other sources will contribute water to the cistern, add them here (e.g. condensate)

This value is user defined and will be treated as a negative daily demand.

Enter the average daily demand for each month throughout the year. (gallons/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

Select the first day of the week this water will typically be input (e.g. Monday).	
Select the last day of the week this water will typically be input (e.g. Friday).	

FIRST FLUSH FILTER DIVERSION AND EFFICIENCY

Enter Approximate Filter Efficiencies associated with the 1.16" and 4.19" storms below.
Minimum values are 95% and 90%, respectively. See Specification for additional details and guidance.

Filter Efficiency Associated with the 1.16" storm (%)	95
	0.05
Filter Efficiency Associated with the 4.19" storm (%)	90
	0.10

Disclaimer: By using this spreadsheet, the User understands and accepts that the accuracy of results provided herein are not guaranteed. It is the responsibility of the User to verify results and to use professional judgement in its application.

Assigning Numeric Code for Day of Week

Category	Read from inut		Numeric Code
Indoor Flushing Toilets			
Start Day Numeric Code	0	9	9
Final Day Numberic Code	0	9	9
			9
			9
Indoor Laundry			
Start Day Numeric Code	0	9	
Final Day Numberic Code	0	9	9
			9
			9
			9
Additional Daily Use			
Start Day Numeric Code	0	9	
Final Day Numberic Code	0	9	
Contribution from other sources			
Start Day Numeric Code	0	9	
Final Day Numberic Code	0	9	

Smart Irrigation?	FALSE
Inches/Week	0

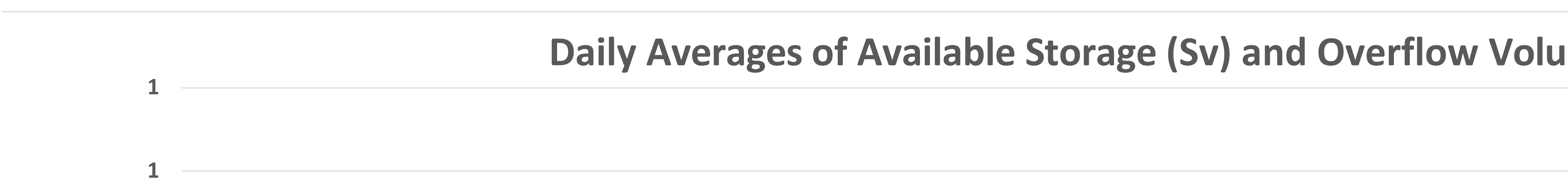
		0	1.2 inch rain	1.2
Monday	1	1	1.7 inch rain	1.7
Tuesday	2	2	3.2 inch rain	3.2
Wednesda	3	3		
Thursday	4	4		
Friday	5	5		
Saturday	6	6		
Sunday	7	7		
		8		
		9		
		10		
		11		
		12		
		13		
		14		
		15		
		16		
		17		
		18		
		19		
		20		
		21		
		22		
		23		
		24		

Storage Volume Summary

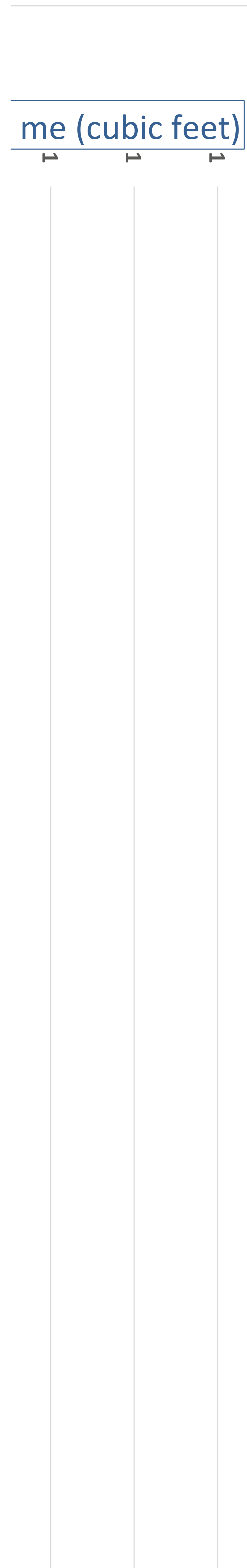
Average Daily Available Storage Volume by Month and Cistern Volume																			
Month\ Cistern Volume (gallons)	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500
January	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
February	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
March	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
April	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
May	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
June	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
July	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
August	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
September	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
October	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
November	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
December	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Daily Average Available Storage Volume, *Sv* (cubic feet)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Note: Cistern Volume does not include detention for larger storm events.
Detention volume that will be drawn down after each storm event should be modeled separately.

Overflow Volume from a 1.16-Inch Rain Event by Cistern Volume																			
Cistern Volume (Gallons)	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500
Overflow Volume (cubic feet)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**



Created: 2021-07-22 09:11:36 [EST]


me (cubic feet)

Appendix L: Glossary

A	
Advanced Design (AD)	Detailed design for an area of a project described explicitly in the following: • Stage II planned unit development (PUD) application to the District of Columbia Zoning Commission; • Application for design review under the Capitol Gateway Overlay District to the District Zoning Commission; and • Final design submission to the National Capital Planning Commission (NCPC)
Affordable housing	A single-family or two-family house that is built to be offered for rent or for sale for residential occupancy below market value and is made available to, and affordable to, a household whose income is equal to, or less than, eighty percent (80%) of the Area Median Income calculation provided by the United States Department of Housing and Urban Development
Animal confinement area	An area, including a structure, used to stable, kennel, enclose, or otherwise confine animals, not including confinement of a domestic animal on a residential property
Applicant	A person or their agent who applies for approval pursuant to this chapter
As-built plan	A set of architectural, engineering, or site drawings, sometimes including specifications that certify, describe, delineate, or present details of a completed construction project
Athletic playing fields	Compacted land cover and synthetic surfaces that are constructed primarily for use for athletic activities at public parks and schools. Compacted land cover and synthetic surfaces for which athletic activities are not the primary use are not considered athletic playing fields, unless these areas are necessary to support use of an adjacent area that is primarily used for athletic activities. Synthetic surfaces must have a minimum surface permeability of at least 10 inches per hour, in accordance with ASTM F2898 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
B	
Best management practice (BMP)	Structural or nonstructural practice that minimizes the impact of stormwater runoff on receiving waterbodies and other environmental resources, especially by reducing runoff volume and the pollutant loads carried in that runoff
Buffer	An area along a stream, river, or other natural feature that provides protection for that feature
Building permit	Authorization for construction activity issued by the <*local jurisdiction*>
C	

Clearing	The removal of trees and brush from the land excluding the ordinary mowing of grass, pruning of trees or other forms of long-term landscape maintenance
Combined sewer overflow (CSO)	The discharge of untreated effluent into a water body as a result of the combined volume of stormwater and sanitary water exceeding the capacity of the combined sewer system and wastewater treatment plant
Combined sewer system (CSS)	Sewer system in which stormwater runoff is conveyed together with sanitary wastewater through sewer lines to a wastewater treatment plant
Common plan of development	Multiple, separate, and distinct land-disturbing, substantial improvement, or other construction activities taking place under, or to further, a single, larger plan, although they may be taking place at different times on different schedules
Compacted cover	An area of land that is functionally permeable, but where permeability is impeded by increased soil bulk density as compared to natural cover, such as through grading, construction, or other activity and will require regular human inputs such as periodic planting, irrigation, mowing, or fertilization. Examples include landscaped planting beds, lawns, or managed turf
Conservation area	An area with a natural cover designation set aside to receive stormwater runoff as part of an impervious surface disconnection practice
Construction	Activity conducted for the following: • Building, renovating, modifying, or razing a structure; or • Moving or shaping of earth, sediment, or a natural or built feature
Contributing drainage area (CDA)	Area contributing runoff to a BMP
Control measure	Technique, method, device, or material used to prevent, reduce, or limit discharge
Critical area stabilization	Stabilization of areas highly susceptible to erosion, including down-slopes and side-slopes, through the use of brick bats, straw, erosion control blanket mats, gabions, vegetation, and other control measures
Cut	An act by which soil or rock is dug into, quarried, uncovered, removed, displaced, or relocated and the conditions resulting from those actions
D	
Demolition	The removal of part or all of a building, structure, or built land cover
Detention	Controlling the peak discharge rate of stormwater from a site
Dewatering	Removing water from an area or the environment using an approved technology or method, such as pumping
Director	The local administrator of the stormwater construction permits.
E	

Easement	A right acquired by a person to use another person's land for a special purpose
Electronic media	Means of communication via electronic equipment, including the internet
Energy Grade Line	The energy grade line represents the total energy at any point along the culvert (pipe) barrel.
Erosion	The process by which the ground surface, including soil and deposited material, is worn away by the action of wind, water, ice, or gravity
Excavation	An act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced or relocated and the conditions resulting from those actions
Exposed area	Land that has been disturbed or land over which unstabilized soil or other erodible material is placed
F	
G	
Grading	Causing disturbance of the earth, including excavating, filling, stockpiling of earth materials, grubbing, root mat or topsoil disturbance, or any combination of them
H	
Hydraulic Grade Line	The hydraulic grade line is the depth to which water would rise in vertical tubes connected to the side of the culvert (pipe) barrel.
I	
Impervious cover	A surface area that has been compacted or covered with a layer of material that impedes or prevents the infiltration of water into the ground, examples include conventional streets, parking lots, rooftops, sidewalks, pathways with compacted sub-base, and any concrete, asphalt, or compacted gravel surface and other similar surface
Infiltration	The passage or movement of surface water through the soil profile
J	
K	
L	
Land cover	Surface of land that is impervious, compacted, or natural
Land cover change	Conversion of land cover from one type to another, typically in order to comply with a requirement of this chapter.
Land-disturbing activity	Movement of earth, land, or sediment that disturbs the land surface and the related use of pervious land to support that movement. Land-disturbing activity includes stripping, grading, grubbing, trenching, excavating, transporting, and filling of land, as well as the use of pervious adjacent land for movement and storage of construction vehicles and materials. Land-disturbing activity does not include repaving or re-milling that does not expose the underlying soil

Low impact development (LID)	A land-planning and engineering-design approach to manage stormwater runoff within a development footprint. It emphasizes conservation, the use of on-site natural features, and structural stormwater BMPs to store, infiltrate, evapotranspire, retain, and detain rainfall as close to its source as possible with the goal of mimicking the runoff characteristics of natural cover
M	
Maintenance agreement	See Section 5.5.2 Maintenance Agreement
Maintenance contract	See "maintenance agreement"
Maintenance responsibility	See Section 5.5.1 Maintenance Responsibility
Maintenance plan	Planned scheduled maintenance for the life of the BMP
Maintenance schedule	See "maintenance plan"
Maintenance standards	Detailed maintenance plan laid out in Exhibit C within declaration of covenants
Major land-disturbing activity	A distinct project or a part of a larger common plan of development that involves the creation, addition or replacement of 5000 square feet of impervious surface, or that involves one acre or greater of land disturbing activities. New development regardless of size, that is part of a larger common plan of development, even though multiple, separate and distinct land disturbing activities, may take place at different times and on different schedules. Multiple distinct areas that each disturb one acre of land, that are in separate, non-adjacent sites, and that are not part of a larger common plan of development do not constitute a major land-disturbing activity.
Major Substantial Improvement	a renovation or addition to a structure or existing property that meets both of the following cost and size thresholds: a) construction costs for the building renovation/addition are greater than or equal to 50% of the pre-project assessed value of the structure as developed using current Building Valuation Data of the International Code Council, and b) combined footprint of structure(s) exceeding the cost threshold and any land disturbance are greater than or equal to 5,000 square feet.
N	
Natural cover	Land area that is dominated by vegetation and does not require regular human inputs such as irrigation, mowing, or fertilization to persist in a healthy condition. Examples include forest, meadow, or pasture
Non-structural BMP	A land use, development, or management strategy to minimize the impact of stormwater runoff, including conservation of natural cover or disconnection of impervious surface
O	
Off-site retention	Use of property not within the limits of disturbance of the project to comply with the stormwater retention volumes required by this Manual

Off-site retention volume (Off_V)	A portion of a required stormwater retention volume or required water quality treatment volume that is not retained on site
On-site retention	Retention of a site's stormwater on that site or via conveyance to a shared stormwater BMP on another site
On-site stormwater management	Retention, detention, or treatment of stormwater on site or via conveyance to a shared stormwater BMP
Owner	The person who owns real estate or other property, or that person's agent
P	
Peak discharge	The maximum rate of flow of water at a given point and time resulting from a storm event
Permeable athletic track	A surface, including a surface made of synthetic material, located at a school or public park that is used for athletic purposes including biking, running, and walking, and that allows the infiltration of water into the ground. The track must have a minimum surface permeability of at least 10 inches per hour, in accordance with the ASTM F2898 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
Permeable playground surface	A surface, including a surface made of synthetic material, located under a playground area at a school or public park, that allows the infiltration of water into the ground. The playground surface must have a minimum surface permeability of at least 10 inches per hour, in accordance with ASTM F2898 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
Person	A legal entity, including an individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, cooperative, the *<local authority>* and its agencies, the State of South Carolina and its agencies, and the federal government and its agencies
Pervious area	Area with a compacted cover designation set aside to receive stormwater runoff as part of an impervious surface disconnection practice
Post-development	Describing conditions that may be reasonably expected to exist after completion of land development activity on a site
Practice	A system, device, material, technique, process, or procedure that is used to control, reduce, or eliminate an impact from stormwater; except where the context indicates its more typical use as a term describing a custom, application, or usual way of doing something
Preconstruction meeting	The mandatory meeting occurring prior to any construction, including the owner, the designer, the installer, and the DHEC inspector. This meeting must contain an on-site component to evaluate the SWMP against existing site conditions. This should include, at a minimum, a visual examination of land cover types, the tree preservation plan, boundaries of the CDA(s), the existing inlet elevation(s) to ensure they conform to original design

Predevelopment	Describing conditions of meadow land and its relationship to stormwater before human disturbance of the land
Pre-project	Describing conditions, including land covers, on a site that exist before the construction described in a Stormwater Management Plan has begun
Publicly-owned or publicly-financed project	A project: a. That is municipally-owned or municipality-instrumentality-owned; b. Where at least 15% of the project's total cost is municipally-financed or municipality-instrumentality-financed; or c. That includes a gift, lease, or sale from municipally-owned or municipality-instrumentality-owned property to a private entity
Public right-of-way (PROW)	The surface, the air space above the surface (including air space immediately adjacent to a private structure located on public space or in a public right-of-way), and the area below the surface of any public street, bridge, tunnel, highway, railway track, lane, path, alley, sidewalk, or boulevard
Public space	All the publicly owned property between the property lines on a street, park, or other public property as such property lines are shown on the records of the State. This includes any roadway, tree space, sidewalk, or parking between such property lines, but it excludes adjacent parks and other public property that is not associated with the public right-of-way
Q	
R	
Raze	The complete removal of a building or other structure down to the ground or to its foundation
Responsible person	Construction personnel knowledgeable in the principles and practices of erosion and sediment control and certified by a Department-approved soil erosion and sedimentation control training program to assess conditions at the construction site that would impact the effectiveness of a soil-erosion or sediment-control measure on the site
Retention	Keeping a volume of stormwater runoff on site through infiltration, evapotranspiration, storage for non-potable use, or some combination of these
Retention capacity	The volume of stormwater that can be retained by a stormwater BMP or land cover
Retrofit	A stormwater BMP or land cover installed in a previously developed area to improve stormwater quality or reduce stormwater quantity relative to current conditions
Runoff	The portion of precipitation (including snow-melt) that travels over the land surface, and also from rooftops, either as sheetflow or as channel flow, in small trickles and streams, into the main water courses

S	
Savannah River Watershed Protection Area	
Sediment	Soil, including soil transported or deposited by human activity or the action of wind, water, ice, or gravity
Sedimentation	The deposition or transportation of soil or other surface materials from one place to another as a result of an erosion process
Shared BMP (S-BMP)	A stormwater BMP, or combination of BMPs, providing stormwater management for stormwater conveyed from another site or sites
Single- or two-family house	An individual house, townhouse, or rowhouse designed and used for occupancy by one or two families. An individual house, townhouse, or rowhouse that has been physically altered for use by more than one or two families is not considered a single- or two-family house
Site	A tract, lot or parcel of land, or a combination of tracts, lots, or parcels of land for which development is undertaken as part of a unit, sub-division, or project. The mere divestiture of ownership or control does not remove a property from inclusion in a site
Site drainage area (SDA)	The area that drains stormwater from the site to a single discharge point or sheet flows from a single area off the site
Soil	All earth material of whatever origin that overlies bedrock and may include the decomposed zone of bedrock that can be readily excavated by mechanical equipment
Soil erosion and sediment control plan	A set of drawings, calculations, specifications, details, and supporting documents related to minimizing or eliminating erosion and off-site sedimentation caused by stormwater on a construction site. It includes information on construction, installation, operation, and maintenance
Soils report	A geotechnical report addressing all soil erosion and sediment control-related soil attributes, including but not limited to site soil drainage and stability
Special watershed protection areas	Areas identified by US Geological Survey 12-digit Hydrologic Unit Code (HUC 12) in the Southern Low Country Stormwater Design Manual that require area-specific stormwater standards
Storm sewer	A system of pipes or other conduits that carries or stores intercepted surface runoff, street water, and other wash waters, or drainage, but excludes domestic sewage and industrial wastes
Stormwater	Flow of water that results from runoff, snow melt runoff, and surface runoff and drainage
Stormwater management	A system to control stormwater runoff with structural and non-structural stormwater BMPs, including the following: (a) quantitative control of volume and rate of surface runoff and (b) qualitative control to reduce or eliminate pollutants in runoff
Stormwater Management Plan (SWMP)	A set of drawings, calculations, specifications, details, and supporting documents related to the management of stormwater for a site. A SWMP includes information on construction, installation, operation, and maintenance

Stormwater Pollution Prevention Plan (SWPPP)	A document that identifies potential sources of stormwater pollution at a construction site, describes practices to reduce pollutants in stormwater discharge from the site, and may identify procedures to achieve compliance
Stormwater retention volume (SWRv)	Volume of stormwater from a site for which the site is required to achieve retention
Stripping	An activity that removes or significantly disturbs the vegetative surface cover including clearing, grubbing of stumps and rock mat, and top soil removal
Substantial improvement	A repair, alteration, addition, or improvement of a building or structure, the cost of which equals or exceeds 50% of the market value of the structure before the improvement or repair is started
Structural stormwater BMP	A practice engineered to minimize the impact of stormwater runoff, including a bioretention, green roof, permeable pavement, system to capture stormwater for non-potable uses, etc.
Supplemental review	A review that *<local jurisdiction>* conducts after the review it conducts for a first resubmission of a plan
Swale	A narrow low-lying stretch of land that gathers or carries surface water runoff
T	
Total suspended solids (TSS)	The entire amount of organic and inorganic particles dispersed in water. TSS is measured by several methods, which entail measuring the dry weight of sediment from a known volume of a subsample of the original
U	
V	
W	
Waste material	Construction debris, dredged spoils, solid waste, sewage, garbage, sludge, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial or municipal waste
X	
Y	
Z	

Appendix M: References and Resources

M.1 References

The following documents provide more detailed information on many aspects of BMP design than is found in this Manual. These resources may be useful for those looking to develop greater understanding of individual BMPs or stormwater design in general. Recommendations in these resources may be used to inform BMP designs; however, where conflicts occur between these resources and the Manual, the requirements of the Manual prevail.

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M.2 Resources for Natural Resources Survey

Resource Group	Resource Type	Sources for Information
General Resources	•Topography •Natural Drainage Divides •Natural Drainage Patterns •Natural Drainage Features (e.g., Swales, Basins, Depressional Areas) •Soils •Erodible Soils Comes with soil survey •Steep Slopes (e.g., Areas with Slopes Greater Than 15%) Can determine from DEM or query soil types with steep slopes. Recommend the former for accuracy. •Trees and Other Existing Vegetation – Can use NLCD data to get forest land cover •Impervious surfaces •Protected Lands	LiDAR: https://coast.noaa.gov/dataviewer/index.html#/lidar/search/ Major basin boundaries: https://apps.dhec.sc.gov/GIS/ClearingHouse/ Soils: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx Land Cover (NLCD): https://www.mrlc.gov/data Land Cover (NOAA C-CAP): https://coast.noaa.gov/digitalcoast/data/ccapregional.html County Level LIDAR http://www.dnr.sc.gov/GIS/lidarstatus.html NLCD impervious surface - https://www.mrlc.gov/data/type/urban-imperviousness Protected Lands (PAD-US) - LINK TNC
Freshwater Resources	•Rivers – NHD or state level data	NHD: https://www.usgs.gov/core-science-systems/ngp/national-hydrography

	should be available •Perennial and Intermittent Streams – This distinction might not be available. •Freshwater Wetlands – National Wetland Inventory	Water classifications (view only): https://gis.dhec.sc.gov/watersheds/ NWI: https://www.fws.gov/wetlands/index.html
Estuarine Resources	•Tidal Rivers and Streams I think we can get all of this from NWI. Tidal influence might not be denoted. •Tidal Creeks •Coastal Marshlands •Tidal Flats •Scrub-Shrub Wetlands	NOAA C-CAP classification scheme includes palustrine forested wetland, palustrine scrub/shrub wetland, palustrine emergent wetland, estuarine forested wetland, estuarine scrub/shrub wetland, estuarine emergent wetland, palustrine aquatic bed, and estuarine aquatic bed County Level LIDAR Breaklines (with terrain dataset) http://www.dnr.sc.gov/GIS/lidarstatus.html
Marine Resources	•Near Coastal Waters •Beaches •Shoreline	NOAA C-CAP classification scheme includes unconsolidated shore DHEC OCRM - https://apps.dhec.sc.gov/GIS/ClearingHouse/ ←look under OCRM from drop down "List GIS Layers by DHEC…"
Groundwater Resources	•Groundwater Recharge Areas •Wellhead Protection Areas	https://scdhec.gov/environment/bureau-water/groundwater-use-reporting/groundwater-management-planning/groundwater-2 http://hydrology.dnr.sc.gov/well-database.html DHEC Watershed atlas - https://gis.dhec.sc.gov/watersheds/ Check under Public Water supply tab in layer contents for protection areas

Resource Group	**Resource Type**	**Sources for Information**
Terrestrial Resources	•Dunes •Maritime Forests •Marsh Hammocks •Evergreen Hammocks •Canebrakes	• Forest inventory analysis (FIA). The SC Forestry Commission would have that data •Natural Communities of SC https://dc.statelibrary.sc.gov/handle/10827/30179

	•Bottomland Hardwood Forests •Beech-Magnolia Forests •Pine Flatwoods •Longleaf Pine-Wiregrass Savannas •Longleaf Pine-Scrub Oak Woodlands	
Other Resources	• Shellfish Harvesting Areas •Floodplains – FEMA data available nationally •Aquatic Buffers •Other High Priority Habitat Areas as described by South Carolina Department of Natural Resources	•FEMA: https://msc.fema.gov/portal/home •SCDHEC: https://apps.dhec.sc.gov/GIS/ClearingHouse/ •GAP/species richness/habitat/etc. data http://www.dnr.sc.gov/GIS/gap/mapping.html •Intertidal Oyster Reefs - http://www.dnr.sc.gov/GIS/descoysterbed.html •Shellfish harvesting areas - Link

Appendix N: Summary of Federal and State Stormwater Regulations

Table of Contents

N.1 Summary of Federal Regulations

In general, Federal regulations and legislation have been applied at the State level to regulate stormwater runoff quality, whereas for many years local stormwater ordinances and regulations focused on regulating drainage, streets, peak stormwater runoff flow and flooding concerns.

Federal regulations that directly affect stormwater runoff control include the Coastal Zone Management Act and the National Pollutant Discharge Elimination System (NPDES) stormwater regulations of the Clean Water Act, administered by the U.S. Environmental Protection Agency (EPA). The Coastal Zone Management Act was designed to encourage and assist coastal states to develop and implement management programs. The State of South Carolina developed its own Coastal Zone Management Act in 1977, to protect coastal resources and promote responsible development in Beaufort County and seven other coastal counties. This will be discussed further in the following section on State regulations. The EPA NPDES requirements are presented below.

The 1987 amendments to the Federal Clean Water Act define specific stormwater discharges as point source discharges subject to NPDES regulations. These amendments required EPA to promulgate regulations pertaining to stormwater discharges via a phased approach.

The initial phase, promulgated by EPA on November 16, 1990, became known as the Phase I Stormwater NPDES regulations. These final regulations created two broad classes of stormwater discharges under the NPDES program:

1) Municipal Separate Storm Sewer System (MS4) discharges; and
2) Stormwater Discharges Associated with Industrial Activity.

The MS4 Program was divided into three categories (large, medium, and small populations) based on U.S. Census Bureau population estimates, with Phase I regulations including only large and medium MS4 stormwater discharges.

The Stormwater Discharges Associated with Industrial Activity program was divided into 11 categories of industrial activity. These included industrial manufacturing facilities, landfills, transportation facilities, construction (land clearing on 5 or more acres), etc., without consideration given to the type of facility owner or operator such that a publicly owned or operated facility could be included in one of the 11 categories.

On December 8, 1999, EPA adopted the Phase II stormwater regulations, which included small MS4 discharges located in an “Urbanized Area” per U.S. Census Bureau definitions and delineations. In addition, the land disturbance activity regulation with the threshold of 5 or more acres (as per the construction activity regulation) was reduced to 1 or more acres, with a provision that construction sites that disturb less than 1 acre could also be regulated if water quality concerns or problems related to the activity warrant permit coverage under the NPDES Program.

The State of South Carolina has been an EPA NPDES Program delegated authority for a number of years. The State agency that administers the Federal NPDES Program in South Carolina is the Department of Health and Environmental Control (DHEC). As such, DHEC oversees all NPDES Program related permitting, monitoring, and enforcement issues in the State of South Carolina. However, EPA does have authority over DHEC on NPDES Program issues and may, at its discretion, conduct independent audits of a DHEC-issued NPDES permit.

N.1.1 MS4 Program

Phase I of the NPDES Stormwater Program required large MS4s (with populations of 250,000 people or greater) and medium MS4s (with populations of 100,000 people or greater but less than 250,000) to apply for permit coverage in two parts. All permits issued under this phase were individual permits and required the development and implementation of a stormwater management program. At a minimum, this program had to address the following key elements:

1) Structural control maintenance
2) Areas of significant development and redevelopment
3) Roadway runoff management
4) Flood control related to water quality issues
5) Municipally owned operations, including landfills, wastewater treatment facilities, etc.
6) Hazardous waste treatment, storage or disposal sites, etc.
7) Application of pesticides, herbicides, and fertilizers
8) Illicit discharge detection and elimination
9) Regulation of sites classified as associated with industrial activity
10) Construction site and post-construction site runoff control
11) Public education and outreach

As of July 2007, the State of South Carolina has one large MS4 (South Carolina Department of Transportation) and four medium MS4s – the City of Columbia, Greenville County, Lexington County, and Richland County.

As of July 2007, there is a list of 70 regulated small MS4s, which did not specifically include Beaufort County. In 2014 this list was increased, and additional communities were added, including Beaufort County. These small MS4s are required to begin running programs to address stormwater runoff from construction sites and post- construction activities. These activities are two of the six components of a stormwater management program as defined by the NPDES Phase II Final Rule, as listed below:

1) Public education and outreach.

2) Public participation/involvement.
3) Illicit discharge detection and elimination.
4) Construction site runoff control.
5) Post-construction runoff control.
6) Pollution prevention/good housekeeping.

Several of these items are addressed by this document and will fulfill part of the NPDES Phase II requirements.

N.1.2 Industrial Activity Program

The NPDES Phase I stormwater regulations created 11 categories of Stormwater Discharges Associated with Industrial Activity. Categories "i "through "ix" and category "xi" became part of the Industrial Program, while category "x" became part of the Construction Program. Thus, the NPDES stormwater program is made up of three distinct program components: the MS4 Program, the Industrial Program, and the Construction Program. Although the Phase I included a provision for a no-exposure permit exemption to category "xi" (light industry) only, the Phase II regulations extended this no-exposure exemption to categories "i" through "ix."

The no-exposure exemption applied to facilities that had no stormwater runoff exposed to raw materials, byproducts, waste products, intermediate products, final products, etc. Activities within the Industrial Program and the Construction Program can have NPDES stormwater permits issued as either individual permits or general permits; however, due to the nature and number of facilities that must be issued NPDES stormwater permits, general permits are typically utilized. On rare occasions, when water quality concerns become a permit issue, DHEC may require an individual permit in lieu of granting general permit coverage. The general permit under the Industrial Program requires the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) for each covered facility and requires monitoring and/or inspections. Although only certain facilities require both, inspections are required of all facilities.

Under the Construction Program, the construction activity category is divided into two phases, Phase I (for large construction sites) and Phase II (for small construction sites). On a case-by-case basis, a permit may also be required when a construction activity involves the disturbance of less than 1 acre of land. Stormwater discharges from construction activities that disturb less than 5 acres of land are called "small construction activities." A Construction Activity permit can either be issued in the form of a general permit or an individual permit. Typically, the general permit is utilized unless specific water quality issues warrant the use of an individual permit. The general permit requires that a SWPPP be prepared and implemented for each construction site, but sampling of stormwater runoff from the site is not required.

Inspections must be conducted at all construction sites covered under the general permit. In addition, a provision in the MS4 program regulations requires that all regulated MS4s implement a program for controlling construction site runoff. This provision essentially requires that the construction site must receive a permit from the regulated MS4 in addition to having to be covered under an NPDES Stormwater Construction Activity permit.

It is important to note that with the March 10, 2003 initiation of the NPDES Phase II Stormwater Program implementation, considerable overlap exists between the Federal NPDES Stormwater Program and the State of South Carolina's Sediment, Erosion, and Stormwater Management Program as discussed below.

N.2 Summary of State Regulations

In addition to being an EPA NPDES Program delegated authority, the State of South Carolina also has its own relevant regulations. The South Carolina's Sediment, Erosion, and Stormwater Management Program was initiated in 1983, and required construction activities on State-owned and State-managed lands to control sediment and erosion. In 1991, via the South Carolina Stormwater Management and Sediment Reduction Act, the program was expanded to include all construction activities that disturbed more than 2 acres of land. Regulation 72-300, entitled "Standards for Stormwater Management and Sediment Reduction," describes the requirements for preparing a stormwater management and sediment and erosion control plan from land disturbance activities. Exemptions, Waivers, and Variances from the Law are explained in Section 72-302. The Bureau of Water of the Office of Environmental Quality Control (EQC) of DHEC is responsible for administering the Sediment, Erosion, and Stormwater Management Program, and by regulation the Office of Ocean and Coastal Resource management (OCRM) implements the program in the eight coastal county areas. A local government may become a State-delegated authority after submitting a request and receiving approval by the State. However, Federal, State, local government, and public school projects must be submitted to DHEC even if they are located within the jurisdiction of a State-delegated entity.

As indicated previously, the Federal NPDES Stormwater Construction Activity Program requires permit coverage for construction sites that disturb more than 1 acre of land and, on a case-by-case basis, even less than 1 acre of land. Consequently, an overlap exists currently between the State's Sediment, Erosion, and Stormwater Management Program and the NPDES Stormwater Construction Activity Program (that is, when more than 2 acres of land are disturbed due to a construction activity, permits must be secured under both programs). The State coordinates the various aspects of the two programs (i.e., permitting, compliance, monitoring, and enforcement) to minimize the overlapping responsibilities. The two programs are integrated into a comprehensive Stormwater Regulatory Program for the State of South Carolina.

The *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities* (DHEC, 2003) includes all existing South Carolina stormwater management regulations required for individuals to submit a stormwater management and sediment reduction permit application to DHEC. Elements of the Federal NPDES Stormwater Program, Coastal Zone Management Program, and the State's Stormwater Management and Sediment Reduction regulations are included in the handbook.

Table 1 summarizes the State regulatory requirements that are applicable to Southern Lowcountry, including jurisdictions in the State of South Carolina's Coastal Zone Management Program. For land disturbance of 0.5 acre or less that is within 0.5 mile of a receiving waterbody in the coastal zone, Section R.72- 307H of the State Stormwater Management and Sediment Reduction Act of 1991 is applicable. Section R.72-307H is also applicable for land disturbance of less than 1 acre, at locations that are not within 0.5 mile of a coastal zone receiving water If the land disturbance is at least 1 acre, but less than 2 acres, the NPDES General Permit and Section R.72-307H apply. Development is highly impervious or is located directly adjacent to a critical area, the more stringent R.72-307I regulations are applicable; otherwise, the less stringent R.72-307H regulations are appropriate.

Table 1. South Carolina Requirements for Land Development in Southern Lowcountry.

Extent of Land Disturbance (acres)	Applicable Regulatory Requirements
Less than 0.5 acre and within 0.5 acre of receiving waters	R.72-307H
Less than 1 acre and not within 0.5 acre of receiving waters	R.72-307H
At least 1 but less than 2 acres	R.72-307H, SCR100000
More than 2 and less than 5 acres	R.72-307I, SCR100000
5 acres or more	R.72-305, R.72-307, SCR100000

Section R.72-307I regulations are also applicable for developments of more than 2 and less than 5 acres. For developments of 5 acres or more, the applicable regulations include Sections R.72-305 and R.72-307 of the Stormwater Management and Sediment Reduction Act of 1991, plus the NPDES General Permit.

Features of the regulations highlighted in Table 1 are presented in

Table *2*. The regulations under Section R.72-307H provide for a simplified stormwater management and sediment control plan that does not require approval by DHEC and does not require preparation or certification by a registered engineer, landscape architect or Tier B land surveyor (SCDHEC, 1997). However, DHEC staff does have the authority to conduct site inspections to ensure compliance with the submitted plan. Under Section R.72-307I, the stormwater management and sediment control plan must be approved by DHEC, and requires preparation and certification by a registered engineer, landscape architect or Tier B land surveyor. The plan must also include BMPs to control erosion and sediment, and measures to control peak discharge rates and peak velocities of stormwater runoff from the site.

Table 2. South Carolina Sediment, Erosion, and Stormwater Management Program Land Development Regulatory Requirement Details Applicable to Non-Coastal Counties.

Plan Feature	Applicable Regulation(s)		
	R.72-307H	R.72-307I	R.72-305, R.72-307, SCR100000
Plan Approval by Implementing Agency	Not required	Required	Required
Plan Preparation / Certification by Registered Professional Engineers / Landscape Architects / Land Surveyors	Not required	Required	Required
BMPs to Control Erosion and Sediment	Not required	Required	Required
Measures to Control Stormwater Quantity	Not required	Required[1]	Required[1]
Measures to Control Stormwater Quality	Not required	Not required	Required[2]

1. Stormwater quantity control requirements include:
   a. Post-development peak discharge rates shall not exceed pre-development discharge rates for the 2- and 10- year frequency, 24-hour duration storm events. Implementing agencies may utilize a less frequent storm event (e.g., 25-year, 24-hour storm) to address existing or future stormwater quantity or quality problems.
   b. Discharge velocities shall be reduced to provide a non-erosive velocity flow from a structure, channel, or other control measure or the velocity of the 10-year, 24-hour storm runoff in the receiving waterway prior to the land disturbance activity, whichever is greater.
   c. Watersheds other than "designated watersheds" that have well documented water quantity problems may have more stringent, or modified, design criteria determined by the local government that is responsive to the needs of that watershed.
2. See Table A-3 for a summary of stormwater quality requirements.

The State regulation requires that post-development peak flows shall not exceed the pre- development peak flow rate for the 2-year/24-hour and 10-year/24-hour design storms. Developments of 5 acres or more must meet all of the requirements listed above and must provide measures for stormwater quality control.

The current NPDES general permit SCR100000 (effective September 1, 2006) includes requirements for inspections on construction sites. Once construction begins, these inspections must be conducted at least once every 7 calendar days, or at least once every 14 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. The inspections must be conducted by qualified personnel (as defined in the permit) and an inspection report must be completed for each inspection. The report must be retained for at least 3 years from the date that permit coverage expires or is terminated. For construction activities disturbing 10 acres or more, a monthly report must also be submitted to DHEC. Monthly reports may also be required on a case-by- case basis.

Stormwater runoff quality control measures required for developments of 5 acres or more are presented in Table 3. In general, the water quality storage requirements depend upon the type of BMP and, in some cases, the location of the development site.

Table 3. South Carolina Coastal Zone Management Program Stormwater Quality Bmp Requirements Beaufort County.

BMP Facility Type	Water Quality Volume Requirements		
	General	**Within 0.5 Miles of a Receiving Waterbody in the Coastal Zone**	**Within 1,000 Ft of Shellfish Beds**
Water quality facility with permanent pool of water (e.g., wet detention pond)	Permanent pool volume of 0.5 inches of runoff per acre of drainage; storage above permanent pool of 0.5 inches of runoff per acre of drainage, required to bleed down over a 24-hour period	Permanent pool volume of 0.5 inches of runoff per acre of drainage or 1.0 inches of runoff per impervious acre of drainage, whichever is greater; same general storage requirement above permanent pool	Permanent pool volume of 0.5 inches of runoff per acre of drainage or 1.5 inches of runoff per impervious acre of drainage, whichever is greater; same general storage requirement above permanent pool
Water quality facility without permanent pool of water (e.g., extended dry detention pond)	Storage of 1.0 inches of runoff from the entire drainage area, required to bleed down over a 24-hour period	General requirements apply	Not applicable
Infiltration practices	Storage of 1.0 inches of runoff per impervious acre of drainage, required to drain completely in 72 hours	General requirements apply	Storage of 1.5 inches of runoff per impervious acre of drainage, required to drain completely in 72 hours

The basic water quality volume requirements vary based on the type of BMP. A water quality facility with a permanent pool of water (e.g., a wet detention pond) has a required permanent pool volume equivalent to 0.5 inch of runoff per acre of drainage, as well as another 0.5 inch of storage above the permanent pool. The storage above the permanent pool is required to bleed down over a 24-hour period. In contrast, a water quality facility without a permanent pool of water (e.g., an extended dry detention pond) has a required water quality storage volume equivalent to 1.0 inch of runoff per acre of drainage, and this volume is required to bleed down over a 24-hour period. Infiltration facilities, which capture runoff and then release the captured runoff through evapotranspiration and infiltration into the underlying soil, are required to provide water quality storage equivalent to 1.0 inches of runoff per impervious acre of drainage.

Under existing State regulations, water quality control facilities with a permanent pool of water may have more stringent requirements if the development is within 0.5 mile of a receiving waterbody in the coastal zone. In this case, the required permanent pool volume is the greater of: (a) 0.5 inch of runoff from the entire drainage area, or (b) 1.0 inch of runoff per impervious acre of drainage. The latter condition will apply for commercial, industrial and high-density residential land uses with an imperviousness of more than 50 percent. There are no special requirements for infiltration facilities and facilities without a permanent pool of water.

Special considerations also apply when the development is within 1,000 ft of shellfish beds (determined from State mapping or by site inspection). In this case, the regulations require that 1.5 inches of runoff per impervious acre of drainage must be retained. Of the three BMP types discussed above, only infiltration facilities are designed to retain runoff (i.e., captured runoff is depleted by storage through evapotranspiration and infiltration into the underlying soil, rather than released to a drainage channel or waterbody). In contrast, facilities such as ponds are designed to detain runoff (i.e., captured runoff is detained for treatment and is then released to a drainage channel or waterbody).

Table 3 shows how the shellfish bed regulation has been interpreted for this report. The requirement for infiltration facilities is 1.5 inches per impervious acre of drainage, which is 50 percent greater than the general requirements. For facilities with a permanent pool, it was presumed that the requirement would be met by providing a permanent pool volume equivalent to 1.5 inches of runoff per impervious acre. For storms producing runoff of 1.5 inches or less, the runoff will be stored in the permanent pool and an equal volume of water will be displaced from the pool and discharged to a drainage channel or waterbody. The table provides no interpretation of the shellfish bed requirements for other facilities without a permanent pool. Such a facility would actually be operating as an infiltration facility.

As mentioned previously, DHEC administers the Federal NPDES Program on behalf of EPA; therefore, along with having jurisdiction over the NPDES Construction Program, DHEC also has jurisdiction over the NPDES Industrial Program. Under the latter program, the general permit (SCR000000) covers all categories of stormwater discharges associated with industrial activity, except the construction activity, which is covered under the Construction Program. SCR00000 requires the development of a SWPPP, which identifies potential sources of stormwater pollution and describes practices to be implemented for reducing stormwater pollutant discharges. These practices may include structural BMPs (e.g., wet detention ponds), good housekeeping practices, spill prevention procedures, and employee training. Annual or semi-annual monitoring of stormwater discharge from the site is required for certain industrial facilities. The monitoring would include measurement of specific pollutants such as nutrients and metals, and acute whole effluent toxicity tests.

Information on the South Carolina Sediment, Erosion, and Stormwater Management Program can be found at: http://www.scdhec.net/water/html/erfmain.html

Information on NPDES Stormwater Program Implementation in South Carolina can be found at: http://www.scdhec.net/eqc/water/html/swnhistory.html

Appendix O: Maintenance Agreement Template

O.1 Maintenance Agreement Template

E.3 Sample Maintenance Agreement

State of South Carolina	**)**	**Permanent Stormwater Facility Maintenance**
	)	**and Responsibility Agreement**
County of Beaufort	**)**	**Tax Map No. ____________________**

This Agreement is entered into this _____ day of ____________________, 20____, by and between ______________________________, (hereinafter referred to as "Landowner") and the County of Beaufort, political subdivision of the State of South Carolina (hereinafter referred to as "County").

It is agreed as follows:

Landowner Responsible for Stormwater Facility:

The South Carolina Stormwater Management and Sediment Reduction Act of 1991 (§48-14-10, et. seq.) and Regulation 72-308 provide that a Landowner shall adequately establish and maintain stormwater management/Best Management Practices (BMP) facilities upon making certain improvements to the Landowner's property. This law applies to any individual, partnership, corporation or other entity, constructing a stormwater facility. It also applies to all subsequent owners of the property. The obligation applies to the maintenance of all pipes, equipment, and channels built to convey stormwater to a retention facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater on the property. (All fixtures and graded or excavated improvements for controlling stormwater are herein the "Facility"). Adequate maintenance is herein defined as keeping the Facility in good working condition so that the Facility is performing all of its design functions in accordance with the purposes for which it is designed.

Maintenance Required:

The Landowner, its successors and assigns, will perform the maintenance, repair, and replacement necessary to keep the Facility in good working order. In the event a maintenance schedule for the Facility (including sediment removal) is outlined on the approved plans, the schedule must be followed.

Inspection Required:

The Landowner, its successors and assigns, shall regularly and periodically inspect the Facility in its entirety. Records shall be kept to identify the dates and maintenance performed and shall be made available to the County at the County's request. The purpose of the inspection is to assure safe and proper functioning of the Facility. The inspection shall cover all parts of the Facility including, but not limited to, berms, outlet structures, pond areas, and access roads. The Landowner's failure to inspect shall be treated as a breach of this Agreement just as much as a failure to repair if repair is needed after inspection.

Access Permitted:

The Landowner grants permission to the County, its authorized employees and agents, to enter upon the Property and to inspect the Facility whenever the County deems necessary. The purpose of inspection is to follow-up on reported or observed deficiencies, to respond to citizen complaints, or to make an inspection if a significant time has passed after the last inspection. The County shall provide the Landowner a copy of the inspection findings and a directive to commence with the repairs if necessary. In the case of multiple Landowners of a single property, notice to one shall suffice as notice to all.

No Duty on the County:

This Agreement creates no affirmative duty on the County to inspect, and it imposes no liability of any kind whatsoever on the County for omissions in inspecting. The Landowner agrees to hold the County harmless from any liability in the event the Facility fails to operate properly due to the Landowner's failure to abide by the terms of this Agreement.

Landowner Covenants:

The Landowner accepts responsibility for ownership and proper maintenance of the stormwater system, the Facility (pond, swales, etc.) on parcel # (R________________________) located at____________________________________, (see attached Site Map) Beaufort, South Carolina, per the approved maintenance plan. The specific BMPs on the property are listed below:

1) ____
2) ____
3) ____
4) ____
5) ____

Landowner will complete any necessary repairs and/or preventive maintenance procedures in a timely manner to ensure proper functioning as a stormwater management device(s).

Landowner understands that the maintenance plan may be amended or revised at any time by the County in order to address changed conditions or to address conditions not being effectively met by the Facility. Following the County's sending notice; Landowner will abide by any prescribed changes.

This covenant to maintain the Facility shall run with the land. Landowner will continue to own and maintain the Facility until the County is notified in writing of a transfer in ownership and maintenance responsibility. The notification will include a date for the transfer of responsibility which will become effective upon the County's receipt of a letter of acceptance from the new owner. Notwithstanding the provision for a letter of acceptance, any new Landowner shall be responsible for all duties and obligations created by this Permanent Stormwater Facility and Maintenance Responsibility Agreement upon it being executed and filed in the Register of Deeds Office for Beaufort County.

Landowner understands that failure to adhere to the signed Maintenance Agreement may result in fines of up to $1,000.00 per day, per violation and /or the institution of a court action, or such other and additional penalties, fines, or assessments as shall be enacted and provided for by the general law of the state or by local regulation lawfully enacted.

(Signatures contained on the next page)

IN WITNESS our hand and seal this_____day of_____________, 20___.

________________________ WITNESS 1	Land Owner Name:____________________ (Print)
________________________ WITNESS 2	Land Owner Signature:____________________
	Mailing Address:____________________ ____________________
	Phone Number: ____________________
	County of Beaufort
________________________ WITNESS 1	
________________________ BY:	____________________ ____________________
WITNESS 2 ________________________ ITS:	County Administrator

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF BEAUFORT)

The foregoing instrument was acknowledged before me this______day of____________, 20___ by____, (Landowner's name).

____
Notary Public for South Carolina
My Commission Expires: __________

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF BEAUFORT)

The foregoing instrument was acknowledged before me this______day of____________, 20___ by ________________, County Administrator for Beaufort County.

____
Notary Public for South Carolina
My Commission Expires: __________

Appendix R: Land Cover Designation and Maintenance

Table of Contents

R.1 General Notes

The retention standard approach taken in this guidance manual for on-site stormwater management and the run-off reduction methodology recognizes the ability of pervious land covers to manage some, or most, of the rainwater that falls on it. This is termed "land abstraction" in this appendix and is assumed to be based on SCS Hydrologic Soil Group (HSG) or soil type and whether the land cover is best represented as Forest/Open Space (RvN), Managed Turf (RvC) or Impervious Cover (RvI). As noted in Section 3.7, Equation 3.2 Stormwater Retention Volume, the designation of Forest/Open Space with these lands will generate between 2-5% stormwater runoff for a design rain event. The designation of compacted cover assumes these lands will generate 15-25% stormwater runoff for a design rain event. Impervious cover will generate 95% stormwater runoff for the design rain event. The minimum area threshold for the natural cover designation is 1,500 square feet, with a minimum length of 30 feet. Areas not meeting the natural cover threshold will be considered compacted cover RvC. To ensure no loss of land abstraction, all land cover designations must be recorded in the maintenance agreement.

R.1.1 Existing Natural Cover Requirements

A site claiming natural cover based on the preservation of existing conditions must ensure conditions remain undisturbed to preserve hydrologic properties equal to or better than meadow in good condition. No credit will be given for areas that are cut and then replaced with planting. The intention of preserving areas is to allow for natural succession with saplings reaching maturity after a period of time.

Preservation areas for natural cover may include the following:

- Portions of residential yards in forest cover that will not be disturbed during construction;
- Community open space areas that will not be mowed routinely, but left in a natural vegetated state, as defined below (can include areas that will be rotary mowed no more than two times per year);
- Utility rights-of-way that will be left in a natural vegetated state (can include areas that will be rotary mowed no more than two times per year); or

- Other areas of existing forest and/or open space that will be protected during construction and that will remain undisturbed.

R.1.2 <u>Planting Requirements for the Creation of Natural Cover</u>

Every 1,500 square feet of created natural area shall be vegetated according to the following options of plant material quantity:

- 1 native understory tree: 1.5-inch caliper (minimum), and 2 native canopy trees: 2.5 inch caliper (minimum), or
- 6 native shrubs: 5 to 7-gallon container size (minimum), or
- 50 native perennial herbaceous or woody plants or clump-forming grasses: 1-gallon container size (minimum), or
- 1 native canopy tree: 2.5-inch caliper (minimum), and 25 native perennial herbaceous plants: 1-gallon container size (minimum), or
- 3 native shrubs: 5 to 7-gallon container size (minimum), and 25 native perennial herbaceous plants 1-gallon container size (minimum)

Plantings shall be indigenous to the immediate area and shall be arranged in a natural random pattern (e.g. not a formal composition). To ensure a resilient planting composition, diversity must be provided in the planting plan: at least 2 different species of trees, 3 different species of shrubs, and/or 5 different types of perennials/grasses shall be used in each planting.

If planting near marshes, vegetation should be elevated as much as possible to ease establishment from the saline environment and lessen the impacts of inundation from King Tide events.

Steep slopes greater than 6% grade will require additional plantings, soil stabilization, or a terracing system.

Whip and seedling stock may be used (when approved by *<local jurisdiction>*) as a site's natural cover creation if a stream bank stabilization opportunity falls within the site's footprint. In this instance, whips or seedlings must be planted at a minimum density of 700 plants per acre, and at least 55% of these plants must remain at the end of the 2-year management period.

Natural regeneration (i.e., allowing volunteer plants to propagate from surrounding natural cover as a cover creation technique) may be allowed by *<local jurisdiction>*, when 75% of the proposed planting area is located within 25 feet of adjoining forest, and the adjoining forest contains less than 20% cover of invasive exotic species (as documented by the South Carolina Exotic Pest Plant Council 2014 list here: https://www.se-eppc.org/southcarolina/SCEPPC_LIST2014finalOct.pdf). In this case, supplemental planting must ensure a density of 400 seedlings per acre.

All plant materials used must be native to the southeastern region and must be installed in areas suitable for their growth. There are several websites that may be consulted to select the most appropriate plantings for the Southern Lowcountry:

- Low Impact Development in Coastal South Carolina: A Planning and Design Guide; see suggested plant lists for bioretention (4.2), open channels (4.8) and stormwater wetlands (4.12) http://www.northinlet.sc.edu/wp-content/uploads/2019/12/LID-in-Coastal-SC.pdf

- South Carolina Wildlife Federation: http://www.scwf.org/native-plant-list
- South Carolina Native Plant Society: https://scnps.org/wp-content/uploads/2012/04/CoastalNativePlantList.pdf
- Carolina Yards Plant Database: https://www.clemson.edu/extension/carolinayards/plant-database/index.html
- Clemson University Cooperative Extension Services Home & Garden Information Center factsheet for freshwater shoreline landscaping: https://hgic.clemson.edu/factsheet/shorescaping-freshwater-shorelines/

Plant irrigation is recommended until established.

R.2 Stormwater Management Plans and Natural Cover

Sites using preservation of existing areas for the natural cover designation shall include on their Stormwater Management Plan (SWMP) their natural resources inventory, a tree and vegetation survey, identification of location, and extent of preservation areas. Depending on the extent of the preservation area, <*local jurisdiction*> may require the SWMP to include a more detailed schedule for retained trees, noting the tree species, size, canopy, condition, and location.

The SWMP will include the identification of material and equipment staging areas and parking areas. Material and equipment staging areas and parking areas must be sufficiently offset for preservation areas to ensure no adverse impacts.

For areas maintained as meadow in good condition, the SWMP shall document either the preservation of existing conditions or the creation of meadow conditions. A plan submission claiming meadow preservation will note the existing meadow boundaries and include a field survey of the richness and diversity of existing plant species and the existing soil conditions by a qualified individual (see Section 2.1.3). A plan submission claiming meadow creation will note the proposed meadow boundaries, the planting and/or seeding species methods, and provide a soil amendment plan as specified in Appendix C Soil Compost Amendment Requirements.

R.3 Construction Requirements for Natural Cover Designation

The preservation of lands designated as natural cover—such as undisturbed portions of yards, community open space, and any other areas designated on a site's SWMP as preserved natural cover—must be shown outside the limits of disturbance on the site's Soil Erosion and Sediment Control Plan. These areas must be clearly demarcated with signage prior to commencement of construction on the site on the site and with fencing during construction.

The creation of lands designated as natural cover as part of a public right-of-way (PROW) project and on sites where soils were not protected from compaction during construction the soils must be conditioned prior to planting with soil compost amendments as prescribed in Appendix C Soil Compost Amendment Requirements.

For maximum survivability, planting of trees, shrubs, and herbaceous vegetation for the creation of natural cover should occur only during the fall and early spring (i.e., September through November and March through May). The work should be done only under the supervision of someone qualified and skilled in landscape installation (see Section 4.14 Tree Planting and Preservation for details on qualifications). Proper maintenance of the materials after installation will be key in ensuring plants survival. Prior to inspection, all trees and shrubs planted must be alive and in good health, and native grass and wildflower seeds must have been sown at adequate densities and at the right time of year for each species.

Once a natural cover designation has been assigned to a portion of regulated development site, that area will need to be recorded in the declaration of covenants, documented at the site prior to construction activities, protected during construction activities, and permanently protected/maintained for the life of the regulated site.

Root pruning and fertilizing are examples of preconstruction activities. These measures aim to increase the wellbeing of trees and prepare them for higher stress. Prior to beginning construction, temporary devices such as fences or sediment controls are installed and remain throughout the construction phase. Some devices, like retaining walls and root aeration systems may remain permanently. For example, if part of a root system is collapsed by a built road, permanent aeration may be necessary for the tree to remain healthy.

R.4 Maintenance Requirements for Natural Cover Designation

All areas that will be considered natural cover for stormwater purposes must have documentation that prescribes that the area will remain in a natural, vegetated state. Appropriate documentation includes subdivision covenants and restrictions; deeded operation and maintenance agreements and plans; parcels of common ownership with maintenance plans; third-party protective easements within the PROW; or other documentation approved by *<local jurisdiction>*.

While the goal is to have natural cover areas remain undisturbed, some activities may be prescribed in the appropriate documentation, as approved by *<local jurisdiction>*, such as forest management, control of invasive species, replanting and revegetation, passive recreation (e.g., trails), limited bush hogging to maintain desired vegetative community, etc.

R.5 Compacted Cover Designation

The compacted cover designation can apply to all site areas that are disturbed and/or graded for eventual use as managed turf or landscaping. Examples of compacted cover include lawns, portions of residential yards that are graded or disturbed and maintained as turf (including yard areas), residential utility connections, and PROW. Landscaping areas intended to be maintained as vegetation other than turf within residential, commercial, industrial, and institutional settings are also considered compacted cover if regular maintenance practices are employed.

Appendix S: Single Family On-Lot Volume Control

Step 2 On-Lot Volume Control

Beaufort County passed the On-Lot Volume Controls on June 13, 2011. This requires On-Lot Volume Control when constructing new homes in communities that do not meet current community-wide runoff volume control requirements. This section is applicable only for home lots of record platted but not yet developed. Worksheets are available in an online calculator format at http://stormwaterworksheet.createandsolve.com/.

Purpose

The purpose of this worksheet and web-based program is to help a homeowner or builder determine the amount of excess stormwater runoff that will come off the property after construction of the home.

It will also assist in selecting the controls necessary to control this excess runoff so that the County's water resources are not impacted. Scientists have determined that excess freshwater runoff into saltwater tidal waters can impact the area's fishery resources.

The worksheet and program will allow the user to print out a sheet that can be used to document satisfactory controls so a zoning permit can be obtained. This zoning permit is necessary for issuance of a building permit.

Step 1 – Lot Information

This information is used to compute the excess runoff after construction. If a homeowner is planning an irrigation system, (entered in Section 1), storage and reuse of stormwater from rooftop should be considered for a portion of the irrigation needs. Use of drinking water for irrigation is an expensive alternative for homeowners, and reduction of this can save money as well as reducing amount of water running off the parcel after construction. While this is recommended, storage and reuse is optional because of its initial cost.

Step 2 – Post Construction Stormwater Runoff Calculations

The amount of excess runoff in gallons can be computed using this web-based program. It will depend on whether the soil is sandy or clay (entered in Section 1). The rainfall event that is used to determine the amount of runoff to be controlled is a 1.95-inch rainfall (95th percentile of average events in a year) in a 24-hour period. Before construction, on sandy soils, generally no runoff will occur with the 1.95-inch rainfall event. For clay soils, more than 0.5 inch of a 1.95 rainfall will runoff before construction. Taking this into account, the program will determine the runoff to be controlled, in gallons, after construction.

Step 3 – Application of Best Management Practices

This section takes the gallons determined in the Step above and guides the user through three steps that will reduce these gallons until they are all being controlled. The first step is an optional

storage and reuse/infiltration practice. This practice will utilize a holding facility of some size and then the water can be utilized for reuse or infiltrated at a slow rate from the storage facility.

When storage is utilized, it will control a certain amount of rooftop impervious surface. The maximum storage allowed for credit is limited to the rooftop impervious surface (in square feet) times 1.15. Additional storage can be added but credit is limited to 1.15 gallon per square foot of rooftop surface. When storage is used, it decreases the amount of impervious surface that needs to be handled by the other practices. This is called unaddressed impervious surface.

The second practice is **disconnected impervious surface**. It can utilize the natural infiltration capacity of the lot to control water running off unaddressed impervious surfaces. It will require a determination of which way the water sheet flows across the lot. The program allows up to two directions to be selected. The user starts with an estimate of the impervious surfaces and pervious portion of the lot. If the lot flows in one direction, the estimate is easy. It would be the unaddressed impervious surface and the previous surface it flows over to the end of the lot. If the ratio of unaddressed impervious surface to pervious area is greater than 5, there will be no credit, and runoff is better controlledby the next step. Figures 5-1 and 5-2 provide examples of one- and two-direction calculations to help in determining input figures for this practice.

If after the employing the first two practices there is still excess runoff to be handled, **rain gardens and other practices** will be used to control the remaining runoff. This will be computed for the user, who will be given a square foot size of a standard rain garden.

This standard size rain garden is 3 ft deep and can have special soil or sand and rock mixture that will store runoff and allow it to infiltrate. There is some flexibility between storage and reuse and rain gardens. If less rain garden is desired, storage can be increased, and vice-versa.

There is an attached sheet at the end of this help sheet that provides examples of alternative practices under this step.

It should be remembered that impervious surface on the property causes the excess volume that needs to be controlled. The amount of controls can be reduced by decreasing the impervious surface on the property by considering pervious driveways and walks, reducing rooftop size (two story versus one story), and other practices.

Step 4 – Summary of Volume ReductionPractices

This section is computed for the user to show a summary. This program allows the user to print a one-page sheet that summarizes entry and practices being used. This sheet would be attached to zoning and building permits and will be checked at completion of the project.

Definitions:

Impervious surface – hard surface that allows rainfall to run off and not infiltrate the soil.

Rooftop impervious surface – horizontal surface area of rooftops including overhangs and other detached buildings/sheds.

Other impervious – generally hard surfaces on the ground like paved driveways, patios, walkways and sidewalks.

Pervious surface – surface that is not hard, such as grass, garden or forest area.

Irrigated area is area that would be served by an installed irrigation system. **Unaddressed impervious surface** – term used to determine amount of impervious surface or runoff gallons that had not been controlled by a previous practice.

Standard rain garden – rain garden that has 3 ft of fill material and a 6-inch maximum ponding depth. Different sizes can be constructed but then credits must be computed from Beaufort County BMP manual.

Conversions

Rainfall to gallons of runoff

Design storm is 1.95 inches, of which 1.85 inches is available to run off impervious surface. 1.85 inch on 1 sq ft of impervious surface is equivalent to 1.15 gallons of runoff

Preconstruction runoff

Clayey soils – 0.53 inches run off for a 1.95-inch storm. 0.53 inch on 1 sq ft is equivalent to 0.33 gallon of runoff.

Sandy soils – No runoff for a 1.95-inch storm

Storage and reuse – if irrigation is used on parcel then storage must be between 0.3 gallon/sq ft of rooftop impervious surface to maximum credit of 1.15 gallon/ sq ft of rooftop impervious surface. Storage can be larger but maximum credit is 1.15g/sq ft.

Rain garden

Square foot of impervious surface per square foot of standard rain garden

Clayey soils 4 sq ft of impervious surface to 1 sq ft of standard rain garden

Sandy soils 7 sq ft of impervious surface to 1 sq ft of standard rain garden

Disconnected imperviousness – is the practice of running uncontrolled stormwater flow from impervious surfaces over pervious surfaces to take advantage of natural infiltration of the soil. Credit is given in Table 5-8 based on ratio of impervious surface over pervious surface to compute a ratio.

Table 5-8 Credit Table for Disconnected Impervious Area

Disconnected Impervious Ratio	**Runoff reduction (Gal/sq. ft-impervious area)**	**Runoff reduction (Gal/sq. ft-impervious area)**
	Clayey	Sandy
0.1	.40	1.15
0.2	.40	1.12
0.4	.38	1.08
0.8	.33	1.01
1.0	.31	.98
2.0	.24	.84
3.0	.19	.74
4.0	.16	.67
5.0	.14	.60

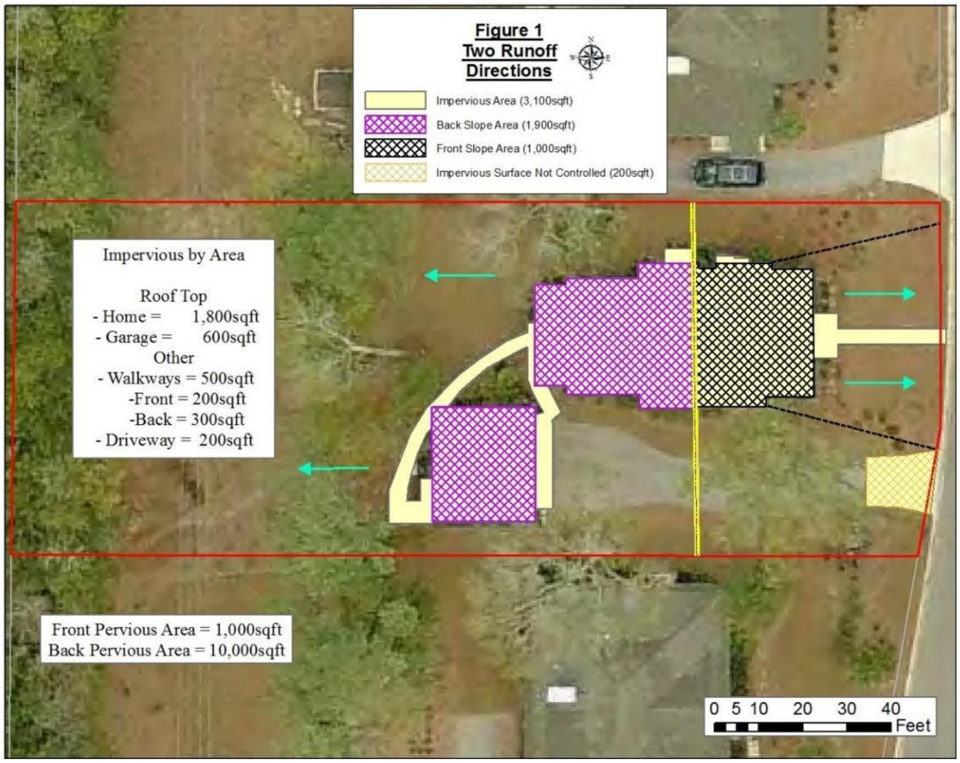


Figure 5-1
Example of a One-Direction Calculation for Disconnected Impervious Surface

This is a home on a 16,000 sq ft lot with about 2,500 sq ft of living space.

In this example, runoff from 1,000 sq ft of impervious surface flows towards the front of the house. It can be made to sheet flow over 1,000 sq ft of lawn (pervious surface). Therefore, on the worksheet or web program, enter 1,000 in impervious area and 1,000 in pervious area of the first direction.

The second direction is to the back of the home, and this 1,900 sq ft of rooftop and other impervious surface flow over 10,000 sq ft of lawn and forest area.

Therefore, enter in the second direction 1,900 sq ft in impervious area and 10,000 in pervious area.

In this example, there is 200 sq ft (paved portion of driveway) that cannot sheet flow over enough pervious area to receive a credit and would not be included in calculations

If storage and reuse/infiltration was used in the first step (say two 500 cisterns/tanks in front of house) then the unaddressed impervious surface would be computed by reducing the first direction impervious surface.

Therefore, the in first direction, enter 130 in impervious surface (reduced by 870 sq ft = 1000 gal/1.15 gal/sq ft) and still 1,000 in pervious surface. See program printout for this example (with storage) in Appendix E.3

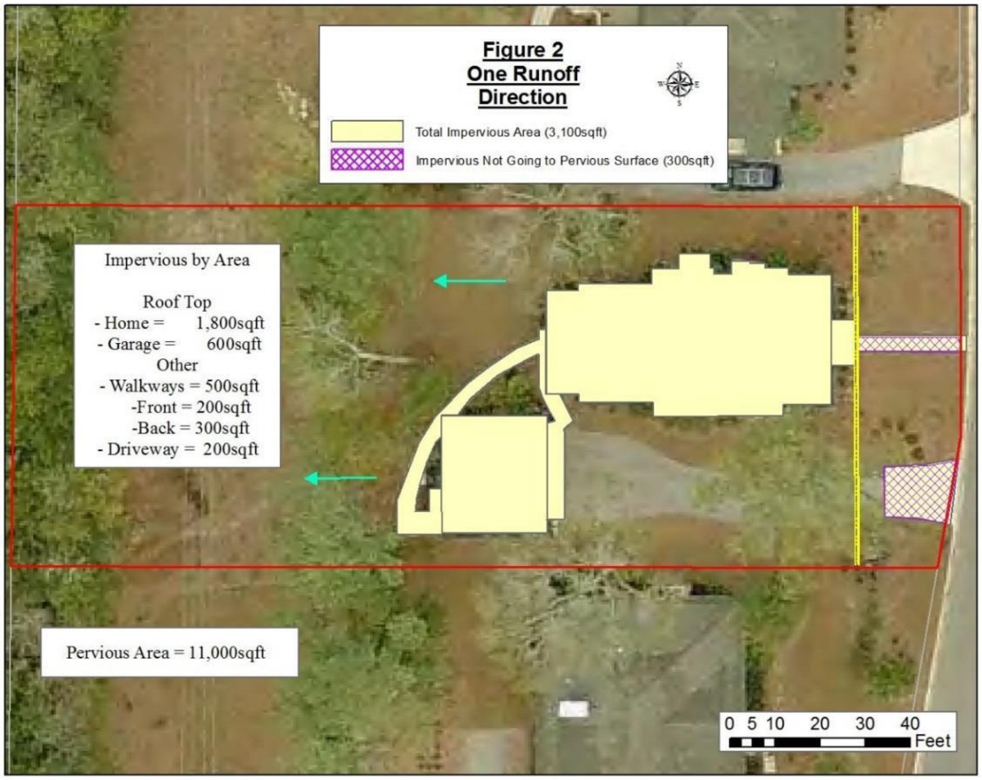


Figure 5-2
Example of a Two-Direction Calculation for Disconnected Impervious Surface

In this example, there would be 2,800 (3,100 to 300) sq ft of impervious surface sheet flowing over 11,000 sq ft of pervious surface out the back yard.

Therefore, enter 2,800 in the first impervious area and 11,000 in the pervious area. The second direction would have zero entered in both categories.

Again, if storage and reuse/infiltration was used, the impervious surface that included in the worksheet or web program would need to be reduced.

If, for example, two 500-gallon storage devices were used, the impervious surface needs to be reduced by 870 sq ft (1000 gal/1.15 gal/sq ft).

Therefore, enter 1,930 in first impervious area and 11,000 in pervious area. The second direction would have zero in bothcategories.

BEAUFORT COUNTY

-STORMWATER PERMIT APPLICATION-

DATE ACCEPTED	RECEIVED BY	FILING FEE	RECEIPT#	PERMIT#	PIN#

PROJECT NAME:	PROJECT TYPE:
PROJECT LOCATION:	
APPLICANT/DEVELOPER NAME, ADDRESS, PHONE#	PROPERTY OWNER NAME, ADDRESS, PHONE#
EMAIL	EMAIL
SWPPP PREPARER NAME, ADDRESS, PHONE#	CONTRACTOR NAME, ADDRESS, PHONE#
EMAIL	EMAIL
QUALIFIED INSPECTOR NAME, ADDRESS, PHONE#	ADDITIONAL INFORMATION:
EMAIL	

SW01 (Single Family Home)

- ☐ COPY OF TIER I STORMWATER POLLUTION PREVENTION PLAN (SWPPP) – (See Appendix D)
- ☐ PLOT PLAN SHOWING, VICINITY MAP, NORTH ARROW, GRAPHIC SCALE, PROPOSED IMPROVEMENTS
- ☐ SITE PLAN SHOWING EXISTING GRADES/CONTOURS/ELEVATIONS AND PROPOSED GRADES/CONTOURS/ELEVATIONS, WITH OFFSITE DISCHARGE POINTS IDENTIFIED
- ☐ NATURAL RESOURCE INVENTORY SHOWING TREES, WETLANDS, DRAINAGE COURSES, AND BUFFERS
- ☐ GRADING AND DRAINAGE CERTIFICATION
- ☐ STEP II VOLUME CONTROL (See Section 5.3) (http://stormwaterworksheet.createandsolve.com)
- ☐ APPLICATION FEE

SW02 (Non Residential and Attached Residential)

- ☐ COPY OF TIER II STORMWATER POLLUTION PREVENTION PLAN (SWPPP)
- ☐ POST CONSTRUCTION STORMWATER PLAN CHECKLIST WITH LOCATION OF ALL ITEMS INDICATED.
- ☐ SITE PLAN: VICINITY MAP, PROJECT LOCATION, NORTH ARROW, GRAPHIC SCALE, PROPOSED IMPROVEMENTS
- ☐ CONSTRUCTION PLANS
- ☐ DRAINAGE CALCULATIONS (See Section 5.3)
- ☐ APPLICATION FEE

Created: 2021-07-22 09:11:36 [EST]

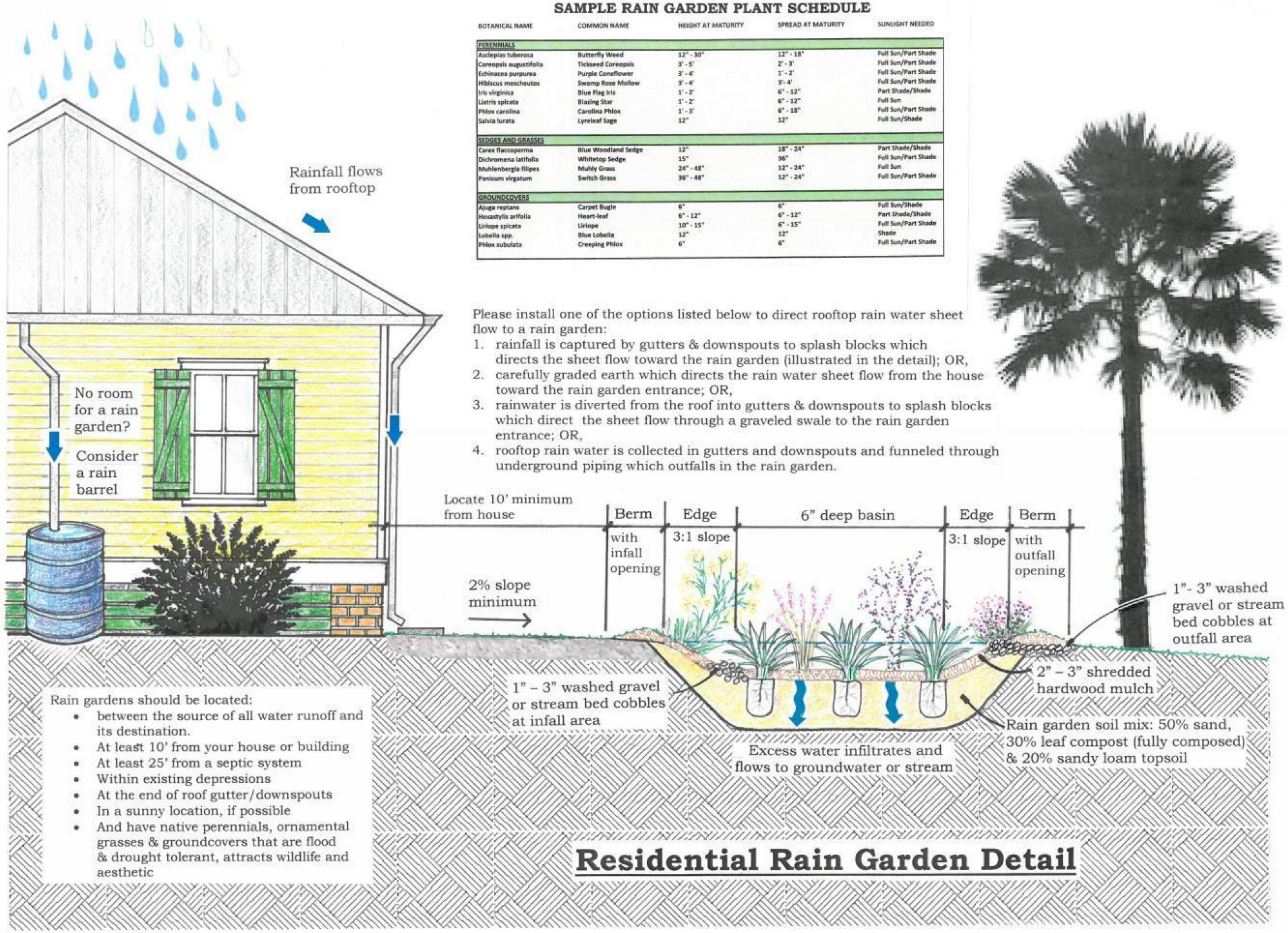
Application Affidavit
The applicant acknowledges that application and issuance of the local Beaufort County Stormwater Permit does not preclude the need to obtain a NPDES permit from SC-DHEC per the South Carolina Erosion and Sediment Reduction act of 1983 as promulgated via 72-300, Standards for Stormwater Management and Sediment Reduction. Any change to the SWPPP associated with this permit as a result of permitting by DHEC renders this permit void until revised by the applicant to match the DHEC approved plan. The applicant further acknowledges the County may refuse to conduct inspections and may issue Notices of Violation, Stop Work Orders, and/or Civil Penalties for failure to comply with DHEC requirements.
Signature________________________________ Date__________________

SAMPLE RAIN GARDEN PLANT SCHEDULE

BOTANICAL NAME	COMMON NAME	HEIGHT AT MATURITY	SPREAD AT MATURITY	SUNLIGHT NEEDED
PERENNIALS				
Asclepias tuberosa	Butterfly Weed	12" - 30"	12" - 18"	Full Sun/Part Shade
Coreopsis augustifolia	Tickseed Coreopsis	3' - 5'	2' - 3'	Full Sun/Part Shade
Echinacea purpurea	Purple Coneflower	3' - 4'	1' - 2'	Full Sun/Part Shade
Hibiscus moscheutos	Swamp Rose Mallow	3' - 4'	3'- 4'	Full Sun/Part Shade
Iris virginica	Blue Flag Iris	1' - 2'	6" - 12"	Part Shade/Shade
Liatris spicata	Blazing Star	1' - 2'	6" - 12"	Full Sun
Phlox carolina	Carolina Phlox	1' - 3'	6" - 18"	Full Sun/Part Shade
Salvia lurata	Lyreleaf Sage	12"	12"	Full Sun/Shade
SEDGES AND GRASSES				
Carex flaccoperma	Blue Woodland Sedge	12"	18" - 24"	Part Shade/Shade
Dichromena latifolia	Whitetop Sedge	15"	36"	Full Sun/Part Shade
Muhlenbergia filipes	Muhly Grass	24" - 48"	12" - 24"	Full Sun
Panicum virgatum	Switch Grass	36" - 48"	12" - 24"	Full Sun/Part Shade
GROUNDCOVERS				
Ajuga reptans	Carpet Bugle	6"	6"	Full Sun/Shade
Hexastylis arifolia	Heart-leaf	6" - 12"	6" - 12"	Part Shade/Shade
Liriope spicata	Liriope	10" - 15"	6" - 15"	Full Sun/Part Shade
Lobelia spp.	Blue Lobelia	12"	12"	Shade
Phlox subulata	Creeping Phlox	6"	6"	Full Sun/Part Shade

Please install one of the options listed below to direct rooftop rain water sheet flow to a rain garden:

1. rainfall is captured by gutters & downspouts to splash blocks which directs the sheet flow toward the rain garden (illustrated in the detail); OR,
2. carefully graded earth which directs the rain water sheet flow from the house toward the rain garden entrance; OR,
3. rainwater is diverted from the roof into gutters & downspouts to splash blocks which direct the sheet flow through a graveled swale to the rain garden entrance; OR,
4. rooftop rain water is collected in gutters and downspouts and funneled through underground piping which outfalls in the rain garden.



Rain gardens should be located:

- between the source of all water runoff and its destination.
- At least 10' from your house or building
- At least 25' from a septic system
- Within existing depressions
- At the end of roof gutter/downspouts
- In a sunny location, if possible
- And have native perennials, ornamental grasses & groundcovers that are flood & drought tolerant, attracts wildlife and aesthetic

Residential Rain Garden Detail

BEAUFORT COUNTY SOUTH CAROLINA 1769

Residential Rain Garden Detail

DATE: 10/01/18

SCALE: Not to Scale

DRAWN BY: NRM

REVISIONS: 10/10/18
11/08/18
11/26/18

RAIN GARDEN DETAIL

Illicit Discharge Detection and Elimination

1.1 Purpose

The purpose of this section is to provide for the health, safety, and general welfare of the citizens of Beaufort County, South Carolina, through regulation of non-storm-water discharges to the storm drainage system to the maximum extent practicable as required by Federal and State law. This ordinance establishes methods for controlling the introduction of pollutants into the MS4 in order to comply with requirements of the NPDES permit process. The objectives of this ordinance are:

1. To regulate the contribution of pollutants to the MS4 by stormwater discharges by any user.

2. To prohibit illicit connections and discharges to the MS4.

3. To establish legal authority to carry out all inspection, surveillance and monitoring procedures necessary to ensure compliance with this ordinance.

1.2 Program

The basic organization of this program is outlined below. The plan is developed around eight key components that are recommended by the U.S. Environmental Protection Agency (EPA) and the Center for Watershed Protection (CWP) for effective Illicit Discharge Detection and Elimination (IDDE) programs. These eight components are intended to help:

- Conduct an audit to understand community needs and capabilities
- Establish adequate legal authority
- Develop a tracking system to map outfalls and document reported illicit discharges
- Conduct desktop analyses to prioritize targets for illicit discharge control
- Conduct rapid reconnaissance of the stream corridor to find problem outfalls
- Apply new analytical and field methods to find and fix illicit discharges
- Educate municipal employees and the public to prevent discharges
- Estimate costs to run a program and conduct specific investigations

Technical information that addresses various aspects of the plan and references cited can be found in the following EPA sponsored publication produced by the CWP (http://www.cwp.org/index.html) and Robert Pitt from the University of Alabama:

Illicit Discharge Detection and Elimination:
A Guidance Manual for Program Development and Technical Assessments
October 2004

1.2.1 Ordinance

In 2016, the County adopted a revised stormwater ordinance that will prohibit illicit discharges along with the necessary enforcement capability. The County will review other potential codes and ordinances that may have potential links to IDDE and make necessary cross-references and statements of supersede as needed to establish consistency.

1.2.2 Reporting and Education

The County has a web application that will allow a person to report a suspecting IDDE to the County staff via the app. The app will allow the individual to provide the GPS location where the suspected discharge has occurred. Records are kept on each report, including the reporting mode (telephone, email, walk-in, etc.), location and nature of the problem, and any actions taken. Citizens can also call the stormwater department at 843.255.2805.

1.2.3 Monitoring

The County has established a dry weather screening program to proactively detect illicit discharge and eliminate them through sampling, testing and enforcement. The County has a separate monitoring plan document that can be found in Appendix C. Inspection protocol and enforcement actions are in the stormwater ordinance found in Appendix G.

1.3 Definition of Illicit Discharge

Illicit discharge is defined in Article V. of Chapter 99: Stormwater Ordinance. A copy of this ordinance is found in Appendix A.

Southern Lowcountry Stormwater Design Manual

Stormwater Best Management Practices

Prepared by

March 2020

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Acronym Definitions

Acronym/Abbreviation	Definition
ARC	Antecedent Runoff Condition
BMP	Best Management Practice
BSD	Better Site Design
CDA	Contributing Drainage Area
CN	Curve Number
C-SWPPP	Construction Stormwater Pollution Prevention Plan
EGL	Energy Grade Line
EPA	United States Environmental Protection Agency
ESC	Erosion and Sediment Control
FHWA	Federal Highway Administration
GI	Green Infrastructure
HDS	Hydraulic Design Services
HGL	Hydraulic Grade Line
HUC	Hydrologic Unit Code
IWS	Internal Water Storage
LID	Low-Impact Development
LOD	Limits of Disturbance
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NC DEQ	North Carolina Department of Environmental Quality
NEH	National Engineering Handbook
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PROW	Public Right-of-Way
PUD	Planned Unit Development
SC DHEC	South Carolina Department of Health and Environmental Control
SC DOT	South Carolina Department of Transportation
SDA	Site Drainage Area
SWMP	Stormwater Management Plan
SWRv	Stormwater Retention Volume

Chapter 1. Introduction, Background, Purpose, and Administration

1.1 Introduction

Upon passage of the Southern Lowcountry Stormwater Ordinance as amended and adopted by Beaufort County Public Works Department, participating municipalities/jurisdictions will follow the design and permitting requirements of the *Southern Lowcountry Stormwater Design Manual*. The Ordinance directs residents, land developers, redevelopment, and government permit applicants to submit details and plans that comply with this Manual. It is the intent of the Ordinance that all proposed development, redevelopment, and major substantial improvement shall provide stormwater quality control for the stormwater retention volume (SWRv) for Watershed Protection Areas and/or Special Watershed Protection Areas. In the following chapters, Better Site Design (BSD) practices, green infrastructure/low impact development practices (GI/LID), and stormwater best management practices (BMPs) are described in detail to support the stormwater retention requirements. Through in-line and off-line application of these practices, the cumulative impact is reduction of the runoff and the retention on site of design storms.

This Manual and the design criteria presented within represent good engineering practice and should be used in the preparation of stormwater management plans. The criteria are intended to establish requirements, minimum standards, and methods for a sound planning, design, and review process. It is intended to guide the stormwater design review of proposed work done by developers, private parties, and governmental agencies.

1.2 Background

The U.S. Environmental Protection Agency (EPA) recommends that the Phase II Small Municipal Separate Storm Sewer System (MS4) permit require the permittee to adopt a planning process that identifies the municipality's program goals (e.g., minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing the program, EPA states that the permit should also require the permittee to assess existing ordinances, policies, programs and studies that address stormwater runoff quality. These policy assessments should include the following:

- Policies and ordinances that:
    - provide requirements and standards to direct growth to identified areas,
    - protect sensitive areas such as wetlands and riparian areas,
    - maintain and/or increase open space (including a dedicated funding source for open space acquisition),
    - provide buffers along sensitive water bodies,
    - minimize impervious surfaces, and
    - minimize disturbance of soils and vegetation;
- Policies or ordinances that encourage infill development in higher density urban areas and areas with existing infrastructure;
- Education programs for developers and the public about project designs that minimize water quality impacts; and
- Measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas (81 Federal Register 237).

1.3 Purpose

This Manual's purpose is to provide a framework for designing a stormwater management system to:

- Improve water quality through runoff reduction to the maximum extent practicable (MEP);
- Prevent downstream stream bank and channel erosion;
- Reduce downstream overbank flooding; and
- Safely pass or reduce the runoff from extreme storm events.

This Manual presents a unified approach for sizing stormwater best management practices (BMPs) in the Southern Lowcountry to meet pollutant removal goals, reduce peak discharges, and pass extreme floods. Additionally, it follows a watershed approach for their size and specification. Based on the site's watershed, stormwater design criteria specific to each must be met for development permit approval.

1.4 Applicability and Exemptions

1.4.1 Applicability

Design criteria in this Manual are applicable to any new development or redevelopment activity that meets one or more of the following criteria, or is a major substantial improvement, unless exempt pursuant to Section 1.4.2 below:

1. New development that involves the creation of 5,000 square feet of land disturbance.
2. Redevelopment that involves the creation, addition, or replacement of 5,000 square feet or more of land disturbance.
3. New development or redevelopment, regardless of size, that is part of a larger common plan of development, even though multiple, separate and distinct land disturbing activities may take place at different times and on different schedules.
4. A major substantial improvement of an existing property, which is defined as a renovation or addition to a structure that meets both of the following cost and size thresholds: a) construction costs for the building renovation/addition are greater than or equal to 50% of the pre-project assessed value of the structure as developed using current Building Valuation Data of the International Code Council, and b) project size where the combined footprint of structure(s) exceeding the cost threshold and any land disturbance is greater than or equal to 5,000 square feet.

The design criteria are applicable for infill development of platted lots, whether they are new development or redevelopment sites if the work involves creation, addition or replacement of 5,000 square feet or more of land disturbance

1.4.2 Exemptions

The following activities are exempt from the permitting requirements of this Manual:

1. Any maintenance, alteration, renewal, or improvement as approved by Beaufort County Public Works Department which does not alter existing drainage pattern, does not result in change or adverse impact on adjacent property and/or downstream properties, or create adverse environmental or water quality impacts, and does not increase the temperature, rate, quality, volume, or location of stormwater runoff discharge.
2. Projects that are exclusively for agricultural or silvicultural activities within areas zoned for these agricultural and silvicultural uses. Proof of Silvaculture permit required;
3. Agricultural activity not involving relocation of drainage canals;

4. Redevelopment that constitutes the replacement of the original square footage of impervious cover and original acreage of other land development activity when the original development is wholly or partially lost due to natural disaster or other acts of God occurring after January 31st, 2021,
5. Work by agencies or property owners required to mitigate emergency flooding conditions. If possible, emergency work should be approved by the duly appointed officials in charge of emergency preparedness or emergency relief. Property owners performing emergency work will be responsible for any damage or injury to persons or property caused by their unauthorized actions. Property owners will stabilize the site of the emergency work within 60 days, or as soon as reasonable, following the end of the emergency period;
6. Golf courses are required to comply with all site runoff volume and water quality and drainage planning and design requirements. However, both golf courses and private lagoons shall be exempt from the peak attenuation requirements.
7. Existing dirt roads which are improved or paves as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 are deemed not to constitute "development" under the County Code of Ordinance Chapter 99 (Stormwater Utility Ordinance), MS4 Program, or this manual and are, therefore, exempt from the provisions and requirements herein.
8. Small subdivisions may be exempt from the permitting requirements of this manual, and shall be handled on a case by case basis and to be approved by the Public Works Director.

1.5 Administration

1.5.1 Approval Requirements

Before the Beaufort County Public Works Department may issue a stormwater permit for any project requiring stormwater management, the Beaufort County Public Works Department must approve a Stormwater Management Plan (SWMP) meeting the requirements of the Southern Lowcountry Stormwater Ordinance and receive all fees required by the Beaufort County Public Works Department for site and building development plans.

A complete SWMP submittal includes a completed engineer's certification statement, a submittal checklist, plans and design that are signed and sealed by a registered professional engineer licensed in South Carolina. Erosion and sediment control for sites below the South Carolina Department of Health and Environmental Control (SC DHEC) National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities (SCR100000) thresholds must obtain permit coverage under this stormwater permit. All construction stormwater permit applications above the SC DHEC thresholds are reviewed by the DHEC Office of Coastal Resources Management, or the reviews are delegated to the Beaufort County Public Works Department to determine compliance with the requirements of SCDHEC's NPDES General Permit for Stormwater Discharges from Construction Activities (SCR100000) and of the Construction Stormwater Pollution Prevention Plan (C-SWPPP). These permit applications must be approved, issued, and provided to Beaufort County Public Works Department prior to the issuance of the stormwater management plan approval.

1.5.2 Fees

An applicant is responsible for paying fees that provide for the cost of review, administration, and management of the stormwater permitting process and inspection of all projects subject to the requirements of Beaufort County Public Works. These fees are posted by the Beaufort County Public Works Department.

Chapter 2. Design, Review, & Permitting Process

2.1 Satisfying the Stormwater Management, Site Planning, & Design Criteria

2.1.1 Overview

This chapter presents a comprehensive set of site planning and design and post-construction criteria that must be applied to new development and redevelopment activities occurring within the Southern Lowcountry region. Satisfying these criteria promotes the systematic development of acceptable stormwater management plans, and a successful integration of natural resource protection and stormwater management through the site planning and design process (Figure 2.2).

Through the use of Better Site Design, as described in detail below, the integration of natural resource protection and stormwater management can be achieved by:

- Identifying and protecting valuable natural resources;
- Limiting land disturbance, new impervious cover, and disturbed pervious cover; and
- Reducing and managing post-construction stormwater runoff rates, volumes, and pollutant loads.

This approach involves the use of two distinct but complementary groups of natural resource protection and stormwater management techniques:

- Green Infrastructure Practices: Natural resource protection and stormwater management practices and techniques (i.e., better site planning and design techniques, low impact development practices) that can be used to help prevent increases in post-construction stormwater runoff rates, volumes and pollutant loads.
- Stormwater Management Practices: Stormwater management practices (e.g., wet ponds, swales) that can be used to manage post-construction stormwater runoff rates, volumes and pollutant loads.

Natural resource protection and stormwater management techniques help control and minimize the negative impacts of the land development process while retaining and, perhaps, even enhancing a developer's vision for a development site. When applied during the site planning and design process, they can be used to create more natural and aesthetically pleasing development projects and create more cost-effective post-construction stormwater management systems (ARC, 2001). The use of these techniques, particularly the green infrastructure practices, can even reduce overall development costs while maintaining or increasing the resale value of a development project (MacMullan and Reich, 2007; US EPA, 2007; Winer-Skonovd et al., 2006).

2.1.2 Better Site Design in the Planning Process

Better Site Design (BSD) refers to encouraged planning land development using certain principles to minimize stormwater impacts. Integral to low impact development design, proper application of BSD principles can allow for smaller required stormwater BMP storage and retention volumes, and can help provide significant reductions in post-construction peak flows and pollutant loads. These principles include reduction/restoration of impervious cover, conservation of natural cover areas, stream restoration, and integration of both structural and non-structural stormwater management within site design. The principles of Better Site Design are referenced in the sections below. To note, any design standards in conflict with the Beaufort County Community Development Code (CDC) will be superseded by the CDC.

Fundamental to the application of Better Site Design is the correlation between impervious surface area in a watershed and negative impacts on receiving water resources. On a national level, the Impervious Cover Model (ICM) estimates stream quality based on percentage of impervious cover (Schueler and Fraley-McNeal, 2009). This model demonstrates that streams follow a continuous gradient of degradation in response to increasing impervious cover in a watershed. Local studies have supported this paradigm, and report that changes in the rate and volume of stormwater runoff were primary causes of ecological impairment in headwater tidal creeks, such as those found in Beaufort and Jasper Counties. These studies have shown that physical and chemical characteristics such as altered hydrography, increased salinity variance, increased chemical contaminants, and increased fecal coliform loadings of tidal creeks were negatively impacted with as little as 10 to 20% impervious cover. When impervious cover exceeded 30% of the watershed, measurable impacts to living resources were observed, indicating the ecological processes in the creek ecosystems were impaired (Holland et al., 2004).

Such findings are of consequence to Beaufort and Jasper Counties. Increasing pressure for development in response to population growth, and land development practices of the Lowcountry result in significant tree removal and loss of vegetative cover from land grading and storm pond construction and increases in impervious surfaces. According to the NOAA C-CAP Land Cover Analysis (https://coast.noaa.gov/ccapatlas/), from 1996 to 2010, the percent net increase in impervious surface area was 60% for Beaufort County and 59% for Jasper County. Table 2. 1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010. below summarizes the findings of this NOAA report. Although the percentage of total wetlands lost is relatively low for both counties, the actual wetland types have been converted from palustrine forested wetlands to palustrine scrub/shrub and palustrine emergent wetlands, which may alter ecosystem processes and hydrology in these areas.

Table 2. 1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010.

	Beaufort County[1]			Jasper County[1]		
Land Cover %	1996	2010	% Change	1996	2010	% Change
Development	3.87	6.16	+59.12	1.62	2.52	+55.15
Forested Area	25.28	21.5	-14.98	62.50	48.37	-22.60
Wetlands	33.85	33.20	-1.93	45.24	44.74	-1.11

[1] Percent of County under each land cover type.

Given the rapid growth the Southern Lowcountry experienced in the past 20 years, the goals of Better Site Design should resonate with those charged with managing stormwater and its release into the area watersheds. Succinctly, the goals of Better Site Design include the following:

- Preventing stormwater impacts rather than mitigating them;
- Managing stormwater (quantity and quality) as close to the point of origin as possible and minimizing collection and conveyance;
- Utilizing simple, nonstructural methods for stormwater management that are lower cost and lower maintenance than structural controls;
- Creating a multifunctional landscape; and
- Using hydrology as a framework for site design.

The Center for Watershed Protection's Better Site Design Handbook outlines 22 model development principles for site design that act to reduce impervious cover, conserve open space, prevent stormwater pollution, and reduce the overall cost of development (CWP, 2017). The principles can provide notable reductions in post-construction stormwater runoff rates, volumes and pollutant loads (ARC, 2001). Better Site Design across the country is implemented through review of existing planning and development codes, and streets, parking and stormwater engineering criteria. Within the context of a stormwater management document and this Manual, the Better Site Design techniques of greatest application include protection of existing natural areas, incorporation of open space into new development, effective sediment and erosion control practices, and stormwater management that mimics natural systems. The following sections apply Better Site Design to the Southern Lowcountry Watershed Protection Areas and Special Watershed Protection Areas to help mitigate the effects of development to the watersheds. Therefore, the conservation principles below are part of an overall watershed approach to stormwater management and will complement the Watershed Protection Area approach in this Manual. Their application is subject to Beaufort County Public Works Department requirements and/or standards.

2.1.3 Site Planning & Design Process

Figure 2.2 depicts the site planning and design process that is captured in *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014) and is applicable to the Beaufort County Public Works Department. The site planning and design checklist of the Southern Lowcountry Design Manual does not make each of the phases of the process a submittal requirement. The checklist, however, gives the Beaufort County Public Works Department the opportunity to ask whether each of these steps have been considered. Required steps for the Beaufort County Public Works Stormwater Permit submittal are the conceptual plan and final plan, with construction and final inspections occurring after final plan has been approved. The actual document submittal begins with the preliminary plan when considered in context of the planning process below:

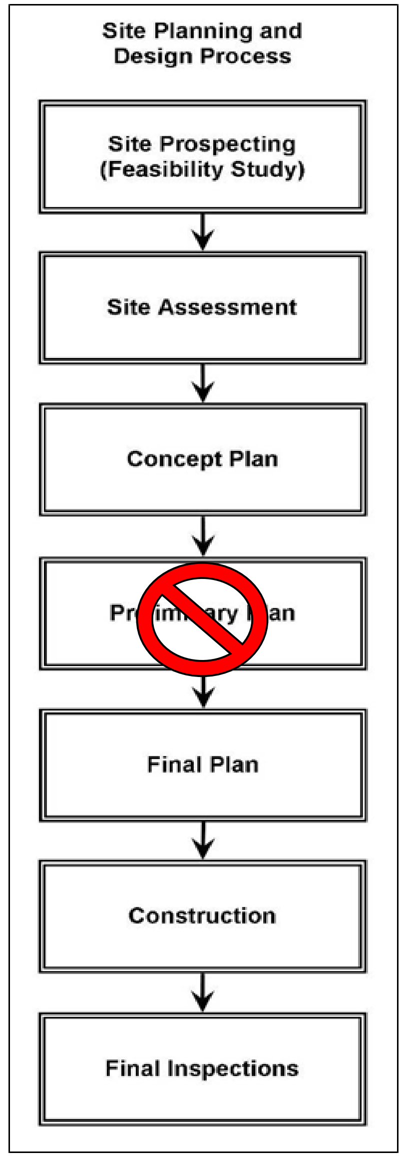


Figure 2.1. Site planning & design process

- Site Prospecting: During the site prospecting phase, some basic information is used to evaluate the feasibility of completing a development or redevelopment project. A *feasibility study* is typically used to evaluate the many factors that influence a developer's decision about whether or not to move forward with a potential development project. Factors that are typically evaluated during a *feasibility study* include information about site characteristics and constraints, applicable local, state and federal stormwater management and site planning and design requirements, adjacent land uses and access to local infrastructure (e.g., water, sanitary sewer).
- Site Assessment: Once a potential development or redevelopment project has been deemed feasible, a more thorough assessment of the development site is completed. The site assessment, which is typically completed using acceptable site reconnaissance and surveying techniques, provides additional information about a development site's characteristics, its natural resource inventory and constraints. Once the assessment is complete, a developer can identify and analyze the natural, man-made, economic and social aspects of a potential development project, define the actual buildable area available on the development site and begin making some preliminary decisions about the layout of the proposed development project.

- Concept Plan: The results of the site assessment are typically used to create a concept pla~~n~~) for the proposed development project. A concept plan is used to illustrate the basic layout of the proposed development project, including lots and roadways, and is usually reviewed with the local development review authority before additional resources are used to create a more detailed plan of development. During this phase, several alternative concept plans can be created and compared with one another to craft a plan of development that best “fits” the character of the development site (Figure 2.3, Figure 2.4, and Figure 2.5). It is at this point in the planning and design process that a Maximum Extent Practicable demonstration described in Section 3.9 is required for development projects that will seek a waiver from requirements of this Manual.
- Final Plan: The final plan adds further detail to the preliminary plan and reflects any changes to the plan of development that were requested or required by the local development review authority. The final plan typically includes all of the information that was included in the preliminary plan, as well as information about landscaping, pollution prevention, erosion and sediment control and long-term operation and maintenance of the site’s post-construction stormwater management system. There may be several iterations of the final plan between the time that it is submitted and the time that it is approved by the local development review authority.
- Construction: Once the final plan has been reviewed and approved, performance bonds are set and placed, contractors are retained, and construction begins. During the construction phase, a development project may be inspected on a regular basis by the local development review authority to ensure that all roadways, parking areas, buildings, utilities and other infrastructure, including the post-construction stormwater management system, are being built in accordance with the approved final plan and that all primary and secondary conservation areas have been protected from any land disturbing activities.
- Final Inspections: Once construction is complete, final inspections take place to ensure that all roadways, parking areas, buildings, utilities and other infrastructure, including the post-construction stormwater management system, were built according to the approved final plan. As-built plans are also typically prepared and executed during this phase. If a development project passes all final inspections, an occupancy permit may be issued for the project.

2.1.4 Natural Resources Inventory

The first step to conserve natural resources is properly documenting existing assets. An up-to-date natural resources inventory map can provide geospatial information for water resources, soils, sensitive natural resource areas, critical habitats, and other unique resources (Ellis et al., 2014).

An application for new development requires a natural resources inventory prior to the start of any land disturbing activities. A natural resources inventory prepared by a qualified person shall be used to identify and map the most critical natural resources identified on the property that would be best to preserve, such as those listed in Table 2.2, as they exist predevelopment. Qualified persons include individuals with a working knowledge of hydrology, wetlands, plant taxonomy, and field survey methods. Qualified individuals include but are not limited to licensed foresters, professional wetland scientists, and geographic information professionals. A thorough assessment of the natural resources, both terrestrial and aquatic, found on a development site shall be submitted in the development application.

Table 2.2. Resources to be identified and mapped during the Natural Resources Inventory.

Resource Group	Resource Type
General Resources	• Topography • Natural Drainage Divides • Natural Drainage Patterns • Natural Drainage Features (e.g., Swales, Basins, Depressional Areas) • Soils • Erodible Soils • Steep Slopes (e.g., Areas with Slopes Greater Than 15%) • Trees and Other Existing Vegetation
Freshwater Resources	• Freshwater Wetlands
Estuarine Resources	• Tidal Rivers and Streams • Tidal Creeks • Coastal Marshlands • Tidal Flats • Scrub-Shrub Wetlands
Marine Resources	• Near Coastal Waters •
Groundwater Resources	• Groundwater Recharge Areas • Wellhead Protection Areas
Terrestrial Resources	• • Bottomland Hardwood Forests • Beech-Magnolia Forests

- Pine Flatwoods
- Longleaf Pine-Wiregrass Savannas
- Longleaf Pine-Scrub Oak Woodlands
- Shellfish Harvesting Areas
- Floodplains

Other Resources

- Aquatic Buffers
- Other High Priority Habitat Areas as described by South Carolina Department of Natural Resources

2.1.5 Conservation Development

Conservation development, also known as open space development or cluster development, is a site planning and design technique used to concentrate structures and impervious surfaces in a small portion of a development site, leaving room for larger conservation areas and managed open spaces elsewhere on the site (Figure 2.2). Alternative lot designs are typically used to "cluster" structures and other impervious surfaces within these conservation developments.

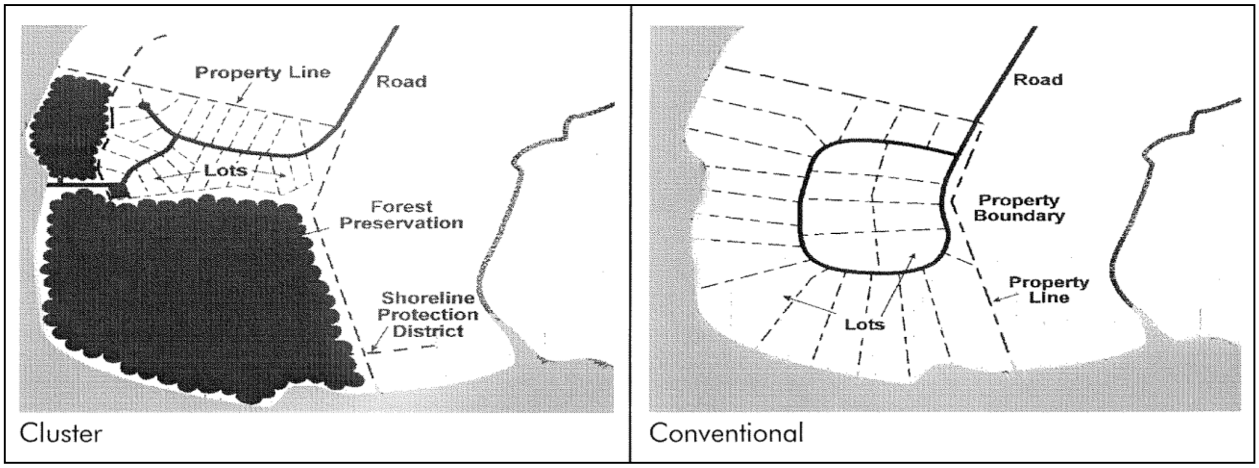


Figure 2.2. Conservation (i.e., cluster) development versus conventional development.

Conservation development projects provide a host of environmental benefits that are typically more difficult to achieve with conventional site design techniques. They provide for better natural resource protection on development sites and inherently limit increases in site imperviousness, sometimes by as much as 40 to 60 percent. Reduced site imperviousness results in reduced post-construction stormwater runoff rates, volumes and pollutant loads, which helps better protect both on-site and downstream aquatic resources from the negative impacts of the land development process. Reduced stormwater runoff rates, volumes and pollutant loads also help reduce the size of and need for storm drain systems and stormwater management practices on development sites.

As a number of recent studies have shown conservation development projects can also be significantly less expensive to build than more conventional development projects. Most of the cost savings can be attributed to the reduced amount of infrastructure (e.g., roads, sidewalks, post-construction stormwater management practices) needed on these development projects. And while these projects are frequently less expensive to build, developers often find that the lots located within conservation developments command higher prices and sell more quickly than those located within more conventional developments (ARC, 2001).

Table 2. 3 provides suggestions for Better Site Design techniques that will help protect valuable resources such as buffers, trees, wetlands, and open space.

Table 2. 3. Better Site Design principles for conservation.

Principle	Description
Vegetated Buffer System	Create a variable width, naturally vegetated buffer system along all streams that also encompasses critical environmental features such as the 100-year floodplain, steep slopes, and freshwater wetlands. *Recommended buffer widths are included in Table 3.2-4 in Ellis et al., 2014*
Buffer Maintenance	The riparian buffer should be preserved or restored with native vegetation that can be maintained through delineation, plan review, construction, and occupancy stages of development.
Clearing and Grading	Clearing and grading of forests and native vegetation should be limited to the minimum amount needed to build lots, allow access, and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner.
Tree Conservation	Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native plants. Wherever practical, manage community open space, street rights-of-way, parking lot islands, and other landscaped areas to promote natural vegetation.
Land Conservation	Open space development should be encouraged to promote conservation of stream buffers, forests, meadows, and other areas of environmental value. In addition, off-site mitigation consistent with locally-adopted watershed plans should be encouraged.
Stormwater Outfalls	New stormwater outfalls should not discharge unmanaged into jurisdictional wetlands, sole-source aquifers, or sensitive areas.

2.1.6 Residential Streets & Parking Lots

Up to 65% of the total impervious cover in a watershed can be the attributed to streets, parking lots, and driveways (CWP, 1998). Table 2.4 describes Better Site Design principles related to techniques to reduce the impervious surfaces associated with these hardscapes.

Table 2.4. Better Site Design principles for streets and parking to meet Beaufort County Community Development Code requirements.

Principle	Description
Street Width	Design residential streets for the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance, and service vehicles.
Street Length	Reduce the total length of residential streets by examining alternative street layouts to determine the best option for increasing the number of homes per unit length.

Right-of-Way Width	Wherever possible, residential street right-of-way widths should reflect the minimum required to accommodate the travel-way, the sidewalk, and vegetated open channels. Utilities and storm drains should be located within the pavement section of the right-of-way wherever feasible.
Cul-de-sacs	Minimize the number of residential cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.
Vegetated Open Channels	Where density, topography, soils, and slope permit, vegetated open channels should be used in the street right-of-way to convey and treat stormwater runoff.
Parking Ratios	The required parking ratio governing a particular land use or activity should be enforced as both a maximum and a minimum in order to curb excess parking space construction. Existing parking ratios should be reviewed for conformance, taking into account local and national experience to see if lower ratio is warranted and feasible.
Parking Lots	Reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in spillover parking areas.
Structured Parking	Utilize structured (e.g., parking garage) and shared parking to reduce impervious surface area.
Parking Lot Runoff	Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips, and/or other practices that can be integrated into required landscaping areas and traffic islands.

2.1.7 Lot Development Principles to Meet Requirements

Development of lots follows similar guidelines for reducing impervious cover and protecting natural areas, such as open space.

Table 2. 5 summarizes Better Site Design principles for lot development. Preserving open space is critical to maintaining water quality at the regional level. Compared to traditional development, open space development can reduce the annual runoff volume from a site by 40%–60%, nitrogen loads by 42%–81%, and phosphorus loads by 42%–69% (CWP, 1998). Large, continuous areas of open space reduce and slow runoff, absorb sediments, serve as flood control, and help maintain aquatic communities. Open space can be provided by minimizing lot sizes, setbacks, and frontage distances

Table 2. 5. Better Site Design principles for lot development.

Principle	Description
Open Space Development	Utilize open space development that incorporates smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection.
Setbacks and Frontages	Consider minimum setbacks allowed by Beaufort County Community Development Code. Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce overall lot imperviousness.
Sidewalks	Where practical, consider locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas.
Driveways	Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.
Rooftop Runoff	Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and should avoid routing rooftop runoff to the roadway and the stormwater conveyance system.
Open Space Management	Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space.

For more detailed descriptions of these techniques, please reference *Better Site Design: A Handbook for Changing Development Rules in Your Community* (CWP, 1998) and Chapter 3 of *Low Impact Development in Coastal South Carolina: A Planning and Design Guide* (Ellis et al., 2014).

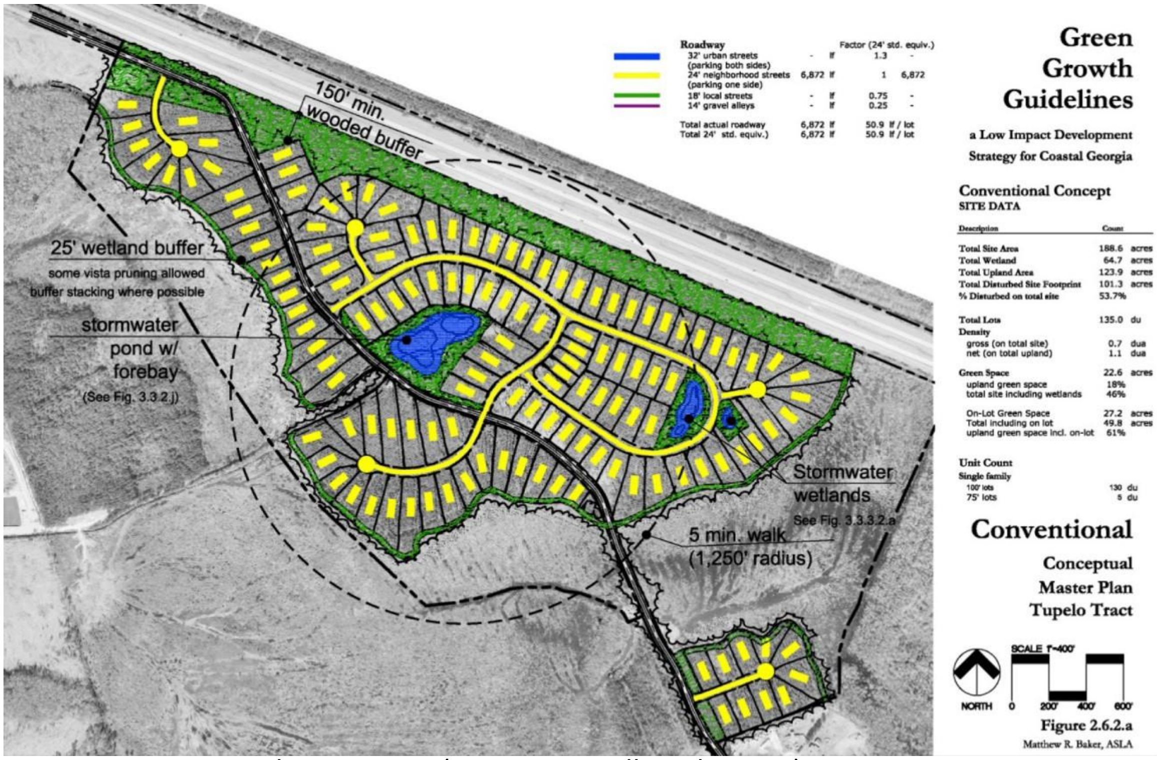


Figure 2.3. Conventional Site Design (source: Merrill et al., 2006).

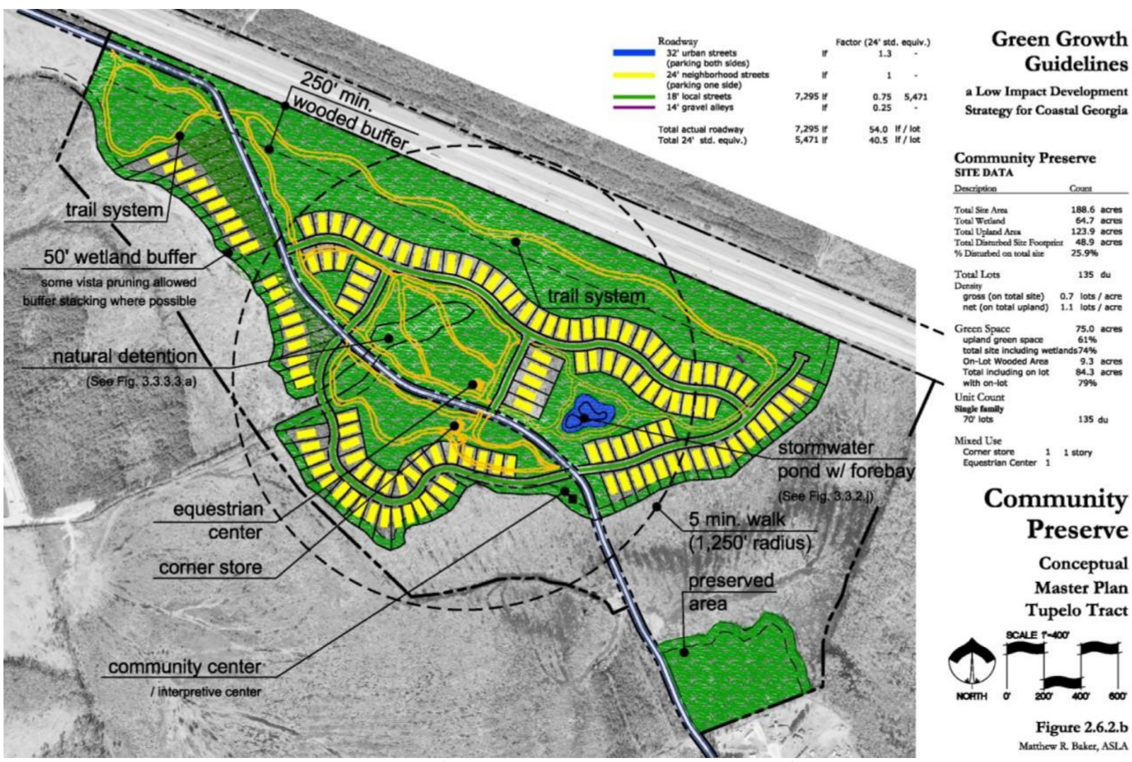


Figure 2.4. Conservation Site Design (source: Merrill et al., 2006).

Figure 2.5. New Urbanist Site Design (source: Merrill et al., 2006).

2.1.8 Integrating Natural Resource Protection & Stormwater Management with the Site Planning & Design Process

In order to successfully *integrate* natural resource protection and stormwater management with the site planning and design process, site planning and design teams are to consider following questions at the beginning of the process:

- What valuable natural resources, both terrestrial and aquatic, can be found on the development site?
- How can better site planning techniques be used to protect these valuable natural resources from the direct impacts of the land development process?
- How can better site design techniques be used to minimize land disturbance and the creation of new impervious and disturbed pervious cover?
- What low impact development practices can be used to help preserve pre-development site hydrology and *reduce* post-construction stormwater runoff rates, volumes and pollutant loads?
- What stormwater management practices can be used to *manage* post-construction stormwater runoff rates, volumes and pollutant loads?
- Are there any site characteristics or constraints that prevent the use of any particular low impact development or stormwater management practices on the development site?

Although answering these questions is no easy task, they can be readily obtained within the context of the six-step *stormwater management planning and design process* outlined in Figure 2.1, and the steps are described in more detail below.

- **Step 1: Pre-Application Meeting**

It is recommended that a pre-application meeting between the applicant's site planning and design team and the Beaufort County Staff Review Team with development review authority occur at the very beginning of the stormwater management planning and design process. This meeting, which should occur during the site prospecting phase of the overall site planning and design process (Figure 2.6), helps establish a relationship between the site planning and design team and the Beaufort County Staff Review Team with development review authority. The pre-application meeting also provides an opportunity to discuss the local site planning and stormwater management design criteria that will apply to the proposed development project, which increases the likelihood that the remainder of the site planning and design process will proceed both quickly and smoothly.

- **Step 2: Review of Local, State, and Federal Stormwater Management, Site Planning, & Design Requirements**

Once a pre-application meeting has been completed, it is recommended that the site planning and design team review the local, state and federal requirements that will apply to the proposed development project. This review should occur during the site prospecting phase of the overall site planning and design process (Figure 2.6), while the feasibility study is still being completed.

During their review of stormwater management and site planning and design requirements, the applicant's site planning and design teams should also investigate opportunities and incentives for land conservation, and opportunities and incentives for conservation development as illustrated earlier in Figure 2.1.

- **Step 3: Natural Resources Inventory**

Once the potential development or redevelopment project has been deemed feasible, acceptable site reconnaissance and surveying techniques must be used to complete a thorough assessment of the natural resources, both terrestrial and aquatic, found on the development site. The identification and subsequent preservation and/or restoration of these natural resources helps reduce the negative impacts of the land development process "by design." The natural resources inventory should be completed during the site assessment phase of the overall site planning and design process (Figure 2.6). A map that is created to illustrate the results of the natural resources inventory, known as a site fingerprint, should be used to prepare a stormwater management concept plan for the proposed development project.

Once the natural resources inventory has been completed and a site fingerprint has been created, the site planning and design team should have a better understanding of a development site's characteristics and constraints. This information can be used to identify primary and secondary conservation areas (Figure 2.6. Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).) and define the actual buildable area available on the development site. Along with information about adjacent land uses and available infrastructure (e.g., roads, utilities), the site fingerprint can also be used to make some preliminary decisions about the layout of the proposed development project and to guide the creation of the stormwater management concept plan.

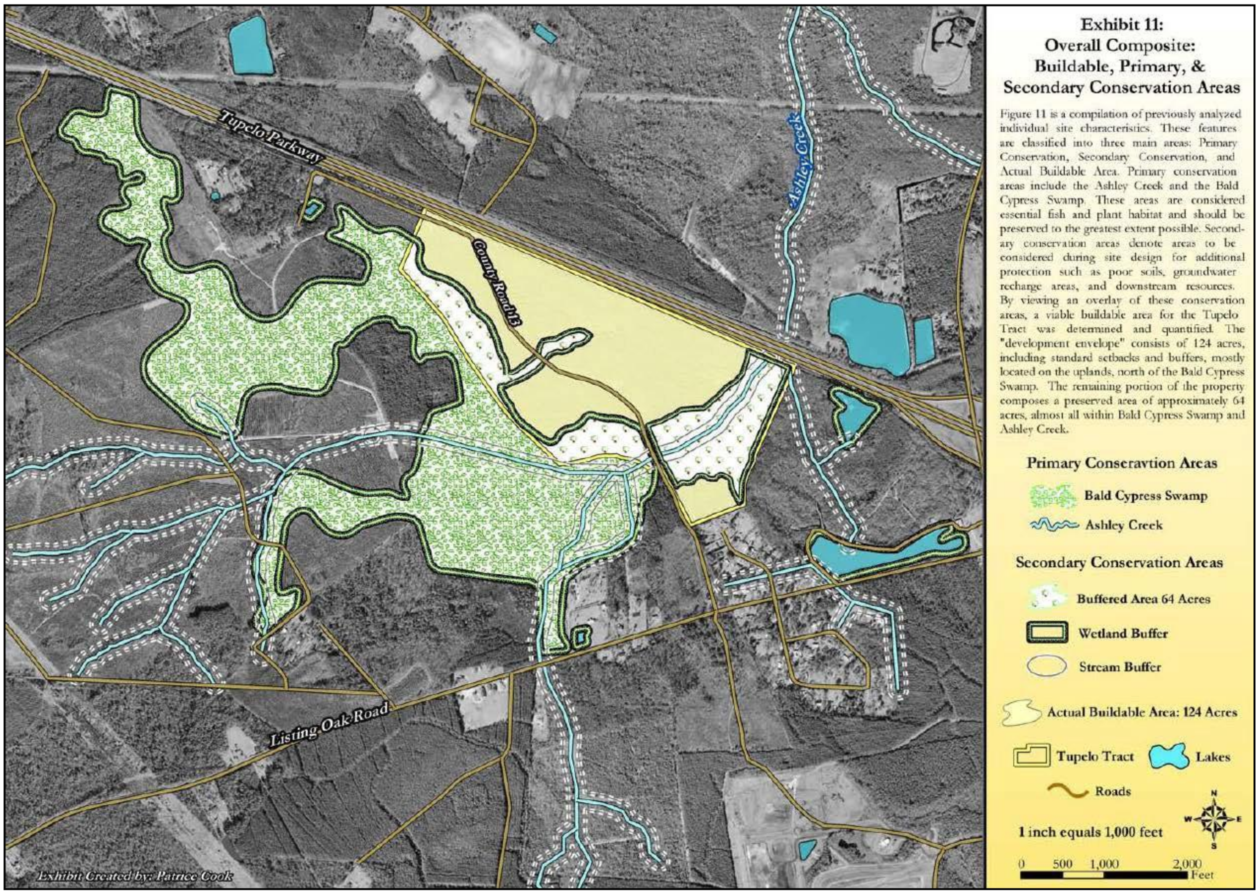


Figure 2.6. Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).

- **Step 4: Prepare Stormwater Management Concept Plan**

After the natural resources inventory has been completed, it is recommended that the site fingerprint be used to develop a stormwater management concept plan for the proposed development project. The stormwater management concept plan should illustrate the layout of the proposed development project and should show, in general, how post-construction stormwater runoff will be managed on the development site.

The creation of a stormwater management concept plan allows the applicant's site planning and design team to make some preliminary decisions about the layout of the proposed development project. If it is submitted to the local development review authority prior to the preparation and submittal of the stormwater management design plan, it can also be used to solicit early feedback on the project and on the green infrastructure and stormwater management practices that will be used to manage post-construction stormwater runoff on the development site.

During the creation of the stormwater management concept plan, most of the site layout, including the layout of lots, buildings, roadways, parking areas, sidewalks and green infrastructure and stormwater management practices, will be completed. Therefore, it is very important that natural resource protection and stormwater management be considered throughout this part of the stormwater management planning and design process.

- **Step 6: Prepare Stormwater Management Design Plan**

Subsequent to review and approval of the stormwater management concept plan, the site planning and design team should prepare a stormwater management design plan. The stormwater management design plan should detail how post-construction stormwater runoff will be managed on the development site and should include maps, narrative descriptions and design calculations (e.g., hydrologic and hydraulic calculations) that show how the stormwater management and site planning and design criteria that apply to the development project have been met. The stormwater management design plan should be submitted to the local development review authority for review and approval.

2.2 Submittal & Review Process of Stormwater Management Plans

The Stormwater Management Plan (SWMP) consists of the entire submittal package and includes the following components:

- Project description and narrative;
- Description of selected stormwater management systems;
- Erosion and sediment control plans;
- Sufficient information to evaluate the environmental characteristics of the affected areas, the potential impacts of the proposed development on water resources, the effectiveness and acceptability of stormwater best management practices (BMPs), and land covers for managing stormwater runoff;
- Supporting computations and drawings; and
- Construction, inspection, and maintenance schedules.

All SWMPs must include the Stormwater submittal checklist (Appendix D) and calculations summary. The plans must include the calculated stormwater retention volume (SWRv) for each BMP and for the overall project, the pre and post development peak flow comparison, extreme flood requirements, and any off-site retention or detention volume obligation.

The SWMP and accompanying documentation may be submitted according to the Beaufort County Public Works Department process, but the applicant must also submit one paper copy of the SWMP carrying the stamp of a registered professional engineer licensed in the State of South Carolina with all supporting documentation to Beaufort County Public Works Department.

Upon acceptance of a complete application (which includes payment of filing fees), the Beaufort County Public Works Department will review the SWMP and make a determination to approve, approve with conditions, or disapprove the SWMP. Relatively large and/or complicated projects tend to require a longer review time than smaller and less complicated projects. A written response of approval or disapproval will be provided to the applicant. If it is determined that more information is needed or that a significant number of changes must be made before the SWMP can be approved, the applicant must resubmit the applications with the revisions required and certified by the registered professional engineer according to the plan resubmittal process of the Beaufort County Public Works Department.

When a SWMP approval is granted, a final submission package is required, including the following:

- One PDF copy of the SWMP, certified by a registered professional engineer licensed in the State of South Carolina,
- A declaration of covenants that has been approved for legal sufficiency by the Beaufort County Public Works Department, and
- All supporting documents specified within this Manual or as requested during the review process according to the Beaufort County Public Works Department requirements.

2.2.1 Components of a Stormwater Management Plan

As itemized in the SWMP checklist in Appendix D Design Checklists, a SWMP includes the following:

Site Plan

The following information must be formatted to print as a standard drawing size of 24 by 36 inches. The site drawing will provide details of existing and proposed conditions:

- A cover page that contains a blank space measuring 7 inches wide by 9.5 inches high. The blank space must be located 1 inch below the top edge and 1 inch from the left edge of the page;
- A plan showing property boundaries and the complete address of the property;
- Lot number or property identification number designation (if applicable);
- North arrow, scale, and date;
- Property lines (include longitude and latitude);
- Location of easements (if applicable);
- Existing and proposed structures, utilities, roads, and other paved areas;
- Existing and proposed topographic contours;
- Soil information for design purposes;
- Area(s) of soil disturbance;
- Drainage area(s) within the limits of disturbance (LOD) and contributing to the LOD;
- Contributing drainage area (CDA) to each BMP;
- Location(s) of BMPs, marked with the BMP ID Numbers to agree with the BMP design summary list;
- Delineation of existing and proposed land covers including natural cover, compacted cover, and impervious surfaces. Consult Appendix G Compliance Calculator Instructions for details;
- Natural resources inventory with site fingerprint map;

- All plans and profiles must be drawn at a scale of 1 in. = 10 ft, 1 in. = 20 ft, 1 in. = 30 ft, 1 in. = 40 ft, 1 in. = 50 ft, or 1 in. = 100 ft. Although, 1 in. = 10 ft, 1 in = 20 ft, and 1 in. = 30 ft, are the most commonly used scales. Vertical scale for profiles must be 1 in. = 2 ft, 1 in. = 4 ft, 1 in. = 5 ft, or 1 in. = 10 ft;
- Drafting media that yield first- or second-generation, reproducible drawings with a minimum letter size of No. 4 (1/8 inch);
- Location and size of existing utility lines including gas lines, sanitary lines, telephone lines or poles, electric utilities and water mains;
- A legend identifying all symbols used on the plan;
- Applicable flood boundaries and FEMA map identification number for sites lying wholly or partially within the 100-year floodplain;
- Site development plan and stormwater management narrative;
- Assess potential application of green infrastructure practices in the form of better site planning and design techniques. Low impact development practice should be used to the maximum extent practicable during the creation of a stormwater management concept plan. A demonstration of better site planning is required. The following site information and practices shall be considered:
    - Soil type (from Soil Study);
    - Depth of ground water on site;
    - Whether the type of development proposed is a hotspot as defined by the Ordinance and Design Manual and address how this influences the concept proposal;
    - Protection of primary and secondary conservation areas;
    - Reduced clearing and grading limits;
    - Reduced roadway lengths and widths;
    - Reduced parking lot and building footprints to minimize impervious surface;
    - Soil restoration;
    - Site reforestation/revegetation;
    - Impervious area disconnection;
    - Green roof (for redevelopment, infill and major substantial improvement projects); and
    - Permeable pavements.
- Stormwater Pollution Prevention Plan (SWPPP) or Erosion and Sediment Control narrative (for projects disturbing over an acre);
- Information regarding the mitigation of any off-site impacts anticipated as a result of the proposed development;
- Construction specifications;
- Design and As-Built Certification, including the following:
    - i Certification by a registered professional engineer licensed in the State of South Carolina seal that the site design, land covers, and design of the BMPs conforms to the standard of care applicable to the treatment and disposal of stormwater pollutants and that the Facility has been designed in accordance with the specifications required under the stormwater ordinance of the Beaufort County Public Works Department.
    - ii Submission one set of the As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina within 21 days after completion of construction of the site, all BMPs, land covers, and stormwater conveyances.
    - iii For a project consisting entirely of work in the public right-of-way (PROW), the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMP and related stormwater infrastructure.

- Maintenance sheet for stormwater BMPs, including the following:
  - i A maintenance plan that identifies routine and long-term maintenance needs and a maintenance schedule;
  - ii A maintenance agreement and schedule for all post construction best management practices in a form and manner that meets the Beaufort County Public Works Department requirements.
  - iii For applicants using Rainwater Harvesting, submission of third-party testing of end-use water quality may be required at equipment commissioning as determined by the requirements in Appendix J Rainwater Harvesting Treatment and Management Requirements. Additional regular water quality reports certifying compliance for the life of the BMP may also be required in Appendix J Rainwater Harvesting Treatment and Management Requirements.

Stormwater Retention Volume Computations

The following summary calculations must be included on the plan set. Supporting documentation and the South Carolina DHEC C-SWPPP are not in the plan set but provided separately.

- Calculation(s) of the required SWRv for the entire site within the LOD and each site drainage area (SDA) within the LOD;
- Calculation(s) for each proposed BMP demonstrating retention value towards SWRv in accordance with Chapters 2 and 4;
- For Rainwater Harvesting BMP, calculations demonstrating the annual water balance between collection, storage, and demand, as determined using the Rainwater Harvesting Retention Calculator;
- For proprietary and non-proprietary BMPs follow the guidance in Chapter 4.13 to identify/receive approval or denial to use these practice(s); and
- Off-site stormwater volume requirement.
- Compliance Calculator sheets identifying that proposed BMP(s) meet standards for water quality

Pre-/Post-Development Hydrologic Computations

Include in the plan set a summary of the pre-/post-runoff analysis with the following information at a minimum:

- A summary of soil conditions and field data;
- Pre- and post-project curve number summary table;
- Pre and post construction peak flow summary table for the 2-, 10-, 25- , 50-, 100-year 24-hour storm events for each SDA within the project's LOD; and
- Flow control structure elevations.

Hydraulic Computations

Hydraulic computations for the final design of water quality and quantity control structures may be accomplished by hand or through the use of software using equations/formulae as noted in Chapters 3 and 4. The summary of collection or management systems will include the following:

- Existing and proposed SDA must be delineated on separate plans with the flow paths used for calculation of the times of concentration;
- Hydraulic capacity and flow velocity for drainage conveyances, including ditches, swales, pipes, inlets, and gutters. Plan profiles for all open conveyances and pipelines, with energy and hydraulic gradients for the 2-, 10-,25-, 50-, 100-year, 24-hour storms;

- The proposed development layout including the following:
  - Location and design of BMP(s) on site, marked with the BMP ID Numbers;
  - Stormwater lines and inlets;
  - A list of design assumptions (e.g., design basis, 2 through 50-year return periods);
  - The boundary of the CDA to the BMP;
  - Schedule of structures (a listing of the structures, details, or elevations including inverts); and
  - Manhole to manhole profile, listing of pipe size, pipe type, slope, (i.e., a storm drain pipe schedule) computed velocity, and computed flow rate, energy grade line (EGL) and hydraulic grade line (HGL).

Supporting Documentation
Provide a written report with the following supporting documentation:

- Pre- and post-project curve number selection
- Time of concentration calculation;
- Travel time calculation;
- Hydrologic computations supporting peak discharges assumed for each SDA within the project's LOD for the 2-, 10-, 25-, 50-, and 100-year, 24-hour storm events;
- SC DHEC's Construction Stormwater Pollution Prevention Plan (C-SWPPP).

A professional engineer registered in the State of South Carolina must also submit the following:

1. Elevation and topographic data illustrating changes in topography and drainage;
2. Impacts upon local flood flows (2-, 10-, 25-, 50-, and 100-year storm events;
3. Identify areas where stormwater flows are discharged off-site or off-property;
4. For proposed off-site/property discharge points, perform analysis of receiving off-site conveyance systems to confirm safe conveyance from the proposed developed property, no negative impact to adjacent properties, and adequacy of the receiving, existing conveyance system for 25-yr storm flows. Such analysis shall be taken to point where the 25-yr storm conveyance is determined to be adequate in the public stormwater conveyance/infrastructure system; and
5. Documentation supporting safe passage of the 100-yr post development flow according to the 10% Rule (see Section 3.8);

2.2.2 Resubmission of Stormwater Management Plans
If changes occur in the design or construction of an accepted SWMP, the applicant may be required to resubmit the SWMP for approval. Examples of changes during design and construction that will require SWMP resubmission for review include, but may not be limited to the following:

1. Revision to the property boundary, property size, or LOD boundaries that may require redesigning BMPs;
2. Any change to SWRv through land cover designation change;
3. Change in compaction or infiltration rates due to construction activities;
4. Encountering contaminated soil or other underground source of contamination;
5. Changes to floodplain designation or requirements;
6. Changes in any component of the BMP that may adversely affect the intended capacity of the approved BMP, such as the following:

   a. Modification to approved BMP selection, dimensions, or location
   b. Modification to approved material specification
   c. Changes to the size, invert, elevation, and slopes of pipes and conveyances
   d. Installation of new drains and conveyance structures
   e. Need for a new storm sewer outlet connection to the sanitary/storm sewer main
   f. Changes to the amount of off-site requirements
   g. Changes to the CDA to a BMP
7. Revision to the approved grading and drainage divides and that may require redesigning BMPs;
8. Relocation of an on-site storm sewer or conveyance; or
9. Abandonment, removal, or demolition of a BMP.

If the applicant resubmits an SWMP after making changes, the resubmission must contain a list of the changes made and may be in the form of a response to comments. The resubmittal plans and calculations must include the stamp of the registered professional engineer in South Carolina.

However, if any of the following minor changes are made to the SWMP, resubmission is not required. These minor changes may be made anytime during inspection or at the as-built submittal by Beaufort County Public Works Department.

1. Changes to SWM components that do not adversely affect BMP capacity while in consultation with Beaufort County Public Works Department. The inspector should review the appropriate manufacturer's documentation to his/her satisfaction before approving such a change and should ensure that such changes are recorded as red line changes or deviations in the as-built plans. These changes include the following:
   a. Changes to parts type of similar function (e.g. dewatering valve)
   b. Change in hole pattern or size of underdrain pipe perforations
   c. Change in project address, ownership, permit status, or zoning

Design Certifications

The engineer shall certify that this Plan satisfies all requirements of the Southern Lowcountry Ordinance and Stormwater Design Manual. The following statement with engineer's seal is required in the Plan submittal.

> The engineering features of all stormwater best management practices (BMPs), stormwater infrastructure, and land covers (collectively the "Facility") have been designed/examined by me and found to be in conformity with the standard of care applicable to the treatment and disposal of stormwater pollutants. The Facility has been designed in accordance with the specification required under of Beaufort County Stormwater Ordinance.

2.3 Construction Inspection Requirements

2.3.1 Inspection Schedule & Reports

Prior to the approval of a SWMP, the applicant will submit a proposed construction inspection schedule. Beaufort County Public Works Department will review the schedule to determine if changes are required. The construction schedule should reflect the construction sequences defined in each BMP section Stormwater Best Management Practices (BMPs) of this Manual. The construction and inspection schedule must be included in the SWMP. Beaufort County Public Works Department may conduct inspections and file reports of inspections during construction of BMPs and site stormwater conveyance systems to ensure compliance with the approved plans.

Note: No stormwater management work may proceed past the stage of construction that Beaufort County Public Works Department has identified as requiring an inspection unless

- Beaufort County Public Works Department has issued an “approved” or “passed” report;
- Beaufort County Public Works Department has approved a plan modification that eliminates the inspection requirement; or
- Beaufort County Public Works Department has eliminated or modified the inspection requirement in writing.

Beaufort County Public Works Department may require that the professional engineer responsible for sealing the approved SWMP, the professional engineer responsible for certifying the as-built SWMP, or, for a project entirely in the PROW, the officer of the contracting company responsible for certifying the Record Drawing be present during inspections.

If Beaufort County Public Works Department conducts an inspection and finds work that is not in compliance with the SWMP, Beaufort County Public Works Department may issue a Notice of Violation, and the applicant must take prompt corrective action. The written notice provides details on the nature of corrections required and the time frame within which corrections must be made.

2.3.2 Inspection Requirements Before & During Construction

Beaufort County Public Works Department construction stormwater inspection form is provided in Appendix E Construction Inspection Form.

Preconstruction Meetings. These meetings are required prior to the commencement of any land-disturbing activities and prior to the construction of any BMPs. The applicant is required to contact Beaufort County Public Works Department to schedule preconstruction meetings three (3) days prior to beginning any construction activity subject to the requirements Beaufort County Public Works Department.

Inspections During Construction. The applicant is required to contact Beaufort County Public Works Department to schedule inspection three (3) days prior to any stage of BMP construction, or other construction activity, requiring an inspection. For large, complicated projects, the applicant and Beaufort County Public Works Department may agree during the preconstruction meeting to an alternative approach such as a weekly notification schedule. Any such agreement must be made in writing and signed by all parties. Beaufort County Public Works Department will revert to the 3-day notification procedure if the agreement is not followed.

During construction, Beaufort County Public Works Department may require the presence of the professional engineer responsible for sealing the approved SWMP; the professional engineer responsible for certifying the as-built SWMP; or for a project entirely in the PROW, the officer of the contracting company responsible for certifying the Record Drawing.

Final Inspection. The applicant is required to contact Beaufort County Public Works Department to schedule a final inspection one week prior to the completion of a BMP construction to schedule a final inspection of the BMP. Upon completion of the BMP, Beaufort County Public Works Department will conduct a final inspection to determine if the completed work was constructed in accordance with approved plans.

Inspection Requirements by BMP Type. Chapter 4 Stormwater Best Management Practices (BMPs) of this Manual provides details about the construction sequences for each BMP. After holding a preconstruction meeting, regular inspections may be made at the following specified stages of construction:

- **Infiltration Systems and Bioretention Areas** may be inspected at the following stages to ensure proper placement and allow for infiltration into the subgrade:
    - During on-site or off-site percolation or infiltration tests;
    - Upon completion of stripping, stockpiling, or construction of temporary sediment control and drainage facilities;
    - Upon completion of excavation to the subgrade;
    - Throughout the placement of perforated PVC/HDPE pipes (for underdrains and observation wells) including bypass pipes (where applicable), geotextile materials, gravel, or crushed stone course and backfill; and
    - Upon completion of final grading and establishment of permanent stabilization;
- **Flow Attenuation Devices**, such as open vegetated swales upon completion of construction;
- **Retention and Detention Structures**, at the following stages:
    - Upon completion of excavation to the sub-foundation and, where required, installation of structural supports or reinforcement for structures, including but not limited to the following:
    - During testing of the structure for water tightness;
    - During placement of structural fill and concrete and installation of piping and catch basins;
    - During backfill of foundations and trenches;
    - During embankment construction; and
    - Upon completion of final grading and establishment of permanent stabilization.
- **Stormwater Filtering Systems**, at the following stages:
    - Upon completion of excavation to the sub-foundation and installation of structural supports or reinforcement for the structure;
    - During testing of the structure for water tightness;
    - During placement of concrete and installation of piping and catch basins;
    - During backfill around the structure;
    - During prefabrication of the structure at the manufacturing plant;
    - During pouring of floors, walls, and top slab;
    - During installation of manholes/trap doors, steps, orifices/weirs, bypass pipes, and sump pit (when applicable);
    - During placement of the filter bed; and
    - Upon completion of final grading and establishment of permanent stabilization.

- **Green Roof Systems**, at the following stages:
  - During placement of the waterproofing layer, to ensure that it is properly installed and watertight;
  - During placement of the drainage layer and drainage system;
  - During placement of the growing media, to confirm that it meets the specifications and is applied to the correct depth (certification for vendor or source must be provided);
  - Upon installation of plants, to ensure they conform to the planting plan (certification from vendor or source must be provided); and
  - At the end of the first or second growing season, to ensure desired surface cover specified in the Care and Replacement Warranty has been achieved.

2.3.3 Final Construction Inspection Reports

Beaufort County Public Works Department will conduct a final inspection to determine if the completed work is constructed in accordance with approved plans and the intent of this Manual and the Stormwater Ordinance. Within 21 days of the final inspection, the applicant must submit an as-built package, including one PDF copy of the as-built SWMP certified by a registered professional engineer licensed in the State of South Carolina. For a project consisting entirely of work in the PROW, the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMPs, related stormwater infrastructure, and land covers.

A registered professional engineer licensed in South Carolina is required to certify as-built SWMPs and state that all activities including clearing, grading, site stabilization, the preservation or creation of pervious land cover, the construction of drainage conveyance systems, the construction of BMPs, and all other stormwater-related components of the project were accomplished in strict accordance with the approved SWMP and specifications. As stated in Section 2.2.2 Resubmission of Stormwater Management Plans, all plan changes are subject to Beaufort County Public Works Department approval. The as-built certification must be on the original SWMP.

Upon completion, these plans will be submitted to Beaufort County Public Works Department for processing. The estimated time for processing will be two weeks (10 working days), after which the plans will be returned to the engineer. Beaufort County Public Works Department will provide the applicant with written notification of the final inspection results.

2.3.4 Inspection for Preventative Maintenance

The Stormwater Ordinance requires maintenance inspections for BMPs and land covers to ensure their ongoing performance is in compliance with their original design. The inspection will occur at least once every three (3) years. Maintenance inspection forms are provided in Appendix F Maintenance Inspection Checklists. Beaufort County Public Works Department may conduct these maintenance inspections, though it may, in certain circumstances, allow a property to self-inspect and provide documentation.

Beaufort County Public Works Department will maintain maintenance inspection reports for all BMPs that they inspect and are provided by the landowner. The reports will evaluate BMP functionality based on the detailed BMP requirements of Stormwater Best Management Practices (BMPs) and inspection forms found in Appendix F Maintenance Inspection Checklists.

If, after an inspection by Beaufort County Public Works Department, the condition of a BMP presents an immediate danger to the public safety or health because of an unsafe condition or improper maintenance, Beaufort County Public Works Department may take such action as may be necessary to protect the public and make the BMP safe. Any costs incurred by Beaufort County Public Works Department may be assessed against the owner(s).

2.4 Inspections & Maintenance

2.4.1 Inspections & Maintenance Responsibilities

A site with an approved SWMP must also have a responsible party inspect and maintain the BMPs and land covers according to the inspections and maintenance schedule in the SWMP and this Manual. Land covers must be maintained in type and extent as approved. Approved BMPs must be kept in good condition, including all the engineered and natural elements of each practice, as well as conveyance features (e.g., grade surfaces, walls, drains, structures, vegetation, soil erosion and sediment control measures, and other protective devices). All repairs or restorations must be in accordance with the approved SWMP.

A Maintenance Agreement including an exhibit stating the owner's specific maintenance responsibilities must be recorded with the property deed at the Record of Deeds. An inspection and maintenance schedule for any BMP will be developed for the life of the project and shall state the inspection and maintenance to be completed, the time for completion, and who will perform the inspections and maintenance. The schedule will be printed on the SWMP and will appear as an exhibit in the Maintenance Agreement.

2.4.2 Inspection & Maintenance Agreements

Inspection and maintenance obligations are binding on current and future owners of a property subject to recorded covenants. Beaufort County Public Works Department will not issue final approval of a complete set of the SWMP for private parcels until the applicant has executed a stormwater maintenance agreement providing notice of this obligation to current and subsequent owners of the land served by the BMP(s) and land covers. Inspection and maintenance agreements by regulated projects include providing access to the site and the BMP(s) at reasonable times for regular inspection by Beaufort County Public Works Department and for regular or special assessments of property owners, as needed, to ensure that the BMP(s) is maintained in proper working condition and the land covers are retained as approved in the SWMP. An example of the declaration of covenants/maintenance agreement for a site with BMPs and designated land covers is provided at the end of this chapter.

The applicant must record the agreement as a declaration of covenants with Beaufort County Public Works Department Recorder of Deeds. The agreement must also provide that, if after written notice by Beaufort County Public Works Department to correct a violation requiring maintenance work, satisfactory corrections are not made by the owner(s) of the land served by the BMP within a reasonable period of time, not to exceed 45 to 60 days unless an extension is approved in writing by Beaufort County Public Works Department. Beaufort County Public Works Department may perform all necessary work to place the BMP in proper working condition. The owner(s) of property served by the BMP will be assessed the cost of the work and any potential penalties/fines.

As-Built Submittals

One set of As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina must be submitted as required by the procedure for handling close out documents for private development projects by Beaufort County Planning and Zoning department.

The following items must be completed and provided:

General Information:

- Words As-Built in or near the project title
- As-Built Signature/Approval block on each sheet
- As-builts shall have a coordinate system based on the South Carolina Coordinate System North American Datum of 1983 (NAD83).
- Elevations shown shall be based on the North American Vertical Datum of 1988 (NAVD88).
- Vicinity map
- Sheets numbered correctly
- Project ID number, Project Name, Permit number and name, address and contact information of project engineer
- All measurements and coordinates shall be shown on all drainage structures, detention and BMP structure outlets, outlet control structures and manholes.
- Any change to BMP capacities, dimensions, specifications or location shall be shown as mark-through of the original design on the drawings
- Elevations to the nearest 0.1 ft.

Basins:

- At least two benchmarks on the plans
- Profile of the top of berm
- Cross-section of emergency spillway at the control section
- Profile along the centerline of the emergency spillway
- Cross-section of berm at the principle spillway
- Elevation of the principle spillway crest or top of structure elevations
- Elevation of the principle spillway inlet and outlet invert
- Riser diameter/dimensions and riser base size
- Diameter, invert elevation and sizes of any stage orifices, weirs or storm drain pipes
- Barrel diameter, length, and slope
- Types of material used
- Outfall protection length, width, depth, size of rip rap and filter cloth
- Size, location, and type of anti-vortex and trash rack device (height and diameter, elevations and spacing)
- Pipe cradle information
- On plan view show length, width and depth of pond and contours of the basin area so that design volume is specified
- As-built spot elevations with the disturbed area required for basin construction in sufficient detail to provide accurate as-built contours
- Core trench limits and elevation s of bottom of cut off trench
- Show length width and depth of outfall rip rap
- Certification by a Geotechnical Engineer for compact and unified soil classes
- Vegetation cover certification
- Show location of planted landscaping
- Utility locations and elevations encountered, test pitted and/or relocation during contract work

Storm Drain Piping:

- At least two benchmarks on the plans
- Diameter and class of pipe
- Invert of pipe at outfall, structures and/or field connections

- Slope of pipe
- Pipe lengths (show stationing)
- Types of materials
- Location of all pipes and structures horizontally on the plan
- Length, width and depth of all rip rap and other outfall protection as specified
- Elevation of rip rap at outfall and at changes in grade
- Utility locations and elevations encountered, test pitted and/or relocation during contract work

Post construction BMP Specific details:

- Provide as-built details as described for each best management practice in Chapter 4.

Chapter 3. Minimum Control Requirements

3.1 Introduction

This chapter establishes the minimum stormwater control standards necessary to implement the Southern Lowcountry Stormwater Ordinance within Beaufort County Public Works Department. The term “runoff reduction” is used throughout this chapter to describe the retention of the stormwater on site. The SWRv is used to describe the volume of stormwater to be retained on site.

Two levels of stormwater retention are prescribed, the 85th and the 95th percentile storm, and are assigned based on a site’s subwatershed as identified by the U.S. Geological Survey Hydrologic Unit Code 12 (HUC-12) presented in Section 3.5.1 below. In addition, peak discharge control of the post-development 2-, 10-,25-, 50-, 100-year, 24-hour storms to their predevelopment flow shall be provided by a combination of structural controls, GI/LID practices and other non-structural BMPs. As well, requirements to manage the 100-yr, 24-hour storm event are provided in the extreme flood event section below. Further, this Manual and Appendices provide the framework and necessary tools to document the methods proposed by development plans to comply with these requirements. It should be noted that stormwater ponds are considered the least favorable structural best management practice to meet the SWRv and water quality requirements of this Manual.

3.2 Regulated Site Definition

According to the Stormwater Ordinance, the design criteria of this Manual shall be applicable to any new development, redevelopment or major substantial improvement activity, including, but not limited to, site plan applications, public improvement projects, and subdivision applications that meet the applicability standards found in Chapter 1.4.

The Southern Lowcountry stormwater design requirements are applied according to the flow chart in Figure 3.1 and should be determined as follows:

1) In sequence, first determine which HUC-12 watershed that the project is in according to Table 3.1. Stormwater design criteria for the development follows the watershed area in which it is located. Next, determine the square feet of impervious area to be created, added or replaced as a part of the development or redevelopment. Will the project disturb greater than 5000 sq feet If the answer is “yes”, the project plan must meet the requirements for stormwater management in this Manual for their respective watershed area.

2) If a project is a major substantial improvement, refer to section 1.4.1 it must meet the water quality criteria for its respective watershed protection area to the maximum extent practicable (MEP) or obtain off-site stormwater credit. The terms MEP and off-site stormwater credit are further explained in Section 3.9 and 3.10 below. A waiver to meet <u>Peak control requirements for major substantial improvement projects may be applied for. Approval is at the discretion of the Public Works Director or their designee.</u>

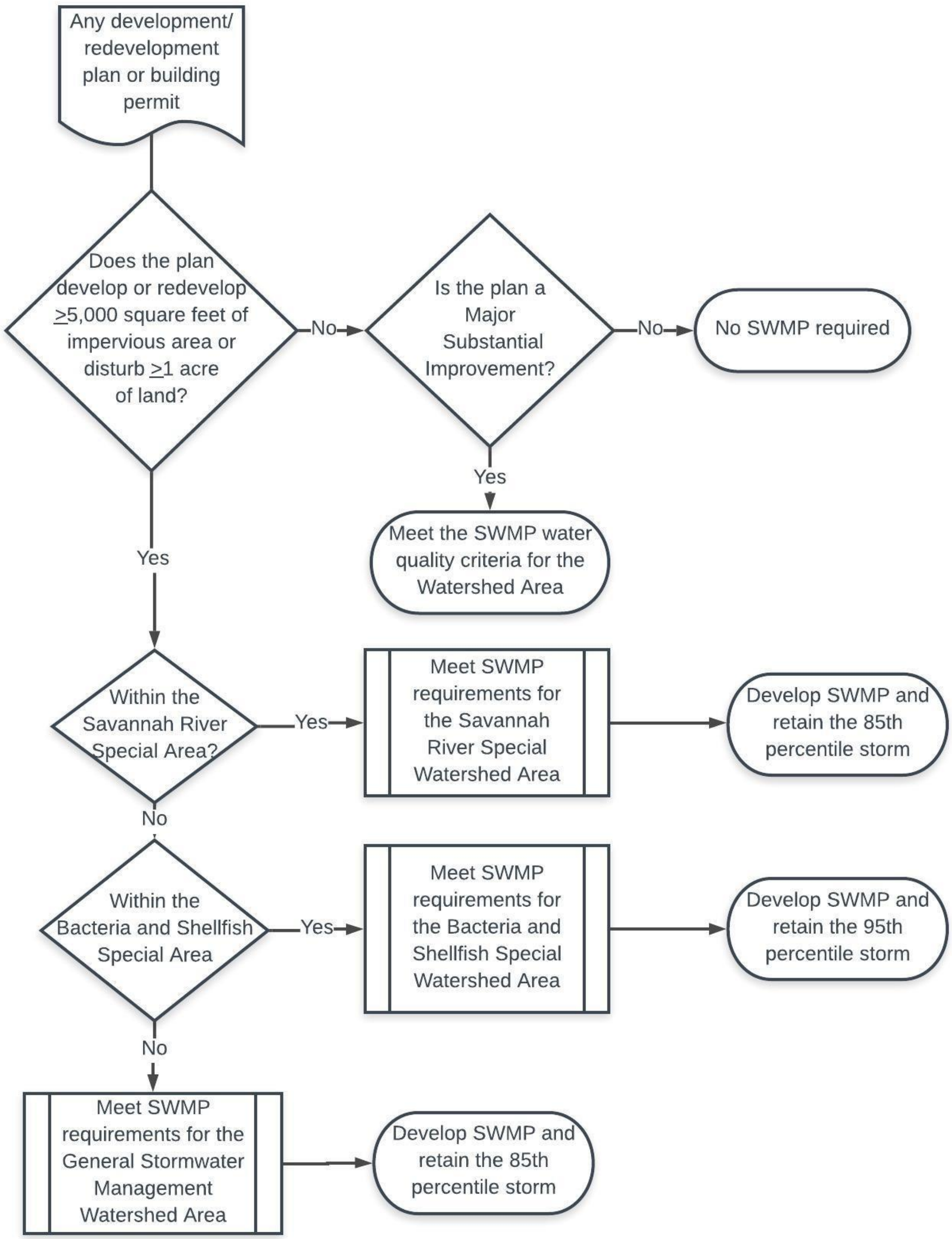


Figure 3.1. Southern Lowcountry Stormwater Design Manual applicability diagram.

3.3 Infill & Redevelopment

An infill project is one on a previously platted property that may or may not have stormwater management capacity in its original development plan. Regardless of size, infill that is part of a larger common plan of development, even through multiple, separate, and distinct land disturbing activities that may take place at different times and on different schedules must comply with this Manual. Such projects may include Planned Unit Developments (PUDs) that have stormwater systems built that do not meet the requirements of this Manual. If the proposed project meets the applicability criteria of Section 1.4.1, the stormwater plan review in this Manual is necessary. If the development's original stormwater management plan is sufficient to meet the current requirements of this Manual and is documented through approved plans and as-built drawings, or current field measurements and engineering calculations, no further stormwater requirements must be met. When the infill project is part of an original plan that does not meet the current stormwater requirements, the level of stormwater management that is provided in the current development may be credited toward the current volume and hydrologic analysis. Infill locations that, due to the municipal jurisdiction's zoning or land use requirements or site conditions, cannot meet the requirements of this Manual must complete the maximum extent practicable (MEP) evaluation in Section 3.9 for approval by the Public Works Director and/or their designee for project advancement/approval.

Similarly, redevelopment may be credited for the level of stormwater in place. If the redevelopment's original stormwater management plan is sufficient to meet the current requirements of this Manual and is documented through approved plans and as-built drawings, or current field measurements and engineering calculations, no further stormwater requirements must be met. When the redevelopment is part of an original plan that does not meet the current stormwater requirements, the level of stormwater management that is provided in the current development may be credited toward the current volume and hydrologic analysis. Redevelopment projects that, due to the municipal jurisdiction's zoning or land use requirements or site conditions, cannot meet the requirements of this Manual must complete the maximum extent practicable (MEP) evaluation in Section 3.9 for project approval.

3.4 Stormwater Runoff Quality & Peak Discharge Control

Since its inception, the Clean Water Act was designed to address the water quality impacts of stormwater runoff. As it has been applied through successive stormwater permit cycles, the Act's requirements have been interpreted to mean application of stormwater best management practices to the maximum extent practicable. The U.S. Environmental Protection Agency (EPA) has stated that such conditions include specific tasks or best management practices (BMPs), BMP design requirements, and performance requirements (EPA, 81 Fed. Reg. 3).

Consistent with the EPA's Phase II MS4 permit, this Manual requires that stormwater runoff shall be adequately treated before it is discharged from a development site. A stormwater management system is assumed to meet the stormwater runoff quality criteria by satisfying the stormwater runoff volume criteria for its respective Watershed Area presented in this Manual. If any of the required stormwater runoff volume cannot be reduced on the site, due to impractical site characteristics or constraints, the following questions shall be addressed in the permitting process:

1. Can the required stormwater volume be obtained from an adjacent site owned or available for stormwater retention purposes;
2. Is there available stormwater retention volume within the adjacent right-of-way and available through fee-in-lieu arrangements within this jurisdiction; and
3. Is a waiver granted based on a maximum extent practicable evaluation?

Further, a stormwater management system is presumed to comply with these criteria if:

- It intercepts and treats stormwater runoff in stormwater management practices that have been selected, designed, constructed and maintained in accordance with this Manual;
- It is provided with documentation to show that total suspended solids, nitrogen and bacteria removal were considered during the selection of the stormwater management practices that will be used to intercept and treat stormwater runoff on the development site;
- It is designed to provide the amount of stormwater load reduction specified in the latest edition of this Manual; and
- It manages the peak flow and extreme flood event storms in accordance with this Manual.

3.5 Southern Lowcountry Stormwater Management Performance Requirements

Stormwater management requirements of this Manual are intended to enhance the quality of development, protect and enhance stormwater quality and management, protect aquatic resources from the negative impacts of the land development process, address water quality impairments or a total maximum daily load, as identified by the South Carolina Department of Health and Environmental Control (DHEC), or address localized flooding issues.

3.5.1 Watershed Protection Area Designations

Not all watersheds of the Southern Lowcountry region require the same level of post-construction stormwater management. Currently, three watershed protection areas are designated with specific unique stormwater management requirements based on the current and anticipated water quality control measures for their contributing watersheds. The Southern Lowcountry Stormwater Ordinance provides Beaufort County Public Works Department the flexibility and authority to designate sub watersheds or drainage areas as Special Watershed Protection Areas that may lead to more restrictive requirements or special criteria. Such special designations and criteria will be provided as a future appendix to this manual.

In the Southern Lowcountry, impairments include recreational water use impairment from bacteria (*Enterococcus* for saltwater and *E. coli* for freshwater), aquatic life use impairment from turbidity or dissolved oxygen, and shellfish harvesting use impairment from fecal coliform bacteria. Stormwater best management practices for these types of impairments include erosion and sediment control for turbidity impairments, illicit discharge detection, vegetated conveyances, vegetated buffers, pet waste programs, and post-construction runoff control. Currently, Southern Lowcountry water quality impairments do not include nutrient impairments, but nutrients can also be addressed through erosion and sediment control and the stormwater best management practices outlined in this Manual.

Most of Beaufort County and the lower reaches of the Jasper County watersheds have shellfish receiving waters or are recreational waters and are therefore sensitive to bacteria impairments. Land development and redevelopment projects in these watersheds require greater scrutiny to ensure that low impact development methods are designed, implemented and maintained to be protective of these water uses.

Watersheds tributary to the Savannah River in the Southern Lowcountry include most of the freshwater wetlands of the region. River water quality is excellent and is a supply for drinking water for the City of Savannah and the Beaufort Jasper Water and Sewer Authority. Savannah River impairments downstream of the I-95 bridge are primarily aquatic life use due to low dissolved oxygen. Since the Savannah River is the boundary of Georgia and South Carolina, it is reasonable to align stormwater requirements within Jasper County with those in Chatham and Effingham Counties, GA. Stormwater permits for the Georgia jurisdictions require use of the Georgia Coastal Stormwater Supplement to the Georgia Stormwater Management Manual, which is primarily a green infrastructure/low impact development (GI/LID) design Manual with requirements specific to the Georgia coastal counties.

The remaining watersheds of the Southern Lowcountry are more upland areas and in agricultural or silvicultural use or are conservation lands. For these areas new development is subject to stormwater management requirements similar to previous county requirements. This Manual unifies stormwater management standards across the designated watersheds rather than differing across county or jurisdictional lines.

The map in Figure 3.2 outlines the boundaries of the three watershed protection areas of the Southern Lowcountry. Requirements specific to each area are further developed in this chapter. Table 3.1 lists the US Geological Survey 12-Digit Hydrologic Unit Code (HUC-12) for the watersheds in each area. To identify a site's HUC-12, refer to the South Carolina DHEC Watershed Atlas, available online at https://gis.dhec.sc.gov/watersheds/. After identifying the site's HUC 12, use Table 3.2 to identify the watershed protection area.

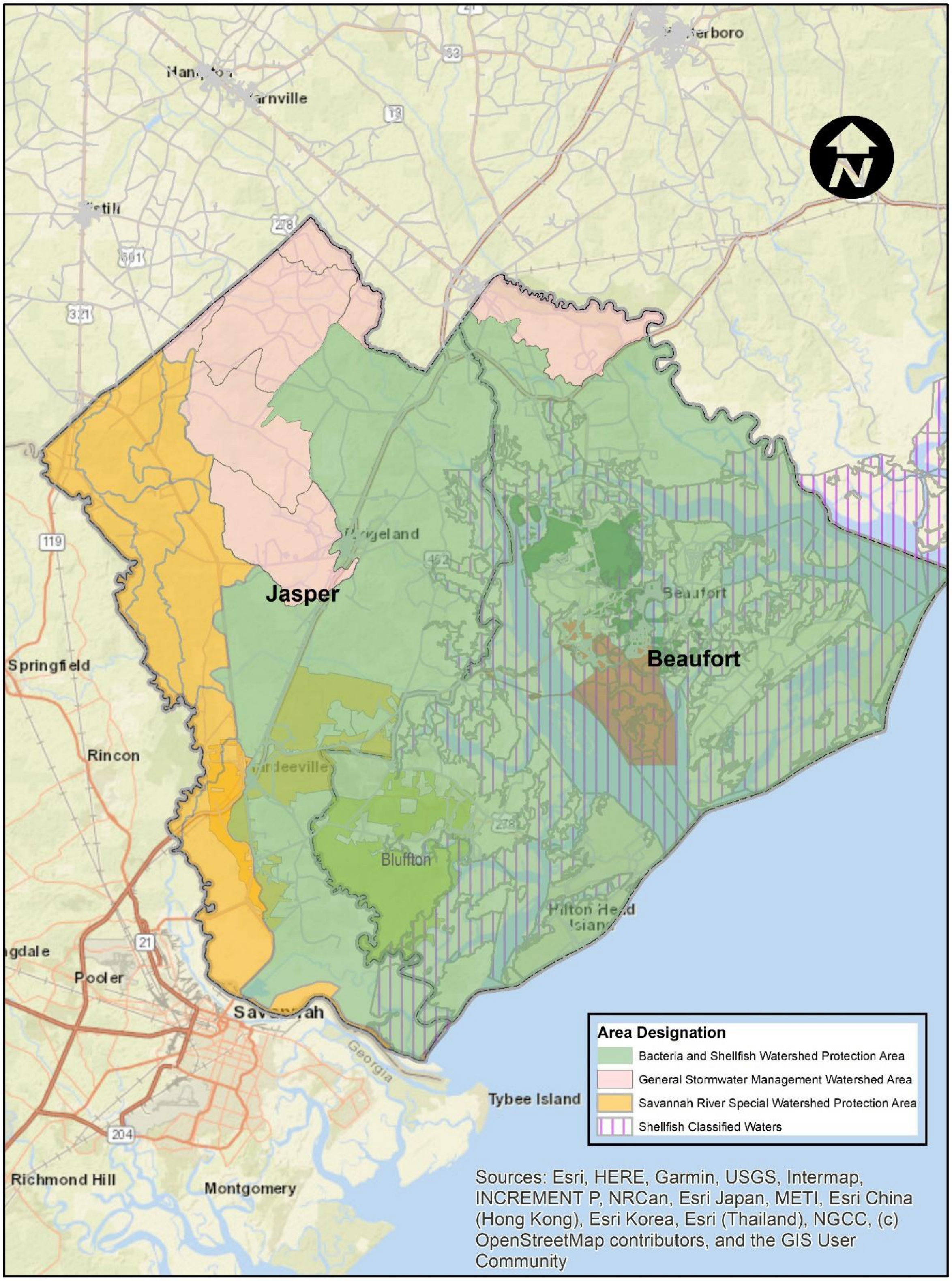


Figure 3.2. Watershed Protection Areas of the Southern Lowcountry.

Table 3.1. Watershed Protection Area HUC-12 Codes.

General Stormwater Management Watershed Areas		Savannah River Watershed Protection Area	
HUC-12 No.	**Watershed Name**	**HUC-12 No.**	**Watershed Name**
030502070704	Middle Combahee River	030601090107	Hog Branch-Savannah River
030502080301	Johns Pen Creek	030601090301	Cypress Branch
030502080302	Cypress Creek	030601090302	Black Swamp
030502080404	Mcpherson Creek-Coosawhatchie River	030601090303	Coleman Run
030502080405	Early Branch-Coosawhatchie River	030601090304	Sand Branch
030601100101	Gillison Branch	030601090305	Dasher Creek-Savannah River
030601100102	Upper Great Swamp	030601090307	Outlet Savannah River
Bacteria and Shellfish Watershed Protection Area			
HUC-12 No.	**Watershed Name**	**HUC-12 No.**	**Watershed Name**
030502070706	Lower Combahee River	030502080605	Boyd Creek-Broad River
030502071101	Wimbee Creek	030502080606	Colleton River
030502071102	Coosaw River	030502080607	Chechessee River
030502071103	Morgan River	030502080608	Broad River-Port Royal Sound
030502071104	Coosaw River-St. Helena Sound	030502100101	Harbor River-St. Helena Sound
030502080406	Bees Creek	030502100102	Harbor River-Trenchards Inlet
030502080407	Tulifiny River-Coosawhatchie River	030601090306	Wright River
030502080501	Battery Creek	030601100103	Lower Great Swamp
030502080502	Upper Beaufort River-Atlantic Intracoastal Waterway	030601100201	Upper New River-Atlantic Intracoastal Waterway
030502080503	Lower Beaufort River-Atlantic Intracoastal Waterway	030601100202	Lower New River-Atlantic Intracoastal Waterway
030502080601	Pocotaligo River-Broad River	030601100301	May River
030502080602	Huspa Creek	030601100302	Broad Creek
030502080603	Whale Branch	030601100303	Cooper River-Calibogue Sound
030502080604	Euhaw Creek	030601100304	Calibogue Sound

3.5.2 Overall Performance Requirements

Based on the watershed water quality criteria, its impairment status, or stormwater permit requirements, development and redevelopment stormwater management performance requirements will differ. These requirements are interpreted in terms of sizing and performance criteria. Table 3.2 presents a summary of the sizing criteria used to achieve the stormwater management performance requirements for each watershed protection area.

Table 3.2. Watershed Area Overall Performance Requirements.

General Stormwater Management Watershed Protection Areas	Savannah River Watershed Protection Area
Overall Performance Requirements	**Overall Performance Requirements**
• Water Quality: Implement Better Site Design, maintain pre-development hydrology of the site to the Maximum Extent Practicable (MEP) for the 85th percentile storm event. • Peak Control: Control post-development peak runoff discharge rate to pre-development rate for: 2-, 10- and 25-year, 24-hour design storm events. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load. • Complete a natural resources inventory for new site development applications.	• Water Quality: Implement Better Site Design, retain the 85th percentile storm event on-site to the MEP or obtain off-site credit. • Peak Control: Control post-development peak runoff discharge rate to pre-development rate for: 2-, 10- and 25-year, 24-hour design storm events. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load. • Complete a natural resources inventory for new site development applications.
Rationale	**Rationale**
The previous Jasper County stormwater design manual specified these overall performance requirements.	The Savannah River watershed adjoins Georgia counties that are subject to similar overall performance requirements as outlined in the Georgia Coastal Stormwater Supplement.

Bacteria and Shellfish Watershed Protection Area	
Overall Performance Requirements	
• Water Quality: Implement Better Site Design and retain the 95th percentile storm on-site with approved infiltration/filtering BMPs. Fulfill MEP requirements or, as a last resort, fulfill off-site credit and/or fee-in-lieu requirements. • As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.	• Peak control: Control the post-development peak runoff discharge rate for the 2, 10, 25, 50, 100-year, 24-hour design storm events to the pre-development discharge rates. • Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis. • Complete a natural resources inventory for new site development applications.
Rationale	
The Bacteria and Shellfish Watershed Protection Areas are either impaired or have TMDLs, or the receiving waters are classified for shellfish harvesting. These watersheds require greater protection due to their Clean Water Act status or water quality classification. The site's natural resource inventory is a necessary component of permit application.	

3.5.3 Southern Lowcountry Stormwater Precipitation & Runoff

As in the natural environment, a site's stormwater runoff volume depends upon soil conditions and land cover. To evaluate each site's development plan, this Manual relies on the rainfall runoff estimating methods of the Natural Resources Conservation Service National Engineering Handbook (NEH). Sometimes referred to as the curve number method or soil cover complex method, NEH chapter 9 describes the runoff response to rainfall events based on hydrologic soil group (HSG A, B, C or D) and land cover type with an integer between 29 and 100 (NRCS, 2004). Accordingly, information documenting the site's soils, their permeability, predeveloped land use or natural cover, and post-developed land cover, as well as the shallow groundwater table, are required in development plans in order to review and permit the development activity.

Precipitation event size and distribution are set by this Manual for the three watershed protection areas that make up the Southern Lowcountry.

The precipitation event distribution terms used in this Manual are defined as follows:

> **85th Percentile Storm** is the 24-hour rainfall amount that according to the National Oceanic and Atmospheric Administration records for the past 30 years in which 85% of all rainfall events do not exceed at the nearest US Weather Service station to the County seat. For the General Stormwater Management Watershed Areas and the Savannah River Watershed Protection Areas, this number is 1.16 inches of rainfall.
>
> **95th Percentile Storm** is the 24-hour rainfall amount that according to the National Oceanic and Atmospheric Administration records for the past 30 years in which 95% of all rainfall events do not exceed at the nearest US Weather Service station to the County seat. For the Bacteria and Shellfish Watershed Protection Areas this is 1.95 inches of rainfall.

Plans submitted for new development or redevelopment must demonstrate through accepted hydrologic methods that the development at post-construction will attenuate and treat the prescribed storm events. This includes volume reduction, peak flow management and extreme flood protection both on site and downstream.

3.5.4 Savannah River Watershed Protection Area

Upon implementation of this Manual, any applicable new development, redevelopment or major substantial improvement in the designated HUC-12 watersheds that are part of the Savannah River watershed shall meet the following requirements:

- Complete a natural resources inventory for new site development applications.
- Document use of Better Site Design.
- Retain the 85th percentile storm event on-site to the MEP or obtain off-site credit.
- Control the post-development peak runoff discharge rate for the 2, 10 and 25-year, 24-hour design storm events to the pre-development discharge rates.
- Accommodate 100-year, 24-hour storm event through the development without causing damage to the on-site and offsite structures. Provide 10% rule analysis.
- At a minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.

3.5.5 Bacteria & Shellfish Watershed Protection Area

Upon implementation of this Manual, any applicable new development, redevelopment or major substantial improvement in the designated HUC-12 watersheds that are part of the Bacteria and Shellfish Watershed Protection Area shall meet the following requirements:

- Complete a natural resources inventory for new site development applications.
- Document use of Better Site Design.
- Retain the 95th percentile storm on-site with approved infiltration/filtering BMPs.
- Fulfill MEP requirements or, as a last resort, fulfill off-site credit and/or fee-in-lieu requirements.
- At a minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.
- Control the post-development peak runoff discharge rate for the 2, 10, 25, 50, and 100-year, 24-hour design storm events to the pre-development discharge rates.
- Accommodate the 100-year, 24-hour storm event conveyance through the site and downstream without causing damage/inundation to structures. Provide 10% rule analysis.

3.5.6 General Stormwater Management Watershed Area

Upon implementation of this Manual, any applicable new development, redevelopment or major substantial improvement in the designated HUC-12 watersheds for the General Stormwater Management Watershed Area shall meet the following requirements:

- Complete a natural resources inventory for new site development applications.
- Document use of Better Site Design.
- Maintain pre-development hydrology of the site to the Maximum Extent Practicable (MEP) for the 85th percentile storm event.
- Control post-development peak runoff discharge rate for the 2, 10, 25, 50, and 100-year, 24-hour design storm events to pre-development discharge rates.
- Accommodate 100-year, 24-hour storm event through the development without causing damage to the on-site and offsite structures. Provide 10% rule analysis.
- As a pollutant removal minimum, intercept and treat stormwater runoff volume to at least an 80 percent reduction in total suspended solids load, 30 percent reduction of total nitrogen load and 60 percent reduction in bacteria load.

3.5.7 Runoff Reduction & Pollutant Removal

It is the minimum criteria of this Manual that a site's stormwater best management practices shall retain the precipitation event size for its watershed protection area as summarized in Section 3.5.2. Through successive application of the practices below and that are described in detail in Chapter 4, provide at least an 80% reduction in total suspended solids loads, 30% reduction of total nitrogen load, and 60% reduction in bacteria load (Jasper County, 2011).

Stormwater best management practices, when built according to the standards in Chapter 4 and maintained according to the site's maintenance agreement, can be expected to achieve runoff reduction and pollutant removal efficiencies according to Table 3.3. These values are to be used in the pollutant removal documentation and are used within the stormwater runoff reduction calculator in Appendix H. Other water quality credits may be assigned for BMPs based on the determination by Beaufort County Public Works Department and valid study results presented with the Stormwater Management Plan submittal.

Table 3.3. Pollutant Removal Efficiencies of Structural BMPs.

BMP	Water Quality Credits			
	Runoff Reduction	TSS % Removal	Total N % Removal	Bacteria % Removal
Bioretention - No Underdrain	100%[1]	100%[1]	100%[6]	100%[6]
Bioretention – Internal Water Storage	75%[1]	85%[1]	85%[4]	80%[5]
Bioretention - Standard	60%[2]	85%[1]	75%[4]	80%[5]
Permeable Pavement - Enhanced	100%[1]	100%[1]	100%[6]	100%[6]
Permeable Pavement - Standard	30%[2]	80%[1]	45%[4]	30%[6]
Infiltration	100%[1]	100%[1]	100%[6]	100%[6]
Green Roof	100%[3]	100%[6]	100%[6]	100%[6]
Green Roof - Irrigated	50%[3]	50%[6]	50%[6]	50%[6]
Rainwater Harvesting	100%[3]	100%[6]	100%[6]	100%[6]
Impervious Surface Disconnection	40%[2]	80%[1]	40%[4]	40%[6]
Grass Channel	10%[2]	50%[1]	25%[4]	30%[5]
Grass Channel - Amended Soils	20%[2]	50%[1]	35%[4]	30%[5]
Dry Swale	60%[2]	85%	70%[4]	80%[5]
Wet Swale	0%[1]	80%[1]	25%[4]	60%[5]
Regenerative Stormwater Conveyance	0%[1]	80%[1]	40%[6]	80%[6]
Filtering Systems	0%[3]	80%[1]	30%[4]	80%[6]
Storage Practices	0%[3]	60%[1]	10%[4]	60%[5]
Stormwater Ponds	0%[1]	80%[1]	30%[4]	60%[5]
Stormwater Wetlands	0%[1]	80%[1]	25%[4]	60%[5]
Tree Planting and Preservation	see section 4.12			
Proprietary Practices	see section 4.13			
Conservation Areas	see section 4.14			

Notes:

The following resources were used to develop the runoff reduction and pollutant removal values in the above table.

1. (ARC, 2016).
2. (Hirschman, 2018).
3. (DOEE. 2013)
4. (Hirschman, 2018). Nitrogen removal values from this source were applied to the remaining volume after runoff reduction was applied. The values provided in the table above represent the results of this application.
5. (Chesapeake Stormwater Network, 2018)
6. Best professional judgement was used where a BMP's pollutant removal values were not available in the above sources, or conflicts were present. In all cases, a BMP's pollutant removal value must be at least as high as its runoff reduction values (for example, if a BMP is assigned a runoff reduction value of 100%, it will also have TSS, nitrogen, and bacteria removal rates of 100%). In addition, it was assumed that a Regenerative Stormwater Conveyance (RSC) will have similar nitrogen removal to bioretention systems, so the nitrogen removal value from the Runoff Reduction Method was applied as described in reference 4, above. It was also assumed that both RSCs and filtering systems will have the same bacterial removal rate as bioretention (with no runoff reduction).

3.6 Erosion & Sediment Control (ESC) Requirements

The design and management of construction site runoff control measures for all qualifying developments as defined in the Ordinance shall be in accordance with SCDHEC NPDES General Permit for Stormwater Discharges from Construction Activities, the SCDHEC Erosion and Sediment Reduction and Stormwater Management regulations and its most current version of standards, where applicable. Beaufort County Public Works Department reserves the right to require additional erosion and sediment control or a higher standard of measure and make their requirement a condition of a development permit approval.

3.7 Retention Standard & Volume

This section provides the formulas and rationale for use of the runoff reduction method to compare predeveloped and post-development hydrology for projects submitted for approval to the Southern Lowcountry jurisdictions.

Runoff reduction is defined as “the total annual runoff volume reduced through canopy interception, soil infiltration, evaporation, transpiration, rainfall harvesting, engineered infiltration, or extended infiltration” (Hirschman, 2008). The formula to calculate the volume reduced through successive application of stormwater best management practices originates with the Natural Resources Conservation Service (NRCS) method of estimating direct runoff from storm rainfall and the curve number method of NEH Chapter 9 (NEH, 2004). As shown in Equation 3.1, rainfall event runoff (Q) is a function of depth of event rainfall (P) over the watershed, the initial abstraction (I_a) and the maximum potential retention (S).

Equation 3.1. Curve number runoff equation.

$$QQ = \frac{(PP - II_{aa})^{22}}{(PP - II_{aa}) + SS}$$

$$II_{aa} = 00.22SS$$

$$QQ = \frac{(PP - 00.22SS)^{22}}{(PP + 00.88SS)}$$

$$QQ - RR = \frac{(PP - 00.22SS)^{22}}{(PP = 00.88SS)}$$

$$SS = \frac{110000}{CCCC} - 11$$

Where:

Q =	Runoff depth (in)
P =	Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)
I_a =	Initial abstraction (in)
S =	Potential maximum retention after runoff begins (in)
CN =	Runoff curve number
R =	Retention storage provided by runoff reduction practices (in)

Not all stormwater BMPs provide runoff reduction equally. Through the crediting procedures of the Compliance Calculator found in Appendix H and the retention volumes required in this section, designers will be able to evaluate their proposed designs and submit for approval in a unified process across the Southern Lowcountry jurisdictions.[1]

Supplemental information on the terms below can be found in the *Low Impact Development in Coastal South Carolina: Planning and Design Guide*, and the Georgia Stormwater Management Manual (Ellis, K. et al., 2014; ARC, 2016).

The Stormwater Retention Volume (SWRv) is the volume of stormwater runoff that is required to be retained, post-development. It is calculated as shown in Equation 3.2 for the entire site and for each site drainage area (SDA). The SDA is defined as the area that drains to a single discharge point from the site or sheet flows from a single area of the site. A development site may have multiple SDAs and runoff coefficients.

Equation 3.2. Stormwater retention volume (SWRv) equation

$$\boldsymbol{SSSSRRSS} = \frac{PP \times [(RRSS_{II} \times II) + (RRSS_{CC} \times CC) + (RRSS_{CC} \times CC)]}{\mathbf{1122}}$$

Where:

SWRv =	Volume required to be retained (cubic feet)
P =	Depth of rainfall event for the designated watershed protection area (85th or 95th percentile rain event)
Rv_I =	Runoff coefficient for impervious cover and BMP cover based on SCS hydrologic soil group (HSG) or soil type
I =	Impervious cover surface area (square feet)
Rv_C =	Runoff coefficient for compacted cover based on soil type
C =	Compacted cover surface area (square feet)
Rv_N =	Runoff coefficient for forest/open space based on soil type
N =	Natural cover surface area (square feet)
12 =	Conversion factor (inches to feet)

	Rv Coefficients			
	A soils	**B Soils**	**C Soils**	**D Soils**
Forest/Open Space (R_{VN})	0.02	0.03	0.04	0.05
Managed Turf *(Rv_C)*	0.15	0.20	0.22	0.25
Impervious Cover (R_{vI})	0.95	0.95	0.95	0.95
BMP	0.95	0.95	0.95	0.95

The Compliance Calculator in Appendix H uses best available pollutant removal efficiencies for total suspended solids, total nitrogen and fecal indicator bacteria. Use of the compliance calculator allows the designer to evaluate alternative designs to arrive at compliance with the runoff reduction and pollutant removal requirements and clearly summarize them for the local plan reviewer. The compliance

[1] Compliance Calculator instructions are found in Appendix G

calculator output is a necessary submittal for a plan reviewer to evaluate selected BMPs to demonstrate compliance with the watershed protection area standards of this Manual.

3.7.1 Total Suspended Solids, Nutrients, & Bacteria

The minimum pollutant removal performance requirements for all watersheds of the Southern Lowcountry include the interception and treatment of stormwater runoff volume to at least an 80% reduction in total suspended solids load, 30% reduction of total nitrogen load, and 60% reduction in bacteria load. These requirements are established for the following reasons.

Stormwater in the Lowcountry conveys the plant nutrients nitrogen and phosphorus. Nitrogen tends to dissolve in water, but phosphorus is adsorbed to suspended solids predominantly. Control of total suspended solids through the BMPs in this Manual will also remove a proportional amount of phosphorus. Relying on the judgement of stormwater researchers and other state design manuals, the approach for the Southern Lowcountry is similar. If a BMP is effective at runoff reduction or retention of stormwater, it is similarly effective at removal of the initial volume of suspended solids (NCDEQ, 2014).

Many of the Southern Lowcountry watersheds at the HUC-12 size are directly tributary to bacteria and shellfish impaired waters. As these watersheds develop with rooftops, roads and other impervious surfaces, there is an increasing potential for bacteria in the stormwater from wildlife populations (deer, racoons, waterfowl), pet waste, septic system discharges and sanitary sewer system malfunctions. Similarly, nutrients can be expected to increase due to fertilizer use in erosion control practices, managed turf and landscaping, septic system leachate, and atmospheric deposition on impervious surfaces. Best management practices, along with better site design practices, can be used to reduce bacteria and nutrients in stormwater to the benefit and restoration of Southern Lowcountry water quality.

3.7.2 Hydrologic & Hydraulic Analysis

In order to prevent an increase in the duration, frequency and magnitude of downstream overbank flooding and scouring, this Manual requires that enough stormwater detention be provided on a development site to control the post-development peak runoff discharge to the predevelopment runoff rates for the 2, 10, 25, 50, and 100 -year, 24-hour storm events. The capacity of the existing downstream receiving conveyance system for all off-site discharge points must be determined to be adequate. An analysis of the downstream conveyance capacity to accommodate the site's post development 25- and 100-year, 24-hour peak flow shall be provided in the engineering report. Discharge to the public right-of-way of the SC State highway system shall comply with the SCDOT Requirements for Hydraulic Design Studies. Necessary upgrades within the public right-of-way due to inadequate capacity for the post-development 25-yr flow must be identified during the permit application process. Upgrades to the downstream system to accommodate the 100-yr 24-hour flow must be considered through the MEP process outlined in Section 3.9. Documentation supporting safe passage of the 100-yr post development flow to the downstream point where the detention or storage area comprises 10% of the total drainage area, and an analysis of the surrounding neighborhood area to identify any existing capacity shortfalls or drainage blockages is required for plan approval. This analysis is called the 10% analysis rule in Section 3.8 of this Manual.

The recommended 2, 10, 25, and 100-year, 24-hour storm event values from Appendix F of the South Carolina DHEC Storm Water Management BMP Handbook, July 31, 2005 for Beaufort and Jasper Counties are in Table 3.4[2].

Table 3.4. Rainfall depth (inches) for the Southern Lowcountry.

Return Period (years)				
County	**2**	**10**	**25**	**100**
Beaufort	4.5	6.9	8.4	11.0
Jasper	4.2	6.4	7.8	10.2

In this Manual, Appendix I General Design Criteria and Guidelines provides the acceptable methodologies and computer models for estimating runoff hydrographs before and after development, as well as design criteria for stormwater collection systems and land cover designations. The following are the acceptable methodologies and computer models for estimating runoff hydrographs before and after development. These methods are used to predict the runoff response from given rainfall information and site surface characteristic conditions. The design storm frequencies used in all of the hydrologic engineering calculations will be based on design storms required in this Manual unless circumstances make consideration of another storm intensity criterion appropriate:

- Rational Method (limited to sites under 10 acres)
- Urban Hydrology for Small Watersheds TR-55
- Storage-Indication Routing
- HEC-1, WinTR-55, TR-20, ICPR v3 or 4 and SWMM computer models

These methods are given as valid in principle and are applicable to most stormwater management design situations in the Southern Lowcountry.

The following conditions should be assumed when developing predevelopment, pre-project, and post-development hydrology, as applicable:

- The design storm duration shall be the 24-hour rainfall event, using the NRCS (SCS) Type III rainfall distribution with a maximum six-minute time increment.
- The predeveloped peaking factor shall be 200 for new development (Blair et al., 2012).
- The post development peaking factor shall be 400.
- For new development sites the predeveloped condition shall be calculated as a composite CN based on the HSG and meadow conditions (NEH, 2004).
- For infill and redevelopment sites, the predeveloped condition shall be calculated as a composite CN based on the HSG and the land cover type and hydrologic condition at the time of the project's initial submittal.

[2] Until SCDHEC updates its Stormwater Management BMP Handbook rainfall table to the NOAA Atlas 14 values, the Southern Lowcountry region shall use the Handbook Appendix F rainfall table for 24 hour storm events.

- Antecedent Runoff Condition (ARC) II is the average adjustment factor for calculations using TR-55. ARC III is to be used for wetter conditions such as areas that receive irrigation water harvested from stormwater ponds and for poorly drained soils.

Project designs must include supporting data and source information. All storm sewer systems shall be analyzed for both inlet and outlet control (including tailwater effects) by using the following:

a. Equations and nomographs as shown in the Federal Highway Administration (FHWA) Hydraulic Design Services (HDS) publication No. 5.

b. Computer programs that calculate the actual hydraulic grade line for the storm sewer system can be used, provided all losses (friction, bend, junction, etc.) are taken into account using the appropriate loss coefficient (K) values.

c. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis.

d. Allowable headwater. The allowable headwater of all culverts, pipe systems, open channels, bridges and roadway culverts shall be established following the SCDOT Requirements for Hydraulic Design Studies.

All culverts, pipe systems, and open channel flow systems shall be sized in accordance with the design criteria found in Appendix I Hydrology and Hydraulics Design Requirements.

3.7.3 Maintenance Easements

Maintenance easements are provided for the protection and legal maintenance of stormwater management facilities not within a right-of-way. Drainage easements shall be required in subdivisions over any portion of a stormwater management facilities not within a right-of-way and necessary for the functioning of the system. Drainage easements for all facilities must be shown on construction drawings and approved by the stormwater manager. The easements shall be designated on the plan prior to issuance of a development permit and recorded in public records with copy of recorded easement submitted prior to Beaufort County Public Works Department permit termination. The minimum allowable width of drainage easements may be as shown in Table 3.5.

Table 3.5. Drainage maintenance access easements.

Stormwater Management Facility	Minimum Easement Width
Closed systems (storm sewers/pipes/culverts)	diameter + 4 ft + 2D(20-ft minimum)*
Open drainage systems	
Bottom width 20 ft or less	15 ft + BW + 2SD (30 ft minimum)**
Bottom width 20 ft to 40 ft	30 ft + BW + 2SD**
Bottom width greater than 40 ft	40 ft + BW + 2SD**
Retention/detention BMPs	20 ft around facility***
Pond Maintenance Access	A 20’ maintenance access easement between lot lines and top of bank shall be provided for stormwater ponds with a permanent pool. The easement shall be provided for boat trailer access, and for all structure maintenance and repair. No permanent structures (mechanical, electrical, phone, fences) or landscaping are allowed within the 20’ pond maintenance access easement.

*Where: D = Depth from grade to pipe invert **Where: BW = Bottom width S = Side slope D = Depth of opening
Note: The minimum required width and configuration of drainage easements may be modified if deemed necessary by the stormwater manager for justifiable reasons.

3.8 Extreme Flood Requirement: 10% Rule

The peak discharge generated by the 100-year, 24-hour storm event under post-development conditions is considered the extreme peak discharge. The intent of the extreme flood protection is to prevent flood damage from infrequent but large storm events, maintain the boundaries of the mapped 100-year floodplain, and protect the physical integrity of the best management practices as well as downstream stormwater and flood control facilities. The 100-yr flow is to be used in the routing of runoff through the drainage system and stormwater management facilities to determine the effects on the facilities, adjacent property, and downstream. Emergency spillways of best management practices should be designed appropriately to pass the resulting flows safely.

Documentation supporting safe passage of the 100-year post-development flow shall be provided by the applicant/engineer. In order to prevent an increase in the duration, frequency and magnitude of downstream extreme flooding over existing conditions, an evaluation must be provided to include downstream analysis to the point where the project comprises 10% of the total contributing drainage area. The 10% rule evaluation must address existing conveyance system capacity and "pinch points" where a pipe/culvert would be overtopped and where the pipe/culvert will need to be upgraded or the peak discharge rate will need to be limited to the capacity of the downstream system.

The 10% rule recognizes the fact that a structural BMP control providing detention has a "zone of influence" downstream where its effectiveness can be felt. Beyond this zone of influence, the structural control becomes relatively small and insignificant compared to the runoff from the total drainage area at that point. Based on studies and master planning results from a large number of sites, that zone of influence is considered to be the point where the drainage area controlled by the detention or storage facility comprises 10% of the total drainage area. For example, if the drainage control drains 10 acres, the zone of influence ends at a point where the total drainage area is 100 acres or greater (ARC, 2016).

Demonstration of safe passage of the 100-year, 24-hour storm shall include a stage storage analysis of the system, an inflow/outflow comparison of the system, and construction of a table showing peak stage elevations in comparison to safe freeboards to structures of the system and adjacent buildings/structures/infrastructure. Safe passage to the receiving water also requires that there be no additional downstream flooding or other environmental impacts (e.g., stream channel enlargement, degradation of habitat).

Typical steps in the application of the 10% rule are:

1. Determine the target peak flow for the site for predevelopment conditions.
2. Using a topographic map, determine the lower limit of the zone of influence (10% point)

3. Using a hydrologic model, determine the predevelopment peak flows and timing of those peaks at each tributary junction beginning at the pond outlet and ending at the next tributary junction beyond the 10% point.
4. Change land use on the site to post-development and rerun the model.
5. Design the structural control facility such that the overbank flood protection (25-year) post-development flow is adequately conveyed to the lower limit of the zone of influence and the Extreme Flood (100-year) post-development flow does not impact any existing structures within the area of zone of influence.
6. If the overbank flood protection (25-year) post-development flow is not adequately conveyed to the lower limit of the zone of influence and/or Extreme Flood (100-year) post-development flow is shown to impact any structure, the structural control facility must be redesigned or one of the following options considered:
    a. Work with Beaufort County Public Works Department to reduce the flow elevation through channel or flow conveyance structure improvements downstream.
    b. Obtain a flow easement from downstream property owners to the 10% point.
    c. Request a detention waiver from Beaufort County Public Works Department. This waiver would be for water quantity control only and best management practices to achieve water quality goals will still be required.

3.9 Maximum Extent Practicable

Maximum extent practicable (MEP) is the language of the Clean Water Act that sets the standards to evaluate efforts pursued to achieve pollution reduction to the Waters of the United States. The MEP refers to management practices; control techniques; and system, design, and engineering methods for the control of pollutants. It allows for considerations of public health risks, societal concerns, and social benefits, along with the gravity of the problem and the technical feasibility of solutions. The MEP for stormwater management is achieved, in part, through a process of selecting and implementing different design options with various structural and non-structural stormwater best management practices (BMPs), where ineffective BMP options may be rejected, and replaced when more effective BMP options are found (DOEE, 2019).

There must be a serious and demonstrated attempt to comply with this Manual, and practical solutions may not be lightly rejected. If project applicants implement and demonstrate only a few of the least expensive BMPs, and the regulated volume has not been retained, it is likely that the MEP standard has not been met. If, on the other hand, a project applicant implements all applicable and effective BMPs except those shown to be technically infeasible, then the project applicant would have achieved retention to the MEP.

Major land-disturbing activities, infill and redevelopment projects, and projects in the existing public right-of-way, must achieve the SWRv, and meet peak flow requirements for channel and extreme flood protection to the MEP. Through application of stormwater best management practices on site or at an off-site property within the same stormwater drainage catchment, land development projects should be able to comply with the Southern Lowcountry Stormwater Ordinance. It is the applicant’s responsibility to demonstrate to the greatest extent that the requirements of this Manual can be met for the proposed development. The applicant must fully demonstrate that the requirements of the Manual are not possible or feasible before entering into a MEP analysis, and only after the concurrence and approval of the Public Works director and/or their designee of Beaufort County Public Works Department based on the project submittals, documentation and discussions. The applicant must realize that if the requirements of the Manual cannot be met, the site may not be conducive for development, as proposed, in the interest of public safety and welfare.

When a new land development project, infill or redevelopment cannot meet the volume and peak flow requirements of this Manual, the following design and review process is required to comply with the MEP requirement. This evaluation is intended to be completed during the concept review stage of plan development.

1) Demonstrate how BSD has been implemented to the maximum extent practicable or document site restrictions that prevent BSD application.
2) List the site restrictions that prevent the on-site use of the stormwater BMPs of this Manual.
3) Cite justification for not being able to retain the SWRv and attain the required peak discharge limits.
4) Is there off-site capacity in the same drainage catchment as defined by Beaufort County Public Works Department to meet the volume and/or peak flow requirements for the site's contributing drainage area(s)?
5) Does the publicly maintained stormwater drainage system have sufficient capacity for the development site's extreme flood peak flow?
6) Develop a cost versus aggregated stormwater retention volume achieved curve for the site's contributing drainage area. A minimum of five cost points with three of the BMP alternatives in series as a treatment train are necessary for the curve. Include the evaluation off-site capacity cost. Identify the inflection point of the cost curve to identify the optimal solution where increased cost does not result in increased effectiveness.
7) The optimum aggregated retention value and BMP selection and size analysis must be submitted as a part of the stormwater management plan for the project.
8) Offsite stormwater volume retention credit or fee-in-lieu documents will be required for project completion.

The MEP submittal must provide documentable evidence of the process the applicant has performed that demonstrates the restrictions to the use and implementation of BMPs and approved by the Beaufort County Public Works Director and/or their designee and to meet the requirements of this Manual in whole or in part.

3.10 Off-Site Stormwater Management

All stormwater management design plans shall include on-site stormwater management practices, unless post-construction stormwater runoff in an off-site or regional stormwater management practice is approved according to this Section.

The off-site or regional stormwater management practice must be located on property legally dedicated to that purpose, be designed and sized to meet the post-construction stormwater management criteria presented in this Manual, provide a level of stormwater quality and quantity control that is equal to or greater than that which would be provided by on-site green infrastructure and stormwater management practices, be in the same drainage catchment, as defined by Beaufort County Public Works Department, as the project area, and have an associated inspection and maintenance agreement and plan. In addition, appropriate stormwater management practices shall be installed, where necessary, to protect properties and drainage channels that are located between the development site and the location of the off-site or regional stormwater management practice.

To be eligible for compliance through the use of off-site stormwater management practices, the applicant must submit a stormwater management design plan to Beaufort County Stormwater Department that demonstrates the adequacy of the off-site or regional stormwater management practice, and demonstrates, to the satisfaction of the Beaufort County Public Works Department that the off-site or regional stormwater management practice will not result in any of the following impacts:

(1) Increased threat of flood damage or endangerment to public health or safety;

(2) Deterioration of existing culverts, bridges, dams, and other structures;

(3) Accelerated streambank or streambed erosion or siltation;

(4) Degradation of in-stream biological functions or habitat; or,

(5) Water quality impairment in violation of state water quality standards and/or violation of any other state or federal regulations.

3.11 Waivers

Individuals seeking a waiver from the requirements of this Ordinance may submit to the *(administrator)* a request for a waiver in accordance with the Southern Lowcountry Stormwater Design Manual.

(1) Request of a Waiver at Staff Level
A written request for a waiver is required and shall state the specific waiver sought and the reasons, with supporting data, a waiver should be granted. The request shall include all information necessary to evaluate the proposed waiver. Requests must outline the need for such a waiver, such as site constraints, soil characteristics, or similar engineering limitations. Cost shall not be considered cause for a waiver. This waiver would be for water quantity control only and best management practices to achieve water quality goals will still be required. The applicant will address the criteria below for consideration of a waiver approval:

a. What exceptional circumstances to the site are evident that on-site or off-site stormwater management requirements cannot be met?
b. What unnecessary hardship is being caused?
c. How will denial of the waiver be inconsistent with the intent of the Ordinance?
d. How will granting the waiver comply with the intent of the Ordinance?
e. How are state and federal regulations still being met?

(2) Review of Waivers
The Public Works Director and/or their designee will conduct a review of the request and will issue a decision within thirty (30) working days of receiving the request.

Chapter 4. Stormwater Best Management Practices (BMPs)

4.1 Standard Stormwater BMP Design Sections

This chapter summarizes and outlines performance criteria for 13 stormwater best management practice (BMP) categories that include:

- Bioretention (4.3)
- Permeable Pavements (4.4)
- Infiltration (4.5)
- Green Roofs (4.6)
- Rainwater Harvesting (4.7)
- Impervious Surface Disconnection (4.8)
- Open Channel Systems (4.9)
- Filtering Systems (4.10)
- Storage Practices (4.11)
- Ponds (4.12)
- Stormwater Wetlands (4.13)
- Tree Planting and Preservation (4.14)
- Proprietary Practices (4.15

Following these criteria is the criteria to credit for stormwater benefit the use of conservation areas and open space preservation.

4.1.1 Format of Standard Stormwater BMP Design Sections

BMP performance criteria are based on several critical design factors to ensure effective and long-lived BMPs. For each BMP, the following factors are discussed:

- General Feasibility
- Conveyance
- Pretreatment
- Design and Sizing
- Landscaping
- Construction Sequencing
- Maintenance
- Stormwater Compliance Calculations

Design components that differ from these specifications, but meet their intent, may be included at Beaufort County Public Works Department's discretion.

4.1.2 Standard Nomenclature

In this chapter, and throughout the guidebook, the terms, *must* or *shall*, denote required aspects of BMPs or their design and implementation. The term, *should*, denotes a recommendation, however, justification may be necessary for design or implementation that does not correspond to certain recommendations.

4.2 Summary of BMP Stormwater Management Capabilities, Site Applicability, & Physical Feasibility

Stormwater management requirements for a given site vary based on the site's location, and minimum control requirements discussed in detail in Section 3.5.

4.2.1 Stormwater Retention & Water Quality Treatment

It is important to note that this Manual, and the associated compliance calculators, make a distinction between stormwater retention volume and stormwater water quality treatment. Not all BMPs achieve stormwater retention and/or water quality treatment equally, as was summarized in Table 3.3. The level to which a BMP provides stormwater retention and water quality treatment is provided in the BMP summary table of each BMP. The stormwater runoff reduction (SWRv) rates are expressed as a percentage of the storage volume provided by the BMP. Calculations for determining storage volume are included in each BMP's specifications. Each BMP's performance on the water quality parameters of total suspended solids, nitrogen and bacteria are also included in the BMP summary table. Note that many BMPs whose main purpose is water quality treatment typically do not have enough volume control to manage larger storm events.

4.2.2 Site Applicability

Certain BMPs are more appropriate than others in certain land uses. Table 4.1 describes the site applicability for each BMP for the following factors:

- <u>Rural Use</u>: This column indicates whether or not the stormwater management practice is typically suited for use in rural areas and on low-density development sites.

- Suburban Use: This column indicates whether or not the stormwater management practice is typically suited for use in suburban areas and on medium-density development sites.
- Urban Use: This column identifies the stormwater management practices that are typically suited for use in urban and ultra-urban areas where space is at a premium.
- Construction Cost: This column assesses the relative construction cost of each of the stormwater management practices.
- Maintenance: This column assesses the relative maintenance burden associated with each stormwater management practice. Note that all stormwater management practices require routine inspection and maintenance.

Table 4.1. Site applicability for BMPs.

BMP	Rural Use	Suburban Use	Urban Use	Construction Cost	Maintenance
Bioretention	Yes	Yes	Yes	Medium	Medium
Permeable Pavement	Maybe	Yes	Yes	High	High
Infiltration	Yes	Yes	Yes	Medium	Medium
Green Roof	Maybe	Yes	Yes	High	Low
Rainwater Harvesting	Yes	Yes	Yes	Medium	Medium
Disconnection	Yes	Yes	Maybe	Low	Low
Open Channels	Yes	Yes	No	Low-Medium	Medium
Filtration	Maybe	Yes	Yes	High	High
Dry Ponds	Yes	Yes	No	Low	Low
Wet Ponds	Yes	Yes	No	Low	Low
Stormwater Wetlands	Yes	Yes	No	Low	Medium

4.2.3 Site Conditions & Physical Feasibility

While some BMPs can be applied almost anywhere, others require specific conditions to be most effective. Physical feasibility refers to the physical site conditions necessary to effectively design and install a BMP. Table 4.2 includes the feasibility factors listed below.

- Contributing Drainage Area (CDA): Volume of water received by a practice can affect BMP performance. This column indicates the contributing drainage areas that typically apply for each BMP.
- Slope: This column describes the influence that site slope can have on the performance of the BMP. It indicates the maximum slope on which the BMP should be installed.
- Minimum Head: This column provides an estimate of the minimum amount of elevation difference needed within the BMP, from the inflow to the outflow, to allow for gravity operation.
- Minimum Depth to Seasonal High Water Table: This column indicates the minimum distance that should be provided between the bottom of the stormwater management practice and the top of the water table.
- Soils: This column describes the influence that the underlying soils (i.e., hydrologic soil groups) can have on the performance of the stormwater management practice.

Table 4.2. Feasibility limitations for BMPs.

BMP	Contributing Drainage Area	Slope	Minimum Head	Minimum Depth to Water Table	Soils
Bioretention	Up to 2.5 acres	Up to 5%[2]	4 - 5 feet	0.5 feet	All soils[3]
Permeable Pavement	Up to 5 times practice surface area	Up to 5%	1 – 4 feet	0.5 feet	All soils[3]
Infiltration	Up to 2 acres	Up to 6%[2]	2 feet	0.5 feet	Must drain within 72 hours
Green Roof	Green roof area + 100%	Up to 30%[4]	N/A	N/A	N/A
Rainwater Harvesting	No limit	No limit	N/A	N/A	N/A
Disconnection	Up to 1,000 ft^2 per downspout	Up to 5%	N/A	N/A	All soils
Open Channels	Up to 2.5 acres	Up to 4%[2]	Varies	Varies	All soils
Filtration					

Irrigation from ponds is not included as a specific best management practice in this M*anual* but is included as Rainwater Harvesting (§4.5). Requirements and guidance for irrigation use of retained stormwater have been included in Hydrologic and Hydraulic Analysis (ARC requirements in §3.7.2); Ponds (§4.10); and Rainwater Harvesting Treatment and Management Requirements (Appendix J). The Rainwater Harvesting Calculator in Appendix K will be used to determine the SWRv credit for ponds used for irrigation, and then these ponds are entered in the Compliance Calculator in Appendix H as rainwater harvesting. Instructions for these entries are included in Appendix G Compliance Calculator Instructions.

Filtration	Up to 5 acres	Up to 6%	2 – 10 feet	0.5 feet	All soils
Storage Practices	Varies	No limit	5 feet	0.5 feet	All soils
Ponds	Greater than 10 acres[1]	Up to 15%	6 – 8 feet	No limit	Slow-draining soils preferred
Stormwater Wetlands	Varies	Up to 8%[2]	2 – 4 feet	No limit	Slow-draining soils preferred

[1] *CDA can be smaller if practice intersects the water table.*
[2] *Check dams may be necessary to create sufficient ponding volume.*
[3] *Slow-draining soils may require an underdrain.*
[4] *Roof slope.*

4.3 Bioretention

<table>
<tr><th colspan="6">Bioretention</th></tr>
<tr><td colspan="6">Definition: Practices that capture and store stormwater runoff and pass it through a filter bed of engineered filter media composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="4">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="4">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small to Large</td><th>TSS[1]</th><th>Total N[1,]</th><th colspan="2">Bacteria[1,2]</th></tr>
<tr><td>85%–100%</td><td>75%–100%</td><td colspan="2">80%–100%</td></tr>
<tr><th colspan="4">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="4">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="4">High</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="4">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td>No Underdrain</td><td>IWS</td><td colspan="2">Standard</td></tr>
<tr><td>Quarterly</td><td>Every 2–3 years</td><td>100% of Sv</td><td>75% of Sv</td><td colspan="2">60%</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="4">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Easily incorporated into new development
▪ High community acceptance
▪ Good for small, highly paved drainage areas (i.e. parking lots)</td><td colspan="4">▪ Maximum CDA is 1 to 2.5 acres
▪ Requires pretreatment to prevent clogging
▪ Requires detailed landscape planning
▪ Not appropriate for steep slopes</td></tr>
<tr><th colspan="2">Components</th><th colspan="4">Design considerations</th></tr>
<tr><td colspan="2">▪ Pretreatment
▪ Conveyance system
▪ Ponding area
▪ Soils/Filter Media/Mulch
▪ Observation Well/Monitoring Port
▪ Plants</td><td colspan="4">▪ Maximum ponding depth 18 inches
▪ Minimum filter media bed depth 18 inches
▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice
▪ Underdrain system may be needed</td></tr>
<tr><th colspan="6">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Mow turf cover periodically
▪ Replace mulch as needed to maintain depth of mulch</td><td colspan="4">▪ Replace plant material, as needed
▪ Replace soil if it becomes clogged
▪ Clean conveyance system(s)</td></tr>
</table>

[1]*Credited pollutant load removal*

Bioretention areas, shallow depressional areas that are filled with an engineered soil media and are planted with trees, shrubs, and other herbaceous vegetation, are one of the most effective stormwater management practices that can be used to reduce post-construction stormwater runoff rates, volumes, and pollutant loads. They also provide a number of other benefits, including improved aesthetics, wildlife habitat, urban heat island mitigation, and improved air quality. See Figure 4.1 for an example image.

They are designed to capture and temporarily store stormwater runoff in the engineered soil media, where it is subjected to the hydrologic processes of evaporation and transpiration, before being conveyed back into the storm drain system through an underdrain or allowed to infiltrate into the surrounding soils. The engineered soil media is comprised of sand, soil, and organic matter.

Typically, bioretention systems are not designed to provide stormwater detention of larger storms (e.g., 2-, 10-, 25-year), but in some circumstances that may be possible. Bioretention practices should generally be combined with a separate facility to provide those controls.

Figure 4.1. Bioretention in parking lot (photo credit: Center for Watershed Protection, Inc.).

Definition. Practices that capture and store stormwater runoff and pass it through a filter bed of engineered filter media composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil. Design variants include the following:

B-1 Bioretention

B-2 Streetscape bioretention

B-3 Engineered tree pits

B-4 Stormwater planters

B-5 Residential rain gardens (for single family homes)

There are three different bioretention design configurations:

- **No Underdrain**. Practices that can infiltrate the design storm volume within 72 hours, and therefore need no underdrain (see Figure 4.2).
- **Internal Water Storage (IWS)**. Practices that include an infiltration sump/storage layer (see) below the underdrain.
- **Standard**. Practices with underdrains (see Figure 4.4).

The particular design configuration to be implemented on a site is typically dependent on specific site conditions and the characteristics of the underlying soils. These criteria are further discussed in this chapter.

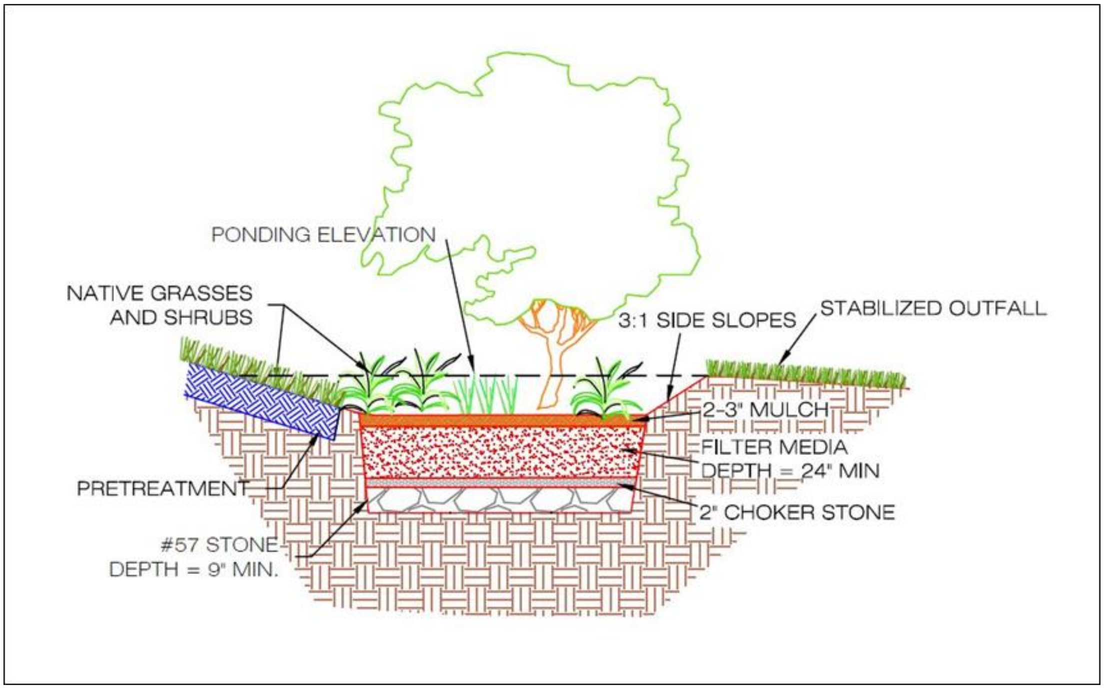


Figure 4.2. Example bioretention design without an underdrain.

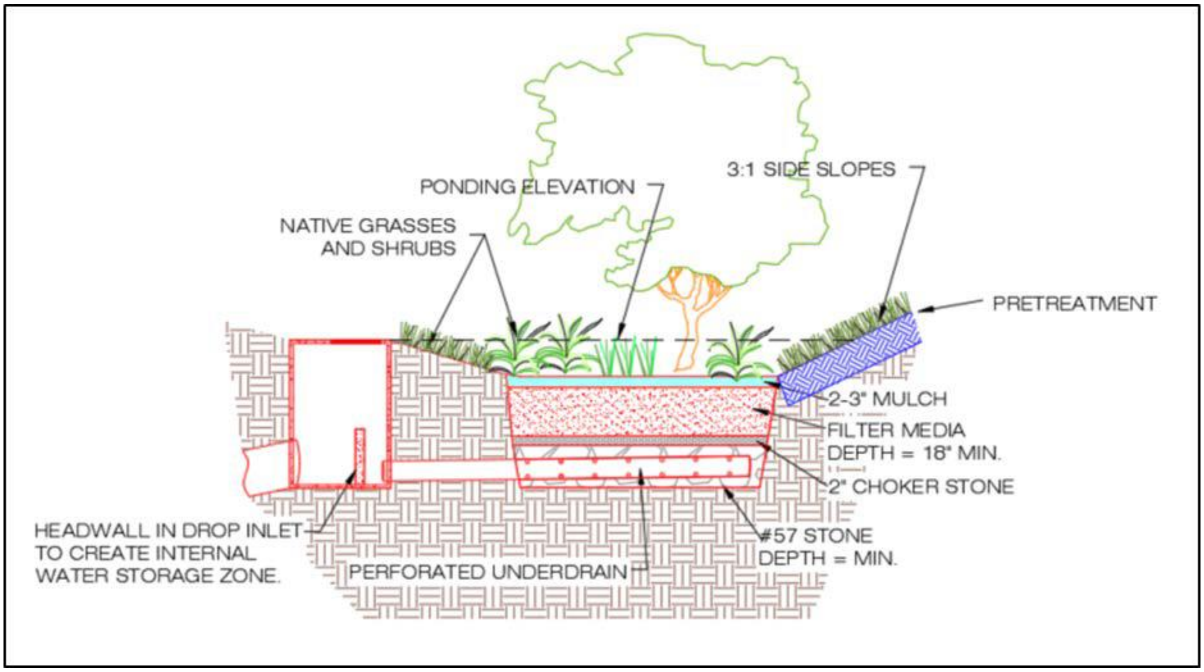


Figure 4.3. Example bioretention design with internal water storage (IWS).

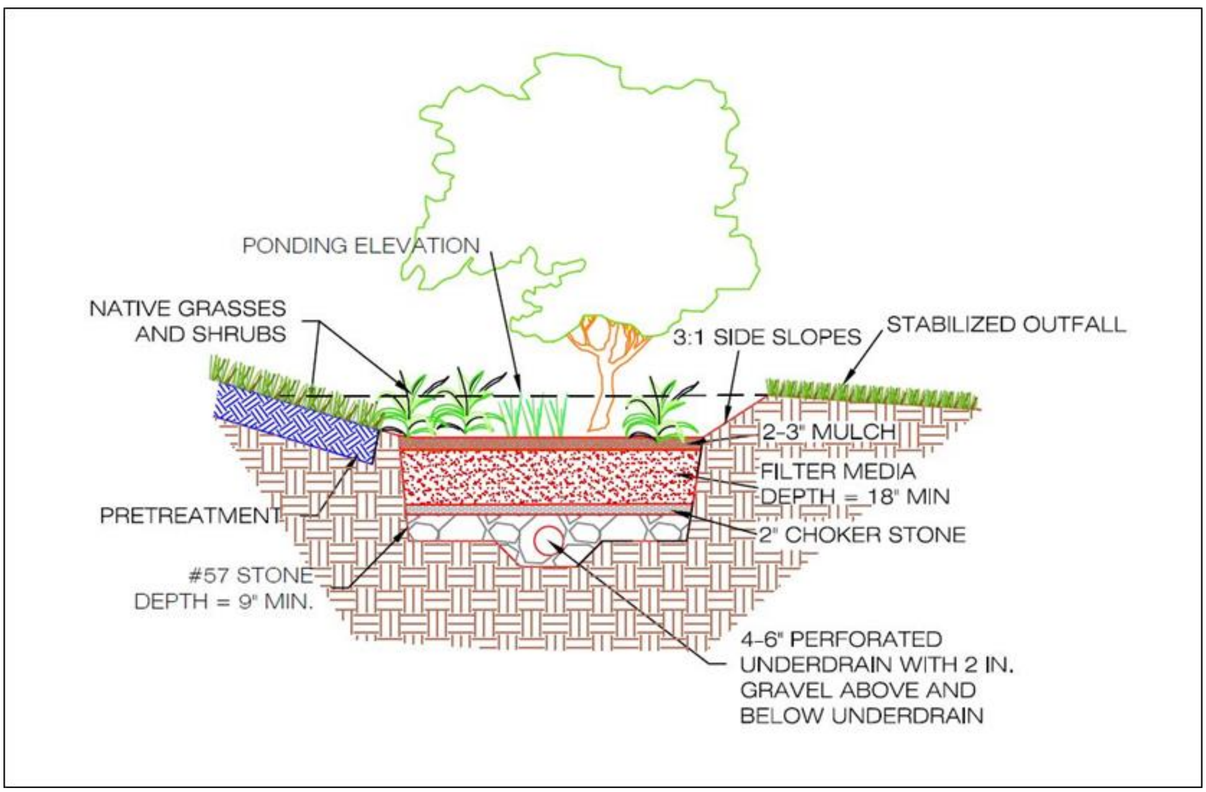


Figure 4.4. Example standard bioretention design.

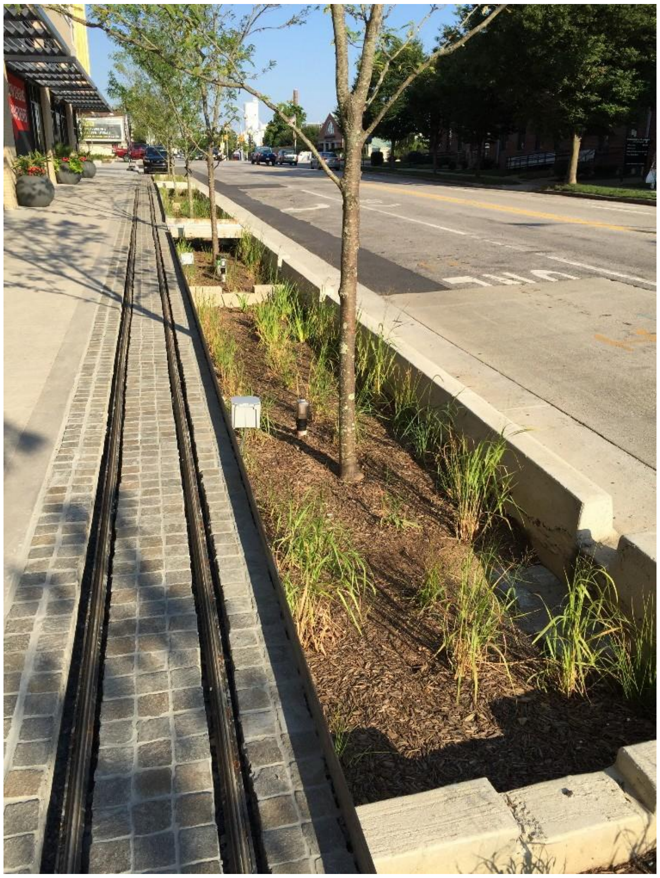


Figure 4.5. Example streetscape bioretention.

4.3.1 Bioretention Feasibility Criteria

Bioretention can be applied in most soils or topography, since runoff simply percolates through an engineered soil bed and is infiltrated or returned to the stormwater system via an underdrain. Key constraints with bioretention include the following:

Required Space

Planners and designers can assess the feasibility of using bioretention facilities based on a simple relationship between the CDA and the corresponding bioretention surface area. The surface area is recommended to be approximately 3 to 6% of CDA, depending on the imperviousness of the CDA and the desired bioretention ponding depth.

Site Topography

Bioretention can be used for sites with a variety of topographic conditions, but it is best applied when the grade of the area immediately adjacent to the bioretention practice (within approximately 15 to 20 feet) is greater than 1% and less than 5%.

Available Hydraulic Head

Bioretention is fundamentally constrained by the invert elevation of the existing conveyance system to which the practice discharges (i.e., the bottom elevation needed to tie the underdrain from the bioretention area into the storm drain system). In general, 4 to 5 feet of elevation above this invert is needed to accommodate the required ponding and filter media depths. If the practice does not include an underdrain or if an inverted or elevated underdrain design is used, less hydraulic head may be adequate.

Water Table

Bioretention must be separated from the water table to ensure that groundwater does not intersect the filter bed. Mixing can lead to possible groundwater contamination or failure of the bioretention facility. A separation distance of no less than 0.5 feet is required between the bottom of the excavated bioretention area and the seasonally high groundwater table.

Tidal Impacts

For systems with an underdrain, the underdrain should be located above the tidal mean high water elevation. For entirely infiltration-based systems, the bottom of the stone reservoir should be located above the mean high water elevation. Where this is not possible, portions of the practice below the tidal mean high water elevation cannot be included in the volume calculations. Also, salt-tolerant vegetation may be necessary in these areas.

Soils and Underdrains

Soil conditions do not typically constrain the use of bioretention, although they do determine whether an underdrain is needed. Underdrains may be required if the measured permeability of the underlying soils is less than 0.3 inches per hour. When designing a bioretention practice, designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B for Geotechnical Information Requirements for Underground BMPs. Impermeable soils will require an underdrain.

For fill soil locations, geotechnical investigations are required to determine if it is necessary to use an impermeable liner and underdrain.

Contributing Drainage Area

Bioretention cells work best with smaller CDAs, where it is easier to achieve flow distribution over the filter bed. The maximum CDA to a standard bioretention area (B-1) is 2.5 acres and can consist of up to 100% impervious cover. The CDA for smaller bioretention practices (B-2, B-3, B-4, and B-5) is a maximum of 1 acre. However, if hydraulic considerations are adequately addressed to manage the potentially large peak inflow of larger CDAs, such as off-line or low-flow diversions, or forebays, there may be case-by-case instances where the maximum CDAs can be adjusted. summarizes typical recommendations for bioretention CDAs.

Table 4.3. Maximum contributing drainage area (CDA) to bioretention.

Bioretention Type	Design Variants	Maximum CDA (acres of impervious cover)
Standard	B-1	2.5
Small-scale bioretention	B-2, B-3, B-4, and B-5	1.0

Pollutant Hotspot Land Uses

Bioretention may not be an appropriate stormwater management practice for certain pollutant-generating sites. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil- water separator or filtering device must be provided. These pretreatment facilities should be monitored and maintained frequently to avoid negative impacts to the bioretention area and subsequent water bodies.

On sites with existing contaminated soils, infiltration is not allowed. An impermeable bottom liner and an underdrain system must be employed when a bioretention area will receive untreated hotspot runoff, and the No Underdrain design configuration cannot be used.

Bioretention can still be used to treat parts of the site that are outside of the hotspot area. For instance, roof runoff can go to bioretention while vehicular maintenance areas would be treated by a more appropriate hotspot practice.

No Irrigation or Baseflow

The planned bioretention area should not receive baseflow, irrigation water, chlorinated wash-water or any other flows not related to stormwater. During the establishment period of the bioretention area, irrigation is allowed, however, to ensure plant survival. In addition, rain gardens or bioretention practices may be incorporated into the design of a Rainwater Harvesting System (See Section 4.7).

Setbacks

To avoid the risk of seepage, stormwater cannot flow from the bioretention area reservoir layer to the traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties.

Bioretention areas should be located at least:

- 10 feet from building foundations*
- 10 feet from property lines
- 150 feet from private water supply wells
- 50 feet from septic systems

*For building foundations, where the 10-foot setback is not possible, an impermeable liner may be used along the sides and bottom of the bioretention area (extending from the surface to the bottom of the practice and outward to meet the 10-foot setback) to prevent seepage or foundation damage.

Proximity to Utilities

Designers should ensure that future tree canopy growth in the bioretention area will not interfere with existing overhead utility lines. When large site development is undertaken the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the PROW. Consult with each utility company on recommended offsets, which will allow utility maintenance work with minimal disturbance to the bioretention system. Where conflicts cannot be avoided, follow these guidelines:

- Consider altering the location or sizing of the bioretention to avoid or minimize the utility conflict. Consider an alternate BMP type to avoid conflict.
- Use design features to mitigate the impacts of conflicts that may arise by allowing the bioretention and the utility to coexist. The bioretention design may need to incorporate impervious areas, through geotextiles or compaction, to protect utility crossings.
- Work with the utility to evaluate the relocation of the existing utility and install the optimum placement and sizing of the bioretention.

- If utility functionality, longevity, and vehicular access to manholes can be assured, accept the bioretention design and location with the existing utility. Incorporate into the bioretention design sufficient soil coverage over the utility or general clearances or other features such as an impermeable liner to assure all entities the conflict is limited to maintenance.

When accepting utility conflict into the bioretention location and design, it is understood the bioretention will be temporarily impacted during utility work but the utility owner will replace the bioretention or, alternatively, install a functionally comparable bioretention according to the specifications in the current version of this Manual. If the bioretention is located in the PROW, the bioretention restoration will also conform with the State of South Carolina Department of Transportation design specifications.

Minimizing External Impacts

Urban bioretention practices may be subject to higher public visibility, greater trash loads, pedestrian traffic, vandalism, and even vehicular loads. Designers should design these practices in ways that prevent, or at least minimize, such impacts. In addition, designers should clearly recognize the need to perform frequent landscaping maintenance to remove trash, check for clogging, and maintain vigorous vegetation. The urban landscape context may feature naturalized landscaping or a more formal design. When urban bioretention is used in sidewalk areas of high foot traffic, designers should not impede pedestrian movement or create a safety hazard. Designers may also install low fences, grates, or other measures to prevent damage from pedestrian short-cutting across the practices.

When bioretention will be included in public rights-of-way or spaces, design manuals and guidance developed by agencies or organizations other than Beaufort County Public Works Department may also apply (e.g., State Department of Transportation).

Economic Considerations

Bioretention areas can be particularly cost effective when they are included in areas of the site already planned for landscaping.

4.3.2 Bioretention Conveyance Criteria

There are two basic design approaches for conveying runoff into, through, and around bioretention practices:

1. Off-line: Flow is split or diverted so that only the design storm or design flow enters the bioretention area. Larger flows bypass the bioretention treatment.
2. On-line: All runoff from the CDA flows into the practice. Flows that exceed the design capacity exit the practice via an overflow structure or weir.

If runoff is delivered by a storm drain pipe or is along the main conveyance system, the bioretention area should be designed off-line so that flows do not overwhelm or damage the practice.

Off-line Bioretention

Overflows are diverted from entering the bioretention cell. Optional diversion methods include the following:

- Create an alternate flow path at the inflow point into the structure such that when the maximum ponding depth is reached, the incoming flow is diverted past the facility. In this case, the higher flows do not pass over the filter bed and through the facility, and additional flow is able to enter as the ponding water filters through the filter media. With this design configuration, an overflow structure in the bioretention area is not required.

- Utilize a low-flow diversion or flow splitter at the inlet to allow only the design storm volume (i.e., the SWRv) to enter the facility (calculations must be made to determine the peak flow from the 85th or 95th percentile storm). This may be achieved with a weir, curb opening, or orifice for the target flow, in combination with a bypass channel or pipe. Using a weir or curb opening helps minimize clogging and reduces the maintenance frequency. With this design configuration, an overflow structure in the bioretention area is required (see on-line bioretention below).

On-line Bioretention

An overflow structure must be incorporated into on-line designs to safely convey larger storms through the bioretention area (see Figure 4.6). The following criteria apply to overflow structures:

- An overflow shall be provided within the practice to pass storms greater than the design storm storage to a stabilized water course. A portion of larger events may be managed by the bioretention area so long as the maximum depth of ponding in the bioretention cell does not exceed 18 inches.
- The overflow device must convey runoff to a storm sewer, stream, or the existing stormwater conveyance infrastructure, such as curb and gutter or an existing channel.
- Common overflow systems within bioretention practices consist of an inlet structure, where the top of the structure is placed at the maximum ponding depth of the bioretention area, which is typically 6 to 18 inches above the surface of the filter bed.
- The overflow device should be scaled to the application. This may be a landscape grate or yard inlet for small practices or a commercial-type structure for larger installations.
- Sufficient depth must be provided between the top of the overflow device and the top of the bioretention area to ensure that the 25-year storm can be safely conveyed through the overflow device.
- The overflow associated with the 2- to 25-year design storms must be controlled so that velocities are non-erosive (generally less than 6 feet per second) at the outlet point, to prevent downstream erosion.

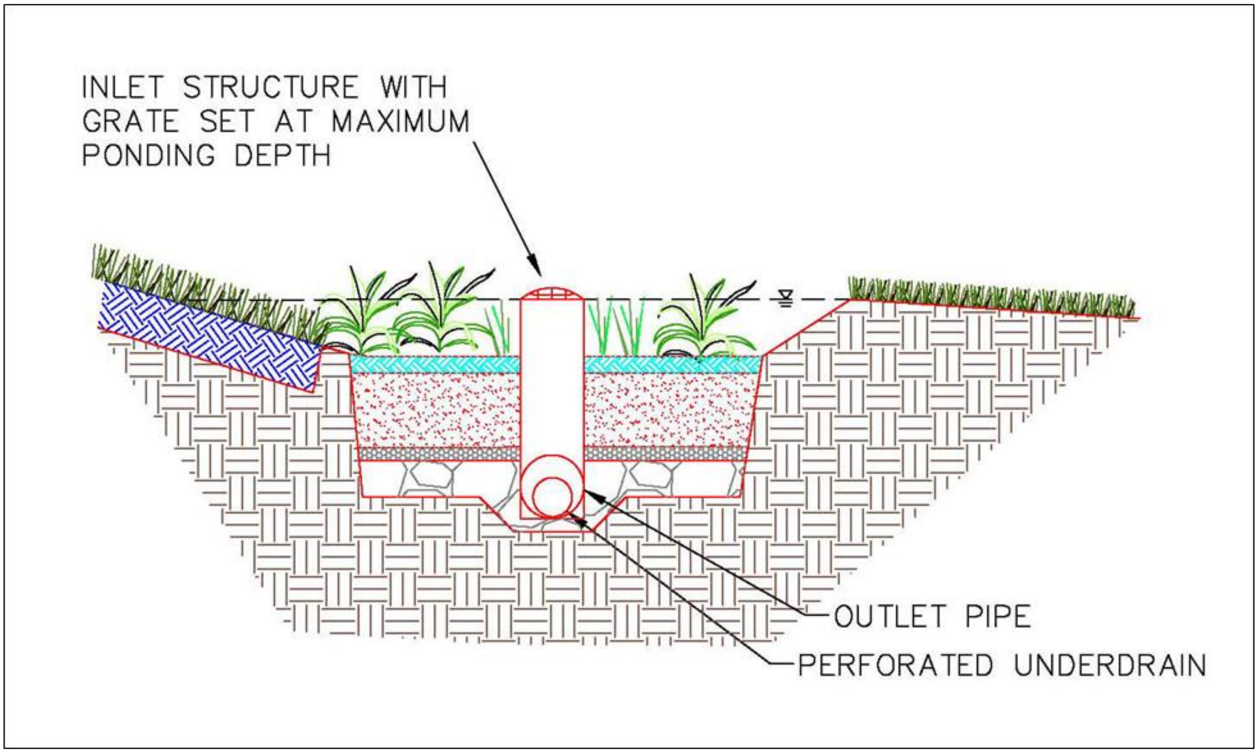


Figure 4.6. Example design of an on-line bioretention with an overflow structure.

4.3.3 Bioretention Pretreatment Criteria

Pretreatment of runoff entering bioretention areas is necessary to trap coarse sediment particles before they reach and prematurely clog the filter bed. Pretreatment measures must be designed to evenly spread runoff across the entire width of the bioretention area. Several pretreatment measures are feasible, depending on the type of the bioretention practice and whether it receives sheet flow, shallow concentrated flow, or deeper concentrated flows. The following are appropriate pretreatment options:

Standard Bioretention (B-1)

- **Pretreatment Cells** (for channel flow). Similar to a forebay, this cell is located at piped inlets or curb cuts leading to the bioretention area and consists of an energy dissipator sized for the expected rates of discharge. It has a storage volume equivalent to at least 15% of the total storage volume (inclusive) with a recommended 2:1 length-to-width ratio. The cell may be formed by a wooden or stone check dam or an earthen or rock berm. Pretreatment cells do not need underlying engineered filter media, in contrast to the main bioretention cell. However, if the volume of the pretreatment cell will be included as part of the bioretention storage volume, the pretreatment cell must de-water between storm events. It cannot have a permanent ponded volume.
- **Grass Filter Strips** (for sheet flow). Grass filter strips that are perpendicular to incoming sheet flow extend from the edge of pavement, with a slight drop at the pavement edge, to the bottom of the bioretention basin at a 5H:1V slope or flatter. Alternatively, if the bioretention basin has side slopes that are 3H:1V or flatter, a 5-foot grass filter strip can be used at a maximum 5% (20H:1V) slope.
- **Stone Diaphragms** (for sheet flow). A stone diaphragm located at the edge of the pavement should be oriented perpendicular to the flow path to pretreat lateral runoff, with a 2- to 4-inch drop from

the pavement edge to the top of the stone. The stone must be sized according to the expected rate of discharge.

- **Gravel or Stone Flow Spreaders** (for concentrated flow). The gravel flow spreader is located at curb cuts, downspouts, or other concentrated inflow points, and should have a 2- to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The gravel must extend the entire width of the opening and create a level stone weir at the bottom or treatment elevation of the basin.
- **Filter System** (see Section 4.10 Filtering Systems). If using a filter system as a pretreatment facility, the filter will not require a separate pretreatment facility.
- **Innovative or Proprietary Structure**. An approved proprietary structure with demonstrated capability of reducing sediment and hydrocarbons may be used to provide pretreatment. Refer to Section 0 Proprietary Practices for information on approved proprietary structures.

Other pretreatment options may be appropriate, but they must trap coarse sediment particles and evenly spread runoff across the entire width of the bioretention area.

Small-Scale Bioretention (B-2, B-3, B-4, and B-5)

- **Leaf Screens**. A leaf screen serves as part of the gutter system to keep the heavy loading of organic debris from accumulating in the bioretention cell.
- **Pretreatment Cells** (for channel flow). Pretreatment cells are located above ground or covered by a manhole or grate. Pretreatment cells are atypical in small-scale bioretention and are not recommended for residential rain gardens (B-5).
- **Grass Filter Strips** (for sheet flow). Grass filter strips are applied on residential lots, where the lawn area can serve as a grass filter strip adjacent to a rain garden.
- **Stone Diaphragm** (for either sheet flow or concentrated flow). The stone diaphragm at the end of a downspout or other concentrated inflow point should run perpendicular to the flow path to promote settling.

  Note: stone diaphragms are not recommended for school settings.
- **Trash Racks** (for either sheet flow or concentrated flow). Trash racks are located between the pretreatment cell and the main filter bed or across curb cuts to allow trash to collect in specific locations and make maintenance easier.

4.3.4 Bioretention Design Criteria

Design Geometry

Bioretention basins must be designed with an internal flow path geometry such that the treatment mechanisms provided by the bioretention are not bypassed or short-circuited. So that the bioretention area to have an acceptable internal geometry, the travel time from each inlet to the outlet should be maximized by locating the inlets and outlets as far apart as possible. In addition, incoming flow must be distributed as evenly as possible across the entire filter surface area.

Inlets and Energy Dissipation

Where appropriate, the inlet(s) to streetscape bioretention (B-2), engineered tree boxes (B-3), and stormwater planters (B-4) should be stabilized using No. 3 stone, splash block, river stone, or other acceptable energy dissipation measures. The following types of inlets are recommended:

- Downspouts to stone energy dissipators.
- Sheet flow over a depressed curb with a 3-inch drop.
- Curb cuts allowing runoff into the bioretention area.
- Covered drains that convey flows across sidewalks from the curb or downspouts.
- Grates or trench drains that capture runoff from a sidewalk or plaza area.
- Drop structures that appropriately dissipate water energy.

Inlets must be designed with sufficient width and slope to avoid unintended bypass. This is of particular concern for curb cuts on streetscape bioretention designs.

Ponding Depth

The recommended surface ponding depth is 6 to 12 inches. Minimum surface ponding depth is 3 inches (averaged over the surface area of the BMP). Ponding depths can be increased to a maximum of 18 inches. However, when higher ponding depths are utilized, the design must consider carefully issues such as safety, fencing requirements, aesthetics, the viability and survival of plants, and erosion and scour of side slopes. This is especially true where bioretention areas are built next to sidewalks or other areas were pedestrians or bicyclists travel. Shallower ponding depths (typically 6 to 12 inches) are recommended for streetscape bioretention (B-2), engineered tree boxes (B-3), and stormwater planters (B-4).

Side Slopes

Traditional bioretention areas (B-1) and residential rain gardens (B-5) should be constructed with side slopes of 3H:1V or flatter. In space-constrained areas, a drop curb design or a precast structure can be used to create a stable, vertical side wall. These drop curb designs should not exceed a vertical drop of more than 12 inches, unless safety precautions, such as railings, walls, grates, etc. are included.

Filter Media

The filter media of a bioretention practice consists of an engineered soil mixture that has been carefully blended to create a filter media that maintains long-term permeability while also providing enough nutrients to support plant growth. The final filter media shall consist of a well-blended mixture of medium to coarse **sand**, **loam soil**, and an **organic amendment** (compost). The sand maintains the desired permeability of the media while the limited amount of loam soil and organic amendments are considered adequate to help support initial plant growth. It is anticipated that the gradual increase of organic material through natural processes will continue to support plant growth without the need to add fertilizer, and the root structure of maturing plants and the biological activity of the media will maintain sufficient long-term permeability.

The following is the recommended composition of the three media ingredients:

- **Sand (Fine Aggregate).** Sand should consist of silica-based medium to coarse sand and be angular or round in shape. The materials shall not be derived from serpentine, shall be free of surface coatings or any other deleterious materials, and shall contain less than 0.5% mica by weight when tested with ASTM C295, Standard Guide for Petrographic Examination of Aggregates for Concrete.

ASTM C-33 concrete sand will typically meet the requirements for the sand to be used in filter media. However, some samples of ASTM C-33 sand may have too high a fraction of fine sand and silt- and clay-sized particles to meet the final filter media particle size distribution requirements. In general, coarser gradations of ASTM C-33 will better meet the filter media particle size distribution and hydraulic conductivity requirements.

Any other materials, such as manufactured sand, limestone-based sands, or crushed glass, shall meet the required particle size distribution (of final filter media mixture) and be demonstrated as adequately durable when tested by AASHTO T-103 or T-104.

- **Loam Soil.** Loam soil is generally defined as the combination of sand-sized material, fines (silt and clay), and any associated soil organic matter. Since the objective of the specification is to carefully establish the proper blend of these ingredients in the final filter media, the designer (or contractor or materials supplier) must carefully select the topsoil source material so as not exceed the amount of any one ingredient.

  Generally, a natural loamy sand, sandy loam, or loam (per the USDA Textural Triangle) A-horizon topsoil free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, viable noxious weed seed, plant propagules, brush, or other objectionable, extraneous matter or debris is suitable for the loam soil source material.

- **Organic Amendments.** Organic amendments shall consist of stable, well-composted, natural, carbon-containing organic materials such as leaf mulch, peat moss, humus, or yard waste (consistent with the material specifications found in Appendix C Soil Compost Amendment Requirements). The material shall be free of debris such as plastics, metal, concrete, stones larger than ½ inch, larger branches and roots, and wood chips over 1 inch in length or diameter.

Complete Filter Media

The complete filter media shall consist of a pug milled or mechanically blended mix of the three source materials. Mixing the filter media on site with excavation or loading equipment is not sufficient to achieve the required blending. The resulting filter media must meet the following particle size composition:

- 80%–90% sand
- 10%–20% silt and clay
- Maximum 10% clay

The particle size analysis must be conducted on the mineral fraction only or following **appropriate treatments to remove organic matter before particle size analysis. Note: The above percentages are based on weight rather than volume.**

Additionally, the final filter media mix must either meet the grain size distribution indicated in Table 4.4**, or have a saturated hydraulic conductivity of 2 to 6 inches per hour according to test procedure ASTM D2434 when compacted (at 60% to 80% optimum moisture content) to a minimum of 86% of the maximum density as determined by AASHTO T 99 (ASTM, 2006).**

Table 4.4. Filter media grain size distribution.

Sieve Type	Particle Size (mm)	Percent Passing (%)
-	8.0	100
No. 5	4.0	92–100
No. 10	2.0	72–100
No. 18	1.0	43–95
No. 35	0.5	20–65
No. 60	0.25	11–37
No. 140	0.105	10–25
No. 270	0.053	10–20
-	0.002	0–10

The filter media shall also meet the following criteria (see summary in Table 4.5):

- Organic content shall be between 3.0% and 5.0% by weight;
- pH shall be between 6.0 and 7.5;
- Cation exchange capacity (CEC) shall be a minimum of 5 meq/100g or cmol+/kg;
- Phosphorus content shall meet one of the following:
    - P-Index between 10 and 30;
    - 15 mg/kg Mehlich I Extraction;
    - 18 to 40 mg/kg Mehlich III Extraction; and
- Soluble salts shall be less than 500 ppm or less than 0.5 mmhos/cm.

Notes:

1. P-Index is an agronomic test used in North Carolina to indicate the potential for P leaching from soil. The test method has been revised to add P concentration to facilitate local lab testing. The value of the P-Index is the correlation between the CEC and P concentrations: higher CEC indicates greater adsorption sites within the media, thus increasing the ability to fix P within the soil, thereby allowing higher P concentrations without leaching. While P-Index may be a better overall representation of P, the test method may not be readily available.

Tests for organic content, CEC, soluble salts, and pH are referenced to be in accordance with Recommended Soil Testing Procedures from the Southeastern United States, Current Edition, Southern Cooperative Series Bulletin No. 419. Use the following tests from Southern Cooperative Series Bulletin No. 419:

(a) Test for soil content by loss of weight on ignition

(b) Test for soil CEC by exchangeable acidity method

(c) Test for soluble salts shall be by the 1:2 (v:v) soil:water Extract Method

(d) Test for pH by the SMP method

Table 4.5. Summary of filter media criteria for bioretention.

Filter Media Criterion	Description	Standard(s)
General Composition	Filter media must have the proper proportions of sand, loam soil, and organic amendments to promote plant growth, drain at the proper rate, and filter pollutants.	80%–90% sand; 10%–20% soil fines; maximum of 10% clay; and 3%–5% organic content Must meet final filter media grain size distribution OR have a saturated hydraulic conductivity of 2–6 inches per hour
Sand	Medium to coarse aggregate	Based on final filter media grain size distribution
Loam Soil	Loamy sand, sandy loam, or loam	USDA Textural Triangle
Organic Amendments	Stable, well-composted, natural, carbon-containing organic materials such as leaf mulch, peat moss, humus, or yard waste.	Appendix C
P-Index or Phosphorus (P) Content	Filter media with high P levels will export P through the media and potentially to downstream conveyances or receiving waters.	P-Index of 10–30 or P content = 5–15 mg/kg (Mehlich I) or 18–40 mg/kg (Mehlich III)
Cation Exchange Capacity (CEC)	The CEC is determined by the amount of soil fines and organic matter. Higher CEC will promote pollutant removal.	CEC > 5 milliequivalents per 100 grams
pH	Soil pH influences nutrient availability and microbial populations.	Between 6.0 and 7.5
Soluble Salts	Filter media with high levels of soluble salts can injure or kill plants.	Less than 500 ppm or less than 0.5 mmhos/cm.

In cases where greater removal of specific pollutants is desired, additives with documented pollutant removal benefits, such as water treatment residuals, alum, iron, or other materials, may be included in the filter media if accepted by Beaufort County Public Works Department.

Filter Media Depth

The filter media bed depth must be a minimum of 18 inches for the No Underdrain or Standard designs. The media depth must be 24 inches or greater for the IWS design **In order to receive the full credit for bacteria removal a minimum media depth of 24” is required.** The media depth must not exceed 6.0

feet. Turf, perennials, or shrubs should be used instead of trees to landscape shallower filter beds. See Table 4.7 and Table 4.8 for a list of recommended native plants.

Surface Cover

Mulch is the recommended surface cover material, but other materials may be substituted, as described below:

- **Mulch**. A 2- to 3-inch layer of mulch on the surface of the filter bed enhances plant survival, suppresses weed growth, pretreats runoff before it reaches the filter media, and prevents rapid evaporation of rainwater. Shredded hardwood bark mulch, aged for at least 6 months, is recommended/required for surface cover, as it retains a significant amount of pollutants and typically will not float away. The maximum depth of the mulch layer is 3 inches.
- **Alternative to Mulch Cover**. In some situations, designers may consider alternative surface covers, such as turf, native groundcover, erosion control matting (e.g., coir or jute matting), river stone, or pea gravel. The decision regarding the type of surface cover to use should be based on function, expected pedestrian traffic, cost, and maintenance. When alternative surface covers are used, methods to discourage pedestrian traffic should be considered. Stone or gravel are not recommended in parking lot applications, since they increase soil temperature and have low water-holding capacity.
- **Media for Turf Cover**. One adaptation suggested for use with turf cover is to design the filter media primarily as a sand filter with organic content only at the top. Compost, as specified in Appendix C Soil Compost Amendment Requirements, tilled into the top layers will provide organic content for the vegetative cover. If grass is the only vegetation, the ratio of organic matter in the filter media composition may be reduced.

Choking Layer

A 2- to 4-inch layer of choker stone (e.g., typically ASTM D448 No. 8 or No. 89 washed gravel) should be placed beneath the filter media and over the underdrain stone.

Geotextile

If the available head is limited, or the depth of the practice is a concern, geotextile fabric may be used in place of the choking layer. An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements, and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used. Geotextile fabric may be used on the sides of bioretention areas as well.

Underdrains

Many bioretention designs will require an underdrain (see Section 4.3.1 Bioretention Feasibility Criteria). The underdrain should be a 4- or 6-inch perforated schedule 40 PVC pipe, or equivalent corrugated HDPE for small bioretention BMPs, with three or four rows of 3/8-inch perforations at 6 inches on center. The underdrain must be encased in a layer of clean, double washed ASTM D448 No.57 or smaller (No. 68, 8, or 89) stone. The maximum depth of the underdrain stone layer combined with the choking layer is 12 inches, and it cannot extend beyond the surface dimensions of the bioretention filter media. The underdrain must be sized so that the bioretention BMP fully drains within 72 hours or less.

Multiple underdrains may be necessary for bioretention areas wider than 40 feet, and each underdrain is recommended to be located no more than 20 feet from the next pipe or the edge of the bioretention.

For long and narrow applications, a single underdrain running the length of the bioretention is sufficient. Each underdrain must include a cleanout pipe (minimum 4 inches in diameter).

All bioretention practices should include at least one observation well and/or cleanout pipe (minimum 4 inches in diameter). The observation wells should be tied into any of the Ts or Ys in the underdrain system and must extend upward above the surface of the bioretention area.

Internal Water Storage (IWS)
In cases where limited head is a site constraint and the bioretention must be designed to be relatively shallow (e.g., depth to groundwater, relatively flat sites, or other factors), or where increased nitrogen removal is desired, an internal water storage design that creates an infiltration sump below the underdrain can be used. The internal water storage zone may be created by an upturned elbow in the underdrain, a weir in the outlet structure, or other means that create a permanently saturated depth above the underdrain. The internal water storage zone must be kept at least 12 inches below the surface of the bioretention area. For more information on this design consult North Carolina Stormwater Design Manual Chapter C-2. (NCDEQ, 2017)

Observation Wells

All bioretention practices must include at least one observation well consisting of a well-anchored, 4- to 6-inch diameter PVC pipe (see Figure 4.7). For standard and IWS bioretention designs, the non-perforated observation wells should be tied into any of the Ts or Ys in the underdrain system and must extend upward above the ponding level. These observation wells can also double as cleanouts. Observation wells for bioretention designs without underdrains should be perforated in the gravel layer only and also must extend upward to the top of ponding.

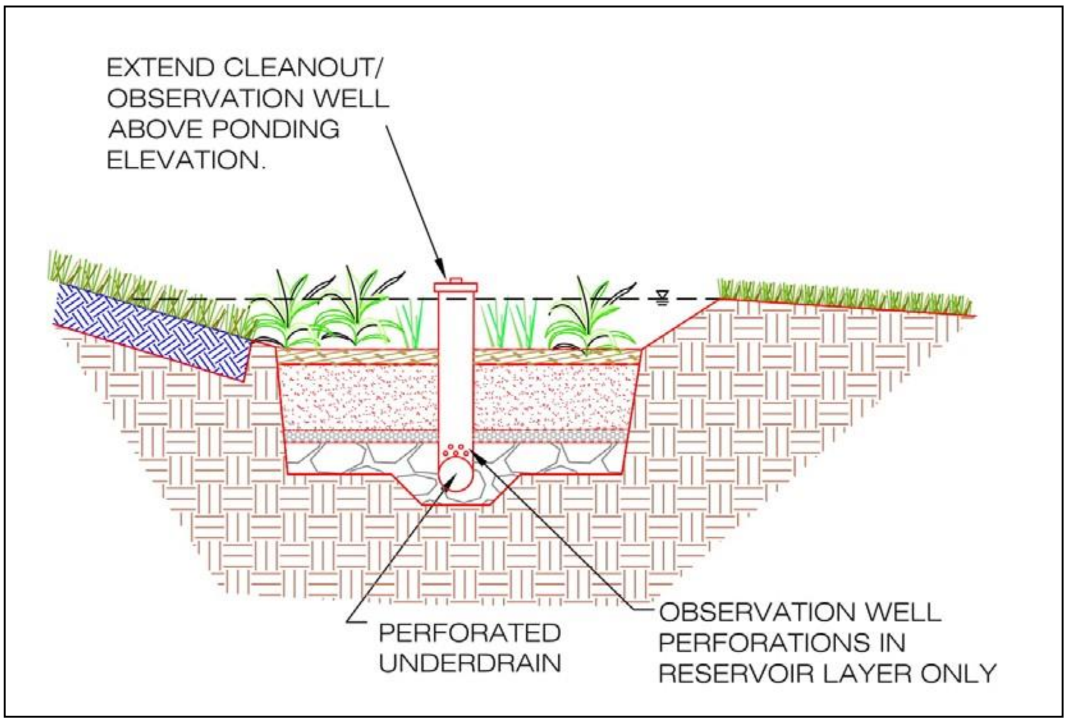


Figure 4.7. Example design of a bioretention with an observation well/cleanout device.

Underground Storage Layer (optional)

For IWS bioretention designs, an underground storage layer consisting of chambers, perforated pipe, stone, or other acceptable material can be incorporated below the filter media layer and underdrain to increase the storage for larger storm events. Unlike the underdrain stone layer, this storage layer can be extended beyond the surface dimensions of the bioretention filter media if additional storage volume is needed. The underground storage layer may be designed to provide detention for the 2- to 25-year, or 100-year storms, as needed. The depth and volume of the storage layer will depend on the target storage volumes needed to meet the applicable detention criteria. Suitable conveyance must also be provided to ensure that the storage is fully utilized without overflow of the bioretention area.

Impermeable Liner (optional)

An impermeable liner is not typically required, although it may be utilized for Standard designs in fill applications where deemed necessary by a geotechnical investigation, on sites with contaminated soils, or on the sides of the practice to protect adjacent structures from seepage. Use a PVC geomembrane liner or equivalent of an appropriate thickness (follow manufacturer’s instructions for installation). Field seams must be sealed according to the liner manufacturer’s specifications. A minimum 6-inch overlap of material is required at all seams.

Material Specifications

Recommended material specifications for bioretention areas are shown in Table 4. 6.

Table 4.6. Bioretention material specifications.

<table>
<tr><th>Material</th><th>Specification</th><th>Notes</th></tr>
<tr><td>Filter Media</td><td>▪ See Table 4.5 and Table 4.6</td><td>Minimum depth of 24 inches (18 inches for standard design).
To account for settling/compaction, it is recommended that 110% of the plan volume be utilized.</td></tr>
<tr><td>Mulch Layer</td><td>Use aged, shredded hardwood bark mulch</td><td>Lay a 2- to 3-inch layer on the surface of the filter bed.</td></tr>
<tr><td>Alternative Surface Cover</td><td>Use river stone or pea gravel, coir and jute matting, or turf cover.</td><td>Lay a 2- to 3-inch layer of to suppress weed growth.</td></tr>
<tr><td>Topsoil for Turf Cover</td><td>Loamy sand or sandy loam texture, with less than 5% clay content, pH corrected to between 6 and 7, and an organic matter content of at least 2%.</td><td>3-inch tilled into surface layer.</td></tr>
<tr><td rowspan="2">Geotextile
or
Choking Layer</td><td>An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used</td><td>Can use in place of the choking layer where the depth of the practice is limited.
Geotextile fabric may be used on the sides of bioretention areas as well.</td></tr>
<tr><td colspan="2">Lay a 2- to 4-inch layer of choker stone (e.g., typically No.8 or No.89 washed gravel) over the underdrain stone.</td></tr>
<tr><td>Underdrain Stone</td><td>1-inch diameter stone must be double-washed and clean and free of all fines (e.g., ASTM D448 No. 57 or smaller stone).</td><td>At least 2 inches above and below the underdrain.</td></tr>
<tr><td>Storage Layer (optional)</td><td colspan="2">To increase storage for larger storm events, chambers, perforated pipe, stone, or other acceptable material can be incorporated below the filter media layer.</td></tr>
<tr><td>Impermeable Liner (optional)</td><td colspan="2">Where appropriate, use a PVC Geomembrane liner or equivalent material of an appropriate thickness.</td></tr>
<tr><td>Underdrains, Cleanouts, and Observation Wells</td><td>Use 4- or 6-inch rigid schedule 40 PVC pipe, or equivalent corrugated HDPE for small bioretention BMPs, with three or four rows of 3/8-inch perforations at 6 inches on center. Multiple underdrains may be necessary for bioretention areas wider than 40 feet, and each underdrain is recommended to be located no more than 20 feet from the next pipe or the edge of the bioretention.</td><td>Lay the perforated pipe under the length of the bioretention cell and install non-perforated pipe as needed to connect with the storm drain system or to daylight in a stabilized conveyance. Install T’s and Y’s as needed, depending on the underdrain configuration. Extend cleanout pipes to the surface of ponding.</td></tr>
<tr><td>Plant Materials</td><td>See Section 4.3.5 Bioretention Landscaping Criteria</td><td>Establish plant materials as specified in the landscaping plan and the recommended plant list.</td></tr>
</table>

Signage

Bioretention units in highly urbanized areas should be stenciled or otherwise permanently marked to designate it as a structural BMP. The stencil or plaque should indicate (1) its water quality purpose, (2) that it may pond briefly after a storm, and (3) that it is not to be disturbed except for required maintenance.

Specific Design Issues for Streetscape Bioretention (B-2)

Streetscape bioretention is installed in the road right-of-way either in the sidewalk area or in the road itself. In many cases, streetscape bioretention areas can also serve as traffic-calming or street-parking control devices. The basic design adaptation is to move the raised concrete curb closer to the street or in the street, and then create inlets or curb cuts that divert street runoff into depressed vegetated areas within the right-of-way. Roadway stability can be a design issue where streetscape bioretention practices are installed. Designers should consult design standards pertaining to roadway drainage. It may be necessary to provide an impermeable liner on the road-side of the bioretention area to keep water from saturating the road's sub-base. Streetscape bioretention in the PROW should comply with State Department of Transportation requirements, where applicable.

Specific Design Issues for Engineered Tree Boxes (B-3)

Engineered tree boxes are installed in the sidewalk zone near the street where urban street trees are normally installed (see Figure 4.8). The soil volume for the tree pit is increased and used to capture and treat stormwater. Treatment is increased by using a series of connected tree planting areas together in a row. The surface of the enlarged planting area may be mulch, grates, permeable pavers, or conventional pavement. The large and shared rooting space and a reliable water supply increase the growth and survival rates in this otherwise harsh planting environment. Engineered tree boxes in the PROW should comply with State Department of Transportation requirements, where applicable.

When designing engineered tree boxes, the following criteria may apply.

- Engineered tree box designs sometimes cover portions of the filter media with pervious pavers or cantilevered sidewalks (see Figure 4.9). In these situations, the following design considerations must be incorporated:
    - The filter media must be connected beneath the surface so that stormwater and tree roots can share this space.
    - As with all bioretention areas, a minimum surface ponding depth of 3 inches, averaged over the surface area of the bioretention area, is required. For example, if the additional surface area under the pavement doubles the overall surface area, then the ponding depth will need to be at least 6 inches.
    - Sand based structural soil (SBSS) may be considered as bioretention filter media if it meets the same phosphorus content limits. However, if the SBSS is to be compacted beyond the State Standards' maximum compaction for bioretention, it shall be assigned a porosity of 0.10. The State Standards call for bioretention soil to be compacted to 84% maximum dry density while SBSS is to be compacted to 93%.
- Installing an engineered tree pit grate over filter bed media is one possible solution to prevent pedestrian traffic and trash accumulation.

- Low, wrought iron fences can help restrict pedestrian traffic across the tree pit bed and serve as a protective barrier if there is a drop-off from the pavement to the micro-bioretention cell.
- A removable grate may be used to allow the tree to grow through it.
- Each tree needs a minimum rootable soil volume as described in Section 4.14~~4.12~~ Tree Planting and Preservation.
- See Section 4.14.2 Planting Trees for further guidance and requirements on tree planting.

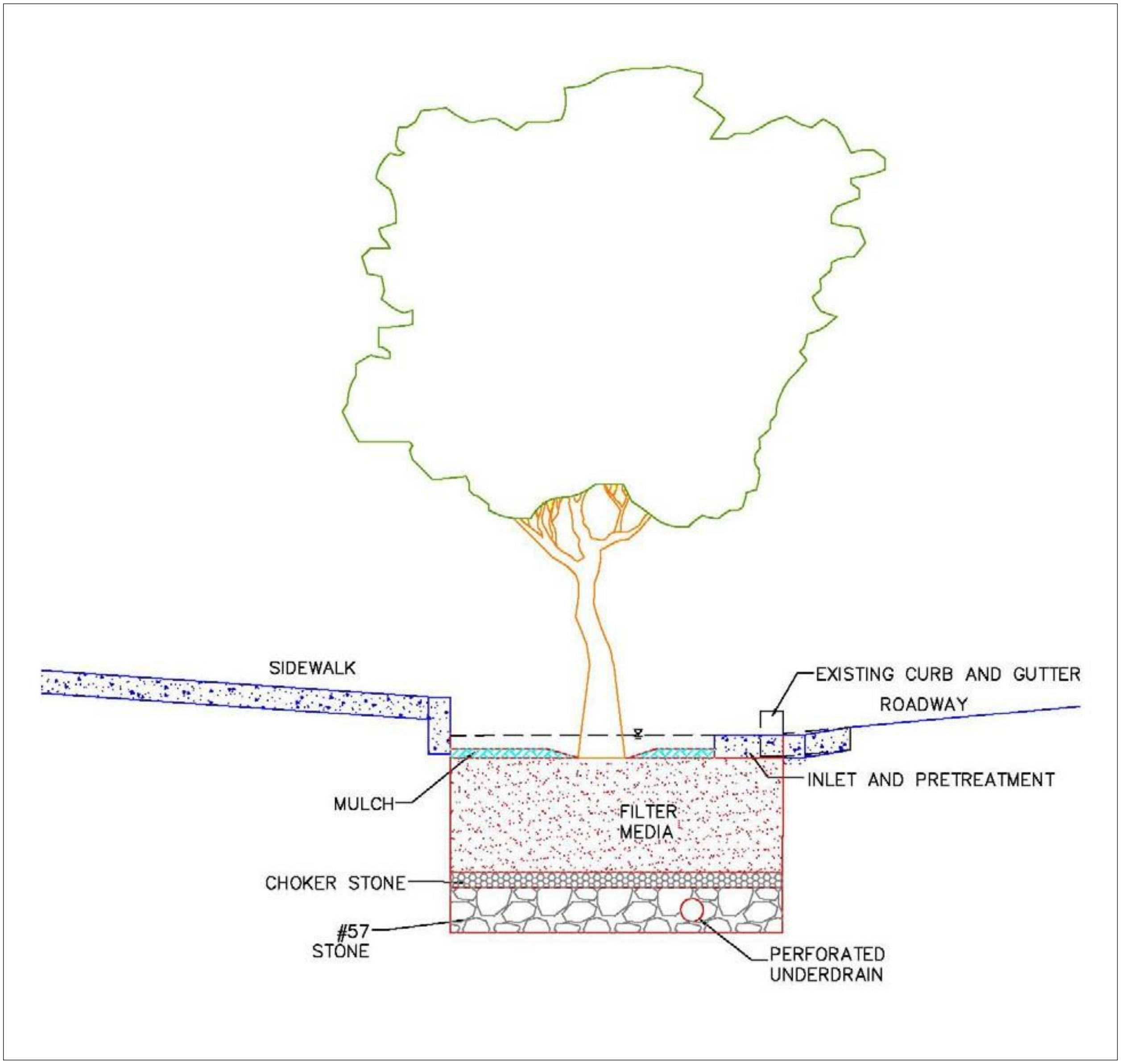


Figure 4.8. Example design of a tree box.

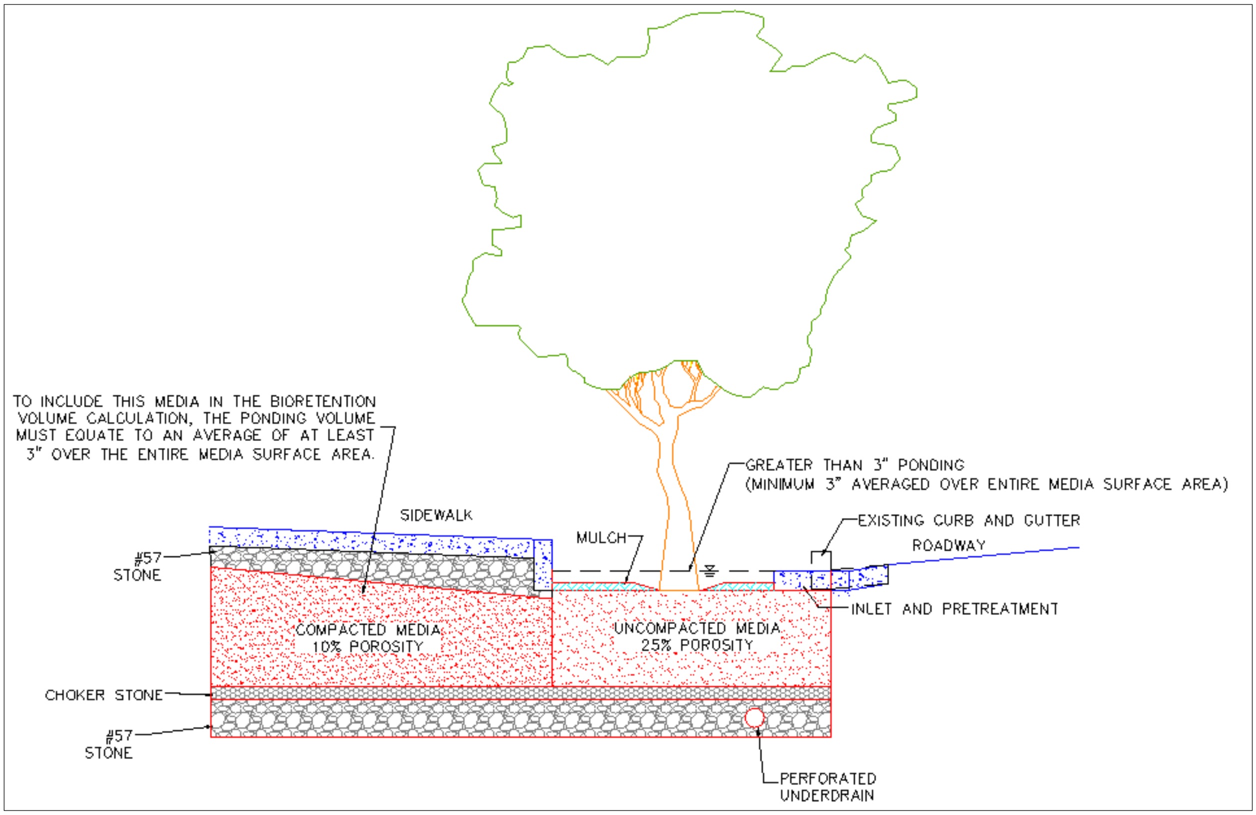


Figure 4.9. Example design of a tree box with compacted media extending below sidewalk.

Specific Design Issues for Stormwater Planters (B-4)

Stormwater planters are a useful option to disconnect and treat rooftop runoff, particularly in ultra-urban areas. Stormwater planters combine an aesthetic landscaping feature with a functional form of stormwater treatment. Stormwater planters generally receive runoff from adjacent rooftop downspouts and are landscaped with plants that tolerate periods of both drought and inundation. The two basic design variations for stormwater planters are the infiltration planter and the filter planter. A filter planter is illustrated in Figure 4.10.

An infiltration planter filters rooftop runoff through soil in the planter followed by infiltration into soils below the planter. Infiltration planters should be placed at least 10 feet away from a building to prevent possible flooding or basement seepage damage.

A filter planter does not allow for infiltration and is constructed with a watertight concrete shell or an impermeable liner on the bottom to prevent seepage. Since a filter planter is self-contained and does not infiltrate into the ground, it can be installed right next to a building. Runoff is captured and temporarily ponded above the planter bed. Overflow pipes are installed to discharge runoff when maximum ponding depths are exceeded, to avoid water spilling over the side of the planter. In addition, an underdrain is used to carry runoff to the storm sewer system.

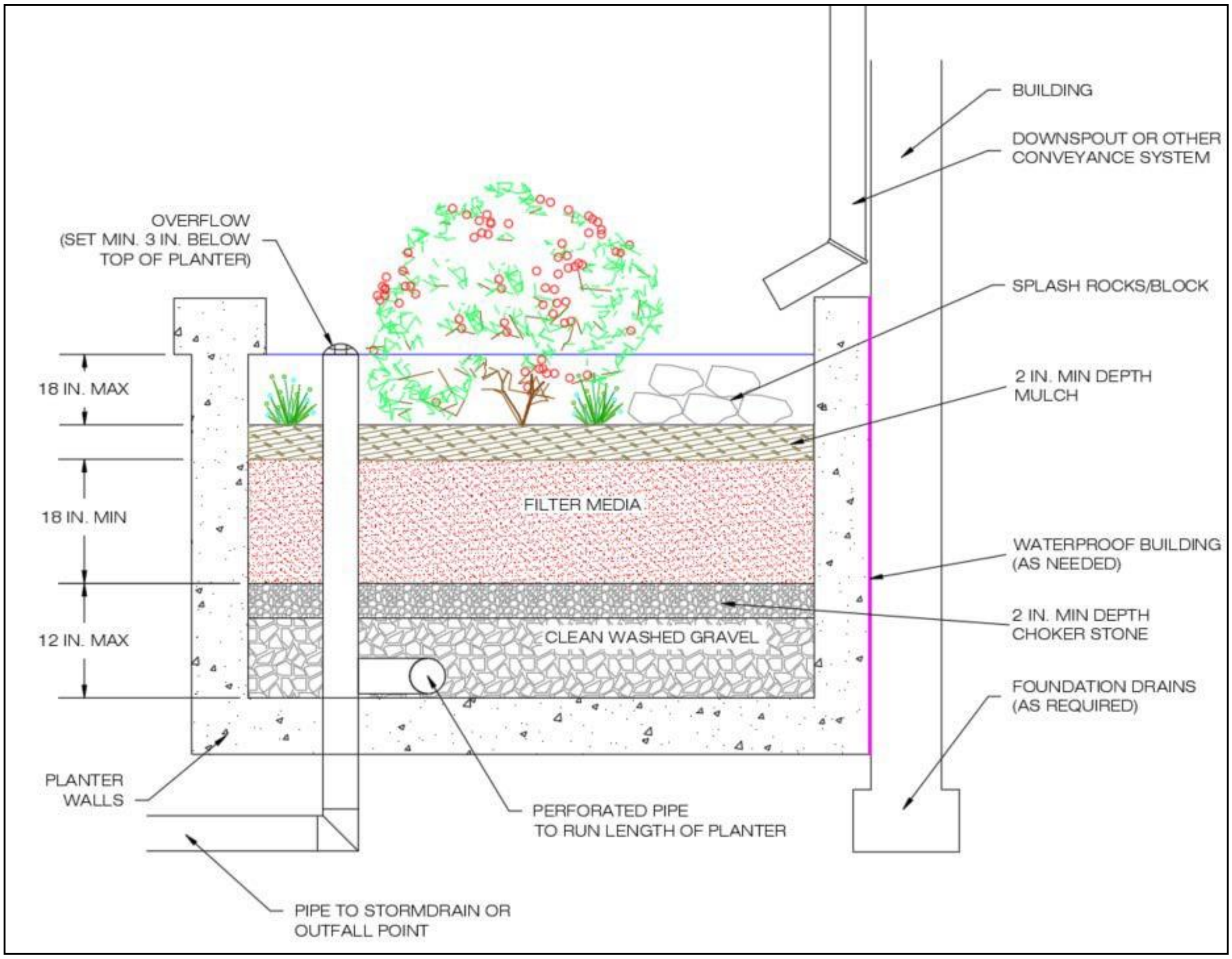


Figure 4.10. Example design of a stormwater planter (B-4).

Plant materials must be capable of withstanding moist and seasonally dry conditions. The planter can be constructed of stone, concrete, brick, wood, or other durable material. If treated wood is used, care should be taken so that trace metals and creosote do not leach out of the planter.

Specific Design Issues for Residential Rain Gardens (B-5)

For some residential applications, front, side, and/or rear yard bioretention may be an attractive option. This form of bioretention captures roof, lawn, and driveway runoff from low- to medium- density residential lots in a depressed area (i.e., 6 to 12 inches) between the home and the primary stormwater conveyance system (i.e., roadside ditch or pipe system).

BMP Sizing

Bioretention is typically sized to capture the SWRv or larger design storm volumes in the surface ponding area, filter media, and gravel reservoir layers of the BMP.

Total storage volume of the BMP is calculated using Equation 4.1.

Equation 4.1. Bioretention storage volume.

$$S_v = SA_{bottom} \times \left[(d_{media} \times \eta_{media}) + (d_{gravel} \times \eta_{gravel})\right] + (SA_{average} \times d_{ponding})$$

Where:

Sv =	Total storage volume of bioretention (cubic feet)
SA_{bottom} =	Bottom surface area of bioretention (square feet)
d_{media} =	Depth of filter media, including mulch later (ft)
η_{media} =	Effective porosity of the filter media (typically 0.25)
d_{gravel} =	Depth of the underdrain and underground storage gravel layer, including choker stone (ft)
η_{gravel} =	Effective porosity of the gravel layer (typically 0.4)
$SA_{average}$ =	Average surface area of the bioretention (square feet), where SA_{top} is the surface area of the top of the bioretention $SA_{average} = \frac{SA_{bottom} + SA_{top}}{2}$
$d_{ponding}$ =	Maximum ponding depth of bioretention (ft)

Equation 4.1 can be modified if the storage depths of the filter media, gravel layer, or ponded water vary in the actual design or with the addition of any surface or subsurface storage components (e.g., additional area of surface ponding, subsurface storage chambers, etc.). The maximum depth of ponding in the bioretention must not exceed 18 inches. If storage practices will be provided off-line or in series with the bioretention area, the storage practices should be sized using the guidance in Section 4.11, and section 4.9 Storage Practices.

Note: In order to increase the storage volume of a bioretention area, the ponding surface area may be increased beyond the filter media surface area. However, the top surface area of the practice (i.e., at the top of the ponding elevation) may not be more than twice the size of the surface area of the filter media (SA_{bottom}).

For bioretention designs without an underdrain, the storage volume must infiltrate within 72 hours, as in Equation 4.2.

Equation 4.2. Bioretention infiltration rate check equation.

$$Sv_{infiltrate} = \frac{SA_{bottom}(K_{sat} \times t_d)}{12}$$

$Sv_{infiltrate}$ =	Storage volume that will infiltration within 72 hours (cubic feet)
SA_{bottom} =	Bottom surface area of bioretention (square feet)
K_{sat} =	Field-verified saturated hydraulic conductivity for the native soils (ft/day)
t_d =	Drawdown time (3 days)

If $Sv_{infiltrate}$ is greater than or equal to Sv, then the entire Sv will infiltrate within 72 hours. If it is not, the storage volume of the bioretention area should be reduced accordingly.

Bioretention can be designed to address, in whole or in part, the detention storage needed to comply with channel protection and/or flood control requirements. The Sv can be counted as part of the 2- to 25-year runoff volumes to satisfy stormwater quantity control requirements.

4.3.5 Bioretention Landscaping Criteria

Landscaping is critical to the performance and function of bioretention areas. Therefore, a landscaping plan shall be provided for bioretention areas.

Minimum plan elements include the proposed bioretention template to be used, delineation of planting areas, and the planting plan including the following:

- Common and botanical names of the plants used
- Size of planted materials
- Mature size of the plants
- Light requirements
- Maintenance requirements
- Source of planting stock
- Any other specifications
- Planting sequence

It is recommended that the planting plan be prepared by a qualified landscape architect professional (e.g., licensed professional landscape architect, certified horticulturalist) to tailor the planting plan to the site-specific conditions.

Native plant species are preferred over non-native species, but some ornamental species may be used for landscaping effect if they are not aggressive or invasive. Some popular native species that work well in bioretention areas and are commercially available can be found in Table 4.7 and Table 4.8.

The degree of landscape maintenance that can be provided will determine some of the planting choices for urban bioretention areas. Plant selection differs if the area will be frequently mowed, pruned, and weeded, in contrast to a site that will receive minimum annual maintenance. In areas where less maintenance will be provided and where trash accumulation in shrubbery or herbaceous plants is a concern, consider a “turf and trees” landscaping model where the turf is mowed along with other turf areas on the site. Spaces for herbaceous flowering plants can be included.

Table 4.7. Bioretention-appropriate plants: perennial and grass

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Aletris farinosa	White Colicroot	FAC	Moist soil	None	
Andropogon gerardii	Big Bluestem	FAC	No	Moderate	
Aquilegia canadensis	Wild Columbine	FACU	No	None	
Asclepias incarnata	Swamp Milkweed	OBL	Saturated	None	
Asclepias lanceolata	Red Milkweed	OBL	Wet soils	Moderate / brackish	
Aster novae-angliae	New England Aster	FACW	Moist soils, yes	Yes	
Athyrium filix-femina	Lady Fern	FAC	Moist to wet soils	None	
Canna glauca	Water Canna	OBL	Moist to wet soils	None	
Canna flaccida	Golden Canna	OBL	Moist to wet soils	None	
Carex stricta	Tussock Sedge	OBL	Saturated, 0-6”	None	
Chasmanthium latifolium	River Oats	FAC	Moist soils	None	
Chelone glabra	White Turtlehead	OBL	Moist to wet soils		
Conoclinium coelestinum	Blue Mistflower	FAC	Moist to Wet soils		
Crinum americanum	Southern Swamp Lily	OBL	Saturated		
Dulichium arundinaceum	Threeway Sedge	OBL	Saturated, shallow	None	
Echinodorus cordifolius	Creeping Burhead	OBL	Saturated, shallow		
Equisetum hyemale	Scouring Rush	FACW	Saturated, shallow		
Eupatorium fistulosum	Joe Pye Weed	FACW	Moist to Wet Soils		
Geranium maculatum	Spotted Geranium	FACU	Moist Soils		

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Helianthus angustifolius	Swamp Sunflower, Narrowleaf Sunflower	FACW	Wet Soils		
Hibiscus coccineus	Scarlet Swamp Hibiscus	OBL	Saturated, shallow		
Hibiscus moscheutos	Rose Mallow, Hibiscus	OBL	Saturated, shallow	Low	
Hymenocallis caroliniana	Spider Lily	OBL	Saturated, shallow	None	
Iris versicolor	Virginia Iris	OBL	Shallow	None	
Juncus effuses	Common Rush	OBL	Shallow <6”	Low	
Liatris spicata	Gayfeather, Blazing Star	FAC	Moist Soils	Low	
Lobelia cardinalis	Cardinal Flower	FACW	Moist to Wet Soils	None	
Lobelia siphilitica	Blue Lobelia	OBL	Moist to wet soils		
Lysimachia ciliata	Fringed Loosestrife	FACW	Moist to wet soils, seasonal flooding		
Mimulus ringens	Allegheny Monkeyflower	OBL	Saturated, shallow		
Onoclea sensibilis	Sensitive Fern	FACW	Moist to wet soils		
Osmunda cinnamomea	Cinnamon Fern	FACW	Moist to wet soils	Low	
Osmunda spectabilis	Royal Fern	OBL	Moist to wet soils	None	
Orontium aquaticum	Golden Club	OBL	Up to 10”		
Panicum virgatum	Switch Grass	FAC	Moist soil	Moderate	
Peltandra virginica	Green Arrow Arum	OBL	Shallow < 1’	Low (< 2 ppt)	
Pontederia cordata	Pickerelweed	OBL	Shallow < 1’	Low (< 3 ppt)	
Physostegia virginiana	Obedient Plant	FACW	Moist soil		
Polygonatum biflorum	Great Solomon’s Seal	FACU	Moist soil		

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Rhynchospora colorata	Starrush Whitetop	FACW	Saturated		
Rudbeckia laciniata	Cutleaf Coneflower	FACW	Moist soil	None	
Sagittaria latifolia	Common Arrowhead, Duck Potato	OBL	Up to 2.0’	None	
Saururus cernuus	Lizard’s Tail	OBL	Shallow < 4”	None	
Schizachyrium scoparium	Little Bluestem	FACU	Moist soil	None	
Schoenoplectus tabernaemontani	Softstem Bulrush	OBL	Wet soil to standing water	Fresh or Brackish	
Solidago sempervirens	Seaside Goldenrod	FACW	Yes	High	
Sorghastrum nutans	Indiangrass	FACU	Moist soil	Moderate	
Spartina alterniflora	Saltmarsh Cordgrass	OBL	Yes	High	
Spartina bakeri	Sand cordgrass	FACW	Moist to wet soils	Fresh - Saline	
Spartina patens	Saltmeadow Cordgrass	FACW	Wet soils	High	
Thalia dealbata	Powdery Alligator-flag	OBL	up to 1.5’	Yes	
Tradescantia virginiana	Virginia Spiderwort	FAC	Moist soils	None	
Vernonia noveboracensis	Ironweed	FACW	Moist soils	None	

1. Wetland Indicator Notes:

FAC = Facultative, equally likely to occur in wetlands or non-wetlands (estimated probability 34%–66%).

FACU = Facultative Upland, usually occurs in non-wetlands (estimated probability 67%–99%), but occasionally found on wetlands (estimated probability 1%–33%).

FACW = FACW Facultative Wetland, usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in non-wetlands.

OBL = Obligate Wetland, occurs almost always (estimated probability 99%) under natural conditions in wetlands

Table 4.8. Bioretention-appropriate plants: shrubs and bushes

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Baccharis halimifolia	Groundsel Tree, Salt Myrtle	FAC	Wet soils	High	
Callicarpa americana	Beautyberry	FACU	Moist soils	None	
Cephalanthus occidentalis	Button Bush	OBL	Up to 3 ft	Low	
Clethra alnifolia	Summersweet Sweet Pepperbush	FACW	Moist to wet soils	None	
Cyrilla racemiflora	Swamp Titi	FACW	Moist to wet soils	Low	
Hamamelis virginiana	Witch Hazel	FACU	Moist to wet soils	None	
Hypericum prolificum	Shrubby St. John's Wort	FAC	Moist soils, flood tolerant	None	
Ilex glabra	Inkberry	FACW	Wet soils, flood tolerant	Moderate	
Ilex verticillata	Winterberry Holly	FACW	Moist to wet soils	None	
Ilex vomitoria	Yaupon Holly	FAC	Moist soils	Moderate	
Itea virginica	Virginia Sweetspire	FACW	Moist to wet soils	None	
Kosteletzkya virginica	Seashore Mallow	OBL	Moist to wet soils	Moderate	
Lindera benzoin	Spicebush	FACW	Seasonal inundation	None	
Myrica cerifera	Wax Myrtle	FAC	Moist to wet soils	Moderate	
Photinia pyrifolia	Red Chokeberry	FACW	Moist soils	Low	
Rhododendron canescens	Dwarf Azalea	FACW	Moist soils	None	
Rhododendron viscosum	Swamp Azalea	OBL	Wet soil	None	
Rosa carolina	Carolina Rose	FACU	Moist to wet soils	Moderate	
Sabal minor	Dwarf Palmetto	FACW	Moist to wet soils	None	
Sambucus canadensis	Elderberry	FACW	Moist to wet soils	None	

Scientific Name	Common Name	Wetland Indicator [1]	Inundation Tolerance	Salt Tolerance	Notes
Serenoa repens	Saw Palmetto	FACU	Occasionally wet	None	
Vaccinium corymbosum	Highbush Blueberry	FACW	Wet soil	High	
Viburnum dentatum	Arrowwood	FAC	Moist to wet	None	

1. Wetland Indicator Notes:
FAC = Facultative, equally likely to occur in wetlands or non-wetlands (estimated probability 34%–66%).
FACU = Facultative Upland, usually occurs in non-wetlands (estimated probability 67%–99%), but occasionally found on wetlands (estimated probability 1%–33%).
FACW = FACW Facultative Wetland, usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in non-wetlands.
OBL = Obligate Wetland, occurs almost always (estimated probability 99%) under natural conditions in wetlands.

Planting recommendations for bioretention facilities are as follows:

- The primary objective of the planting plan is to cover as much of the surface areas of the filter bed as quickly as possible. Herbaceous or ground cover layers are as or more important than more widely spaced trees and shrubs.
- Native plant species should be specified over non-native species.
- Plants should be selected based on a specified zone of hydric tolerance and must be capable of surviving both wet and dry conditions (“Wet footed” species should be planted near the center, whereas upland species do better planted near the edge).
- Woody vegetation should not be located at points of inflow; trees should not be planted directly above underdrains but should be located closer to the perimeter.
- Shrubs and herbaceous vegetation should generally be planted in clusters and at higher densities (i.e., 5 feet on-center and 1 to 1.5 feet on-center, respectively).
- If trees are part of the planting plan, a tree density of approximately one tree per 250 square feet (i.e., 15 feet on-center) is recommended.
- Designers should also remember that planting holes for trees must be at least 3 feet deep to provide enough soil volume for the root structure of mature trees. This applies even if the remaining filter media layer is shallower than 3 feet.
- Tree species should be those that are known to survive well in the compacted soils and the polluted air and water of an urban landscape.
- If trees are used, plant shade-tolerant ground covers within the drip line.

4.3.6 Bioretention Construction Sequence

Soil Erosion and Sediment Controls

The following soil erosion and sediment control guidelines must be followed during construction:

- All bioretention areas must be fully protected by silt fence or construction fencing.
- Bioretention areas intended to infiltrate runoff must remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment and loss of design infiltration rate.
  - Where it is infeasible keep the proposed bioretention areas outside of the limits of disturbance, there are several possible remedies for the impacted area. If excavation in the proposed bioretention area can be restricted, then the remediation can be achieved with deep tilling practices. This is only possible if in situ soils are not disturbed any deeper than 2 feet above the final design elevation of the bottom of the bioretention. In this case, when heavy equipment activity has ceased, the area is excavated to grade, and the impacted area must be tilled to a depth of 12 inches below the bottom of the bioretention.
  - Alternatively, if it is infeasible to keep the proposed bioretention areas outside of the limits of disturbance, and excavation of the area cannot be restricted, then infiltration tests will be required prior to installation of the bioretention to ensure that the design infiltration rate is still present. If tests reveal the loss of design infiltration rates, then deep tilling practices may be used in an effort to restore those rates. In this case further testing must be done to establish design rates exist before the bioretention area can be installed.
  - Finally, if it is infeasible to keep the proposed bioretention areas outside of the limits of disturbance, excavation of the area cannot be restricted, and infiltration tests reveal design rates cannot be restored, then a resubmission of the SWMP will be required.
- Bioretention areas must be clearly marked on all construction documents and grading plans.
- Large bioretention applications may be used as small sediment traps or basins during construction. However, these must be accompanied by notes and graphic details on the soil erosion and sediment control plan specifying that:

  (1) the maximum excavation depth of the trap or basin at the construction stage must be at least 1 foot higher than the post-construction (final) invert (bottom of the facility), and
  (2) the facility must contain an underdrain.

The plan must also show the proper procedures for converting the temporary sediment control practice to a permanent bioretention BMP, including dewatering, cleanout, and stabilization.

Bioretention Installation

The following is a typical construction sequence to properly install a bioretention basin. These steps may be modified to reflect different bioretention applications or expected site conditions:

1. Stabilize Contributing Drainage Area

Construction of the bioretention area may only begin after the entire CDA has been stabilized with vegetation. It may be necessary to block certain curb or other inlets while the bioretention area is being constructed. The proposed site should be checked for existing utilities prior to any excavation.

2. Preconstruction Meeting
The designer, the installer, and Beaufort County Public Works Department inspector may have a preconstruction meeting, checking the boundaries of the CDA and the actual inlet elevations to ensure they conform to original design. Since other contractors may be responsible for constructing portions of the site, it is quite common to find subtle differences in site grading, drainage and paving elevations that can produce hydraulically important differences for the proposed bioretention area. The designer should clearly communicate, in writing, any project changes determined during the preconstruction meeting to the installer and the inspector. Material certifications for aggregate, filter media, and any geotextiles should be submitted for approval to the inspector at the preconstruction meeting.

3. Install Soil Erosion and Sediment Control Measures to Protect the Bioretention
Temporary soil erosion and sediment controls (e.g., diversion dikes, reinforced silt fences) are needed during construction of the bioretention area to divert stormwater away from the bioretention area until it is completed. Special protection measures, such as erosion control fabrics, may be needed to protect vulnerable side slopes from erosion during the construction process.

4. Install Pretreatment Cells
Any pretreatment cells should be excavated first and then sealed to trap sediment.

5. Avoid Impact of Heavy Installation Equipment
Excavators or backhoes should work from the sides to excavate the bioretention area to its appropriate design depth and dimensions. Excavating equipment should have scoops with adequate reach so they do not have to sit inside the footprint of the bioretention area. Contractors should use a cell construction approach in larger bioretention basins, whereby the basin is split into 500- to 1,000-square foot temporary cells with a 10- to 15-foot earth bridge in between, so that cells can be excavated from the side.

6. Promote Infiltration Rate
It may be necessary to rip the bottom soils to a depth of 6 to 12 inches to promote greater infiltration.

7. Order of Materials
If using a geotextile fabric, place the fabric on the sides of the bioretention area with a 6-inch overlap on the sides. If a stone storage layer will be used, place the appropriate depth of No. 57 stone (clean, double washed) on the bottom, install the perforated underdrain pipe, pack No. 57 stone at least 2 inches above the underdrain pipe, and add the choking layer or appropriate geotextile layer as a filter between the underdrain and the filter media layer. If no stone storage layer is used, start with at least 2 inches of No. 57 stone on the bottom and proceed with the layering as described above.

8. Layered Installation of Media
Apply the media in 12-inch lifts until the desired top elevation of the bioretention area is achieved. Wait a few days to check for settlement and add additional media, as needed, to achieve the design elevation.

Note: The batch receipt confirming the source of the filter media should be submitted to the Beaufort County Public Works Department inspector.

9. Prepare Filter Media for Plants

Prepare planting holes for any trees and shrubs, install the vegetation, and water accordingly. Install any temporary irrigation.

10. Planting

Install the plant materials as shown in the landscaping plan, and water them as needed.

11. Secure Surface Area

Place the surface cover (i.e., mulch, river stone, or turf) in both cells, depending on the design. If coir or jute matting will be used in lieu of mulch, the matting will need to be installed prior to planting (Step 10), and holes or slits will have to be cut in the matting to install the plants.

12. Inflows

If curb cuts or inlets are blocked during bioretention installation, unblock these after the CDA and side slopes have good vegetative cover. It is recommended that unblocking curb cuts and inlets take place after two to three storm events if the CDA includes newly installed asphalt, since new asphalt tends to produce a lot of fines and grit during the first several storms.

13. Final Inspection

Conduct the final construction inspection using a qualified professional, providing Beaufort County Public Works Department with an as-built, then log the GPS coordinates for each bioretention facility, and submit them for entry into the maintenance tracking database.

14. Construction Supervision

Supervision during construction is recommended to ensure that the bioretention area is built in accordance with the approved design and this specification. Qualified individuals should use detailed inspection checklists that include sign-offs at critical stages of construction, to ensure that the contractor's interpretation of the plan is consistent with the designer's intentions.

Construction phase inspection checklist can be found in Appendix E Construction Inspection Checklists.

4.3.7 Bioretention Maintenance Criteria

When bioretention practices are installed, it is the owner's responsibility to ensure they, or those managing the practice:

(1) be educated about their routine maintenance needs,
(2) understand the long-term maintenance plan, and
(3) be subject to a maintenance covenant or agreement, as described below.

Maintenance of bioretention areas should be integrated into routine landscape maintenance tasks. If landscaping contractors will be expected to perform maintenance, their contracts should contain specifics on unique bioretention landscaping needs, such as maintaining elevation differences needed for ponding, proper mulching, sediment and trash removal, and limited use of fertilizers and pesticides.

Maintenance tasks and frequency will vary depending on the size and location of the bioretention, the landscaping template chosen, and the type of surface cover in the practice. A generalized summary of common maintenance tasks and their frequency is provided in Table 4.9.

Table 4.9. Typical maintenance tasks for bioretention practices.

Frequency	Maintenance Tasks
Upon establishment	▪ For the first 6 months following construction, the practice and CDA should be inspected at least twice after storm events that exceed 0.5 inch of rainfall. Conduct any needed repairs or stabilization. ▪ Inspectors should look for bare or eroding areas in the CDA or around the bioretention area and make sure they are immediately stabilized with grass cover. ▪ One-time, spot fertilization may be needed for initial plantings. ▪ Watering is needed once a week during the first 2 months, and then as needed during first growing season (April through October), depending on rainfall. ▪ Remove and replace dead plants. Up to 10% of the plant stock may die off in the first year, so construction contracts should include a care and replacement warranty to ensure that vegetation is properly established and survives during the first growing season following construction.
At least 4 times per year	▪ Mow grass filter strips and bioretention with turf cover ▪ Check curb cuts and inlets for accumulated grit, leaves, and debris that may block inflow
Twice during growing season	▪ Spot weed, remove trash, and rake the mulch
Annually	▪ Conduct a maintenance inspection ▪ Supplement mulch in devoid areas to maintain a 3-inch layer ▪ Prune trees and shrubs ▪ Remove sediment in pretreatment cells and inflow points
Once every 2–3 years	▪ Remove sediment in pretreatment cells and inflow points ▪ Remove and replace the mulch layer
As needed	▪ Add reinforcement planting to maintain desired vegetation density ▪ Remove invasive plants using recommended control methods ▪ Remove any dead or diseased plants ▪ Stabilize the CDA to prevent erosion

Standing water is the most common problem outside of routine maintenance. If water remains on the surface for more than 72 hours after a storm, adjustments to the grading may be needed or underdrain repairs may be needed. The surface of the filter bed should also be checked for accumulated sediment or a fine crust that builds up after the first several storm events. There are several methods that can be used to rehabilitate the filter. These are listed below, starting with the simplest approach and ranging to more involved procedures (i.e., if the simpler actions do not solve the problem):

- Open the underdrain observation well or cleanout and pour in water to verify that the underdrains are functioning and not clogged or otherwise in need of repair. The purpose of this check is to see if there is standing water all the way down through the soil. If there is standing water on top, but not in the underdrain, then there is a clogged soil layer. If the underdrain and stand pipe indicates standing water, then the underdrain must be clogged and will need to be cleaned out.
- Remove accumulated sediment and till 2 to 3 inches of sand into the upper 6 to 12 inches of soil.

- Install sand wicks from 3 inches below the surface to the underdrain layer. This reduces the average concentration of fines in the media bed and promotes quicker drawdown times. Sand wicks can be installed by excavating or auguring (i.e., using a tree auger or similar tool) down to the top of the underdrain layer to create vertical columns that are then filled with a clean open-graded coarse sand material (e.g., ASTM C-33 concrete sand or similar approved sand mix for bioretention media). A sufficient number of wick drains of sufficient dimension should be installed to meet the design dewatering time for the facility.
- Remove and replace some or all of the filter media.

Maintenance Inspections

It is recommended that a qualified professional: state law states anyone that can stamp a set of plans (surveyors, engineers, landscape architects) conduct a spring maintenance inspection and cleanup at each bioretention area. Maintenance inspections should include information about the inlets, the actual bioretention facility (sediment buildup, outlet conditions, etc.), and the state of vegetation (water stressed, dead, etc.) and are intended to highlight any issues that need or may need attention to maintain stormwater management functionality. Reporting to the Beaufort County Public Works Department may be required to be submitted on an annual basis.

Maintenance inspection checklists for bioretention areas and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.3.8 Bioretention Stormwater Compliance Calculations

Bioretention performance varies depending on the design configuration of the system.

No Underdrain

Bioretention designs with no underdrain are credited with100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (Table 4.10).

Table 4.10. Retention and pollutant removal for bioretention practices without underdrains.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

Internal Water Storage (IWS)

Bioretention designs with IWS are credited with75% retention for the storage volume (Sv) provided by the practice as well as 85% TSS, 85% TN, and 80% bacteria removal (Table 4.11).

Table 4.11. Retention and pollutant removal for bioretention practices with IWS design.

Retention	= 75%
TSS Removal	= 85%
TN Removal	= 85%
Bacteria Removal	= 80%

Standard

Standard bioretention designs are credited with 60% retention for the storage volume (Sv) provided as well as 85% TSS, 75% TN, and 80% bacteria removal. (Table 4.12).

Table 4.12. Retention and pollutant removal for standard bioretention practices.

Retention	= 60%
TSS Removal	= 85%
TN Removal	= 75%
Bacteria Removal	= 80%

The practice must be sized using the guidance detailed in Section 4.1.4 Bioretention Design Criteria. Note: Additional retention can be achieved if trees are utilized as part of a bioretention area (see Section 4.14 Tree Planting and Preservation).

Bioretention also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) from the total runoff volume for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.4 Permeable Pavement Systems

<table>
<tr><th colspan="6">Permeable Pavement Systems</th></tr>
<tr><td colspan="6">Definition: Paving systems that capture and temporarily store the SWRv by filtering runoff through voids in an alternative pavement surface into an underlying stone reservoir. Filtered runoff may be collected and returned to the conveyance system or allowed to partially (or fully) infiltrate into the soil.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="4">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="4">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th>TSS[1]</th><th colspan="2">Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80-100%</td><td colspan="2">45-100%</td><td>30-100%</td></tr>
<tr><th colspan="4">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="4">Volume</th></tr>
<tr><td>High</td><td>High</td><td colspan="4">Moderate</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="4">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><th colspan="2">Standard Design</th><th colspan="2">Enhanced Design</th></tr>
<tr><td>2-4 times per year</td><td>Every 2-3 years</td><td colspan="2">30%</td><td colspan="2">100%</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="4">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Reduces runoff volume, attenuates peak runoff rate and outflow
▪ Reduces slick surfaces during rain
▪ Water quality enhancement from filtration of stormwater</td><td colspan="4">▪ Sediment-laden runoff can clog pervious pavement, causing it to fail
▪ Incorrect installation practices can clog pores</td></tr>
<tr><th colspan="2">Components</th><th colspan="4">Design considerations</th></tr>
<tr><td colspan="2">▪ Open graded pavement mix or pavers with open surfaces
▪ Bedding course
▪ Open-graded base material
▪ Underdrain (where required)
▪ Subgrade with minimal compaction</td><td colspan="4">▪ Same basic considerations as any paved area
▪ Infiltration rate of native soil determines applicability and need for underdrain
▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice
▪ Not appropriate for heavy or high traffic areas
▪ Accessibility, aesthetics, maintainability</td></tr>
<tr><th colspan="2">Installation Considerations</th><th colspan="4">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Proper construction sequencing and installation is crucial to ensure proper functioning
▪ Subgrade cannot be overly compacted</td><td colspan="4">▪ Vacuum or jet wash to increase pavement life and avoid clogging
▪ Ensure that contributing area is clear of debris and sediment.</td></tr>
</table>

[1]*Credited pollutant load removal*

Permeable pavement systems represent alternative paving surfaces that capture and temporarily store the design volume by filtering runoff through voids in the pavement surface into an underlying stone reservoir (see Figure 4.11). Filtered runoff may be collected and returned to the conveyance system, or it may be allowed to infiltrate into the soil.

Permeable pavement systems may also provide stormwater detention of larger storms (e.g., 2- to 25-year).

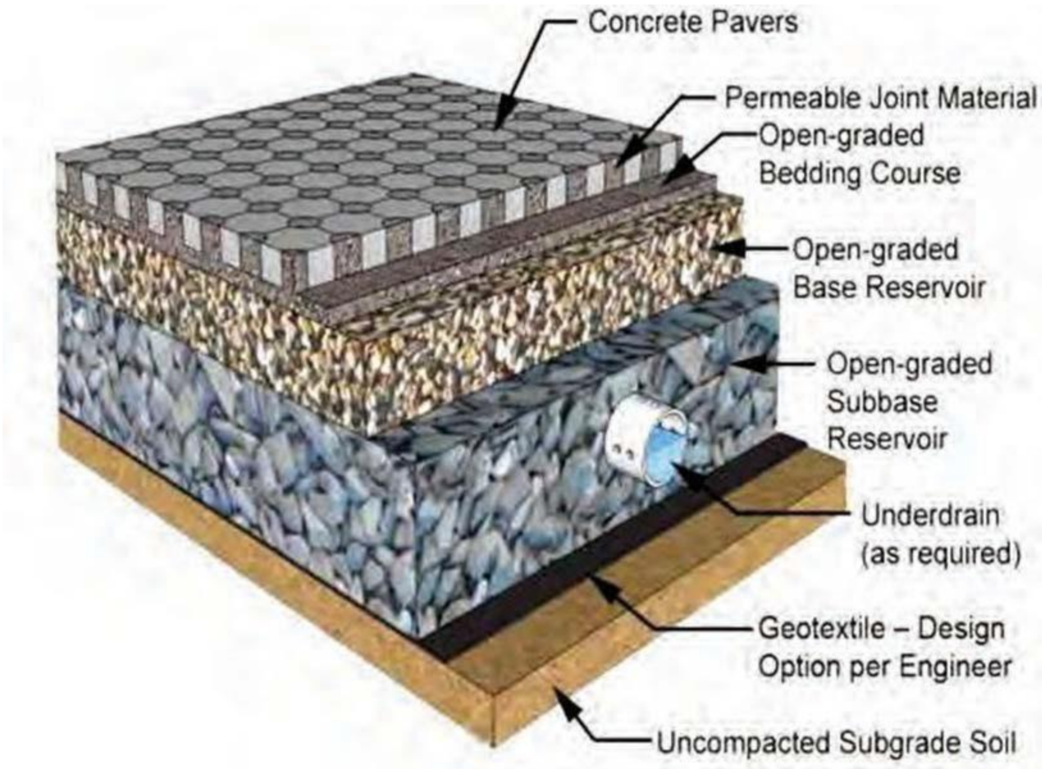


Figure 4.11. Cross-section of permeable pavement (source: ICPI).

Definition

This is a paving system that captures and temporarily stores the SWRv by filtering runoff through voids in an alternative pavement surface into an underlying stone reservoir. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil.

Design variants include the following:

- P-1 Porous asphalt (PA)
- P-2 Pervious concrete (PC)
- P-3 Permeable pavers (PP)

Other surface material variations of permeable pavement that can be part of a permeable pavement system, such as porous rubber, plastic grid pavers, and synthetic turf systems are also encompassed in this section.

Porous Asphalt

Porous asphalt (also known as pervious asphalt) consists of a special open-graded surface course bound together by asphalt cement. The open-graded surface course in a typical porous asphalt installation is 3 to 7 inches thick and has a void ratio of between 15% and 20%. Porous asphalt is thought to have a limited ability to maintain its structure and permeability during hot summer months and, consequently, is currently not recommended for use in coastal South Carolina. If it is used on a development site in the coastal region, it should be carefully monitored and maintained over time.

Pervious Concrete

Pervious concrete (also known as porous concrete) is similar to conventional concrete in structure and form but consists of a special open-graded surface course, typically 4 to 8 inches thick, that is bound together with Portland cement. This open-graded surface course has a void ratio of 15% to 25% (conventional concrete pavement has a void ratio of between 3% and 5%), which gives it a high permeability that is often many times more than that of the underlying native soils, and allows rainwater and stormwater runoff to rapidly pass through it and into the underlying stone reservoir. Although this particular type of permeable pavement surface may not require an underlying base layer to support traffic loads, site planning and design teams may wish to provide it to increase the stormwater storage capacity provided by a pervious concrete system.

Permeable Pavers

Permeable pavers (PP) are solid structural units (e.g., blocks, bricks) that are installed in a way that provides regularly spaced openings through which stormwater runoff can rapidly pass through the pavement surface and into the underlying stone reservoir. The regularly spaced openings, which generally make up between 8% and 20% of the total pavement surface, are typically filled with pea gravel (i.e., ASTM D 448 Size No. 8, 3/8 inch to 1/8 inch). Typical PP systems consist of the pavers, a 1.5- to 3-inch thick fine gravel bedding layer and an underlying stone reservoir.

Design Configurations

There are two types of permeable pavement design configurations:

- **Standard Design**
  Practice with a standard underdrain design and no infiltration sump or water quality filter (see Figure 4.12).
- **Enhanced Design**
  Practice with underdrains that contain a water quality filter layer and an infiltration sump beneath the underdrain sized to drain the design storm in 48 hours (see Figure 4.13) or practices with no underdrains that can infiltrate the entire design storm volume in 48 hours (see Figure 4.14).

The particular design configuration to be implemented on a site is typically dependent on specific site conditions and the characteristics of the underlying soils. These criteria are further discussed below.

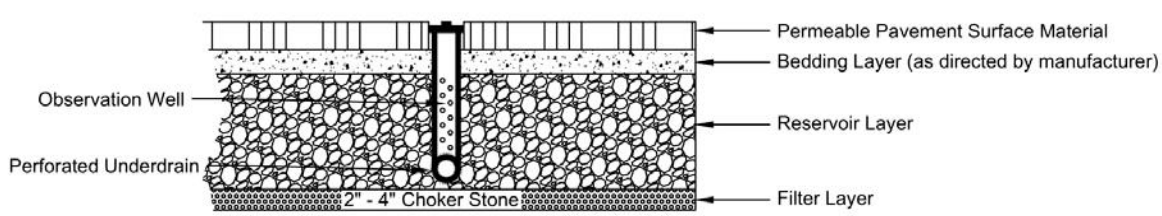


Figure 4.12. Cross-section of a standard permeable pavement design.

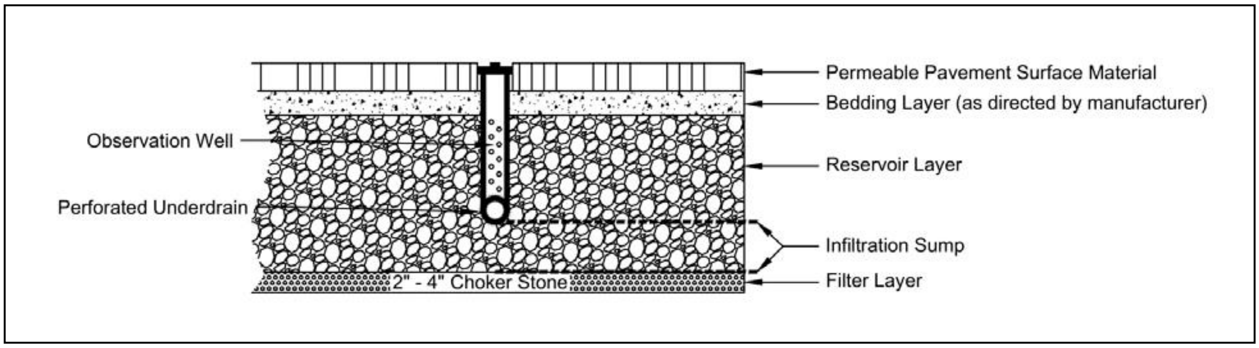


Figure 4.13. Cross-section of an enhanced permeable pavement design with an underdrain.

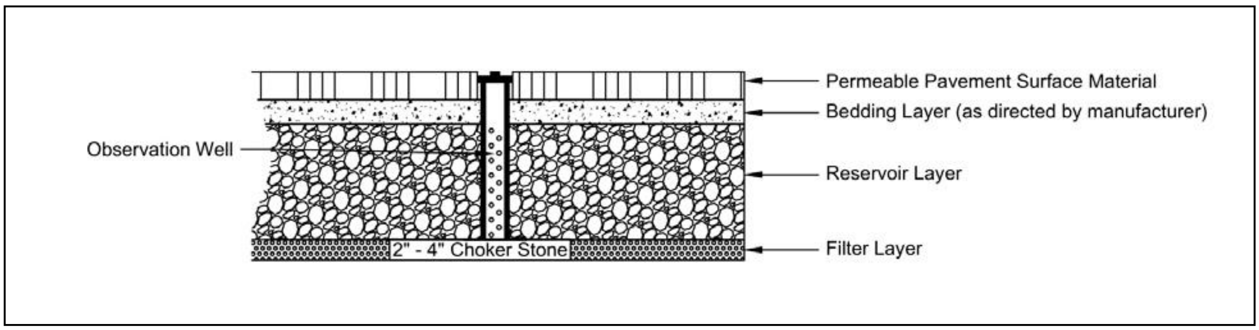


Figure 4.14. Cross-section of an enhanced permeable pavement design without an underdrain.

4.4.1 Permeable Pavement Feasibility Criteria

Since permeable pavement has a very high retention capability, it should always be considered as an alternative to conventional pavement. Permeable pavement is subject to the same feasibility constraints as most infiltration practices, as described below.

Required Space

A prime advantage of permeable pavement is that it does not normally require additional space at a new development or redevelopment site, which can be important for tight sites or areas where land prices are high.

Soils

Soil conditions do not typically constrain the use of permeable pavement, although they do determine whether an underdrain is needed. Underdrains may be required if the measured permeability of the underlying soils is less than 0.5 inches per hour (although utilization of an infiltration sump may still be feasible). When designing an infiltrating permeable pavement practice, designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B Geotechnical Information Requirements for Underground BMPs. Impermeable soils will require an underdrain.

In fill soil locations, geotechnical investigations are required to determine if the use of an impermeable liner and underdrain are necessary or if the use of an infiltration sump is permissible (see Section 4.4.4 Permeable Pavement Design Criteria).

Contributing Drainage Area

The portion of the CDA that does not include the permeable pavement may not exceed 5 times the surface area of the permeable pavement (2 times is recommended) and it should be as close to 100% impervious as possible to reduce sediment loading.

Pavement Surface Slope

Steep pavement surface slopes can reduce the stormwater storage capability of permeable pavement and may cause shifting of the pavement surface and base materials. The permeable pavement slope must be less than 5%. Designers may consider using a terraced design for permeable pavement in areas with steeper slopes (3%–5%). In all cases, designs must ensure that the slope of the pavement does not lead to flow occurring out of the stone reservoir layer onto lower portions of the pavement surface.

Minimum Hydraulic Head

The elevation difference needed for permeable pavement to function properly is generally nominal, although 1 to 4 feet of head from the pavement surface to the underdrain outlet is typically necessary. This value may vary based on several design factors, such as required storage depth and underdrain location.

Minimum Depth to Water Table

A high groundwater table may cause runoff to pond at the bottom of the permeable pavement system. Therefore, a minimum vertical distance of 0.5 feet (preferably 2 feet) must be provided between the bottom of the permeable pavement installation (i.e., the bottom invert of the reservoir layer) and the seasonal high water table.

Tidal Impacts

For systems with an underdrain, the underdrain should be located above the tidal mean high water elevation. For entirely infiltration-based systems, the bottom of the stone reservoir should be located above the mean high water elevation. Where this is not possible, portions of the practice below the tidal mean high water elevation cannot be included in the volume calculations.

Setbacks

To avoid the risk of seepage, stormwater cannot flow from the permeable pavement reservoir layer to the traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements. Where the 10-foot setback is not possible, an impermeable liner may be used along the sides and bottom of the permeable pavement practice (extending from the surface to the bottom of the practice and outward to meet the 10-foot setback).

Proximity to Utilities

Interference with underground utilities should be avoided if possible. When large site development is undertaken the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the public right-of-way (PROW). Consult with each utility company on recommended offsets, which will allow utility maintenance work with minimal disturbance to the permeable pavement. Permeable pavement in the public right-of-way (PROW) must conform with the State of South Carolina Department of Transportation design specifications. Where conflicts cannot be avoided, follow these guidelines:

- Consider altering the location or sizing of the permeable pavement to avoid or minimize the utility conflict. Consider an alternate BMP type to avoid conflict.
- Use design features to mitigate the impacts of conflicts that may arise by allowing the permeable pavement and the utility to coexist. The permeable pavement design may need to incorporate impervious areas, through geotextiles or compaction, to protect utility crossings.
- Work with the utility company to evaluate the relocation of the existing utility and install the optimum placement and sizing of the permeable pavement.
- If utility functionality, longevity, and vehicular access to manholes can be assured, accept the permeable pavement design and location with the existing utility. Design sufficient soil coverage over the utility or general clearances or other features, such as an impermeable liner, to assure all entities that the conflict is limited to maintenance.

When accepting utility conflict into the permeable pavement location and design, it is understood the permeable pavement will be temporarily impacted during utility work, but the utility owner will replace the permeable pavement or, alternatively, install functionally comparable permeable pavement according to the specifications in the current version of this guidebook. Restoration of permeable pavement that is located in the PROW will also conform with the State of South Carolina Department of Transportation design specifications.

Pollutant Hotspot Land Uses

Permeable pavement is not appropriate for certain pollutant-generating sites. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil-water separator or filtering device must be provided, or the areas should be diverted from the permeable pavement.

On sites with existing contaminated soils, infiltration is not allowed. Permeable pavement areas must include an impermeable liner, and the Enhanced Design configuration cannot be used.

High Loading Situations

Permeable pavement is not intended to treat sites with high sediment or trash/debris loads, since such loads will cause the practice to clog and fail. Sites with considerable pervious area (e.g., newly established turf and landscaping) can be considered high loading sites and the pervious areas should be diverted if possible, from the permeable pavement area. If unavoidable, pretreatment measures, such as a gravel or a sod filter strip should be employed (see Section 4.4.3 Permeable Pavement Pretreatment Criteria).

High Speed Roads

Permeable pavement should not be used for high speed roads, although it has been successfully applied for low speed residential streets, parking lanes, and roadway shoulders.

Economic Considerations

Permeable pavement tends to be expensive relative to other practices, but when the cost of land and traditional paving are included in the calculations, permeable pavement becomes much more competitive. Permeable pavement is very space-efficient, since it combines a useful pavement surface with stormwater management for runoff and, in standard design configurations, water quality treatment.

4.4.2 Permeable Pavement Conveyance Criteria

Permeable pavement designs must include methods to convey larger storms (e.g., 2- to 25-year) to the storm drain system. Conveyance methods include the following:

- Place an overdrain—a horizontal perforated pipe near the top of the reservoir layer—to pass excess flows after water has filled the base.
- Increase the thickness of the top of the reservoir layer by as much as 6 inches to increase storage (i.e., create freeboard). The design computations used to size the reservoir layer often assume that no freeboard is present.
- Create underground detention within the reservoir layer of the permeable pavement system. Reservoir storage may be augmented by corrugated metal pipes, plastic or concrete arch structures, etc.
- Route overflows to another detention or conveyance system.
- Set the storm drain inlets flush with the elevation of the permeable pavement surface to effectively convey excess stormwater runoff past the system. The design should also make allowances for relief of unacceptable ponding depths during larger rainfall events.

4.4.3 Permeable Pavement Pretreatment Criteria

Pretreatment for most permeable pavement applications is not necessary. Additional pretreatment is recommended if the pavement receives runoff from adjacent pervious areas. For example, a gravel or sod filter strip can be placed adjacent to pervious (landscaped) areas to trap coarse sediment particles before they reach the pavement surface in order to reduce clogging.

4.4.4 Permeable Pavement Design Criteria

Type of Surface Pavement

The type of pavement should be selected based on a review of the pavement specifications and properties and designed according to the product manufacturer’s recommendations.

Pavement Bottom Slope

For unlined designs, the bottom slope of a permeable pavement installation should be as flat as possible (i.e., 0% longitudinal and lateral slopes) to enable even distribution and infiltration of stormwater. On sloped sites, internal check dams or barriers, as shown in Figure 4.15 can be incorporated into the subsurface to encourage infiltration. Barriers may be constructed of concrete, earthen berms, impermeable membranes, or low permeability geotextile. In this type of design, the depth of the infiltration sump would be the depth behind the check dams. The depth and spacing of the barriers are dependent upon the underlying slope and the saturated hydraulic conductivity, as any water retained by the flow barriers must infiltrate within 48 hours. If an underdrain will be used in conjunction with the flow barriers, it can be installed over the top of the barriers, or parallel to the barriers with an underdrain in each cell.

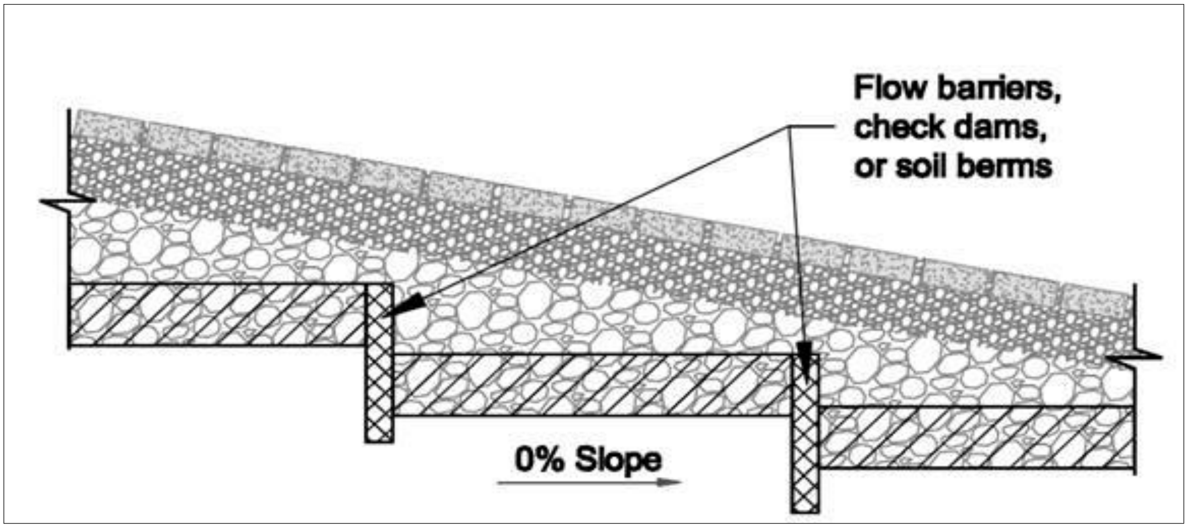


Figure 4.15. Use of flow barriers to encourage infiltration on sloped sites.

Internal Geometry and Drawdowns

- **Rapid Drawdown**
  Permeable pavement must be designed so that the target storage volume is detained in the reservoir for as long as possible, 36 to 48 hours, before completely discharging through an underdrain. A minimum orifice size of 1 inch is recommended regardless of the calculated drawdown time.

  Note: A 48-hour maximum drawdown time is utilized for permeable pavement rather than the 72-hour value used for other BMPs. This shorter drawdown time, in accordance with industry standards, is intended to ensure that the subgrade does not stay saturated for too long and cause problems with the pavement.

- **Infiltration Sump**
  To promote greater retention for permeable pavement located on marginal soils, an infiltration sump can be installed to create a storage layer below the underdrain invert. This design configuration is discussed further below.

Reservoir Layer

The reservoir layer consists of the stone underneath the pavement section and above the bottom filter layer or underlying soils, including the optional infiltration sump. The total thickness of the reservoir layer is determined by runoff storage needs, the saturated hydraulic conductivity of in-situ soils, structural requirements of the pavement sub-base, depth to water table, and frost depth conditions (see Section 4.4.1 Permeable Pavement Feasibility Criteria). A geotechnical engineer should be consulted regarding the suitability of the soil subgrade.

- The reservoir below the permeable pavement surface should be composed of clean, double-washed stone aggregate and sized for both the storm event to be treated and the structural requirements of the expected traffic loading. Additional chamber structures may also be used to create larger storage volumes.

- The storage layer may consist of clean, double-washed No. 57 stone, although No. 2 stone is preferred because it provides additional structural stability. Other appropriate materials may be used if accepted by the Beaufort County Public Works Department.
- The bottom of the reservoir layer should be completely flat so that runoff will be able to infiltrate evenly through the entire surface. The use of terracing and check dams is permissible.

Underdrains

Most permeable pavement designs will require an underdrain (see Section 4.4.1 Permeable Pavement Feasibility Criteria). Underdrains can also be used to keep detained stormwater from flooding permeable pavement during extreme rain events. Multiple underdrains are typically necessary for permeable pavement wider than 40 feet, and each underdrain is recommended to be located 20 feet or less from the next pipe or the edge of the permeable pavement. For long and narrow applications, a single underdrain running the length of the permeable pavement is sufficient. The underdrain should be perforated schedule 40 PVC pipe (corrugated HDPE may be used for smaller load-bearing applications), with three or four rows of 3/8-inch perforations at 6 inches on center. The underdrain must be encased in a layer of clean, double-washed No. 57 stone, with a minimum 2-inch cover over the top of the underdrain. The underdrain system must include a flow control to ensure that the reservoir layer drains slowly (within 36 to 48 hours).

- The underdrain outlet can be fitted with a flow-reduction orifice within a weir or other easily inspected and maintained configuration in the downstream manhole as a means of regulating the stormwater detention time. The minimum diameter of any orifice is 1 inch. The designer should verify that the volume will draw down completely within 36 to 48 hours.
- On infiltration designs, an underdrain(s) can be installed and capped at the downstream structure as an option for future use if maintenance observations indicate a reduction in the soil permeability.

Observation Wells

All permeable pavement practices must include observation wells. The observation well is used to observe the rate of drawdown within the reservoir layer following a storm event and to facilitate periodic inspection and maintenance. The observation well should consist of a well-anchored, perforated 4- to 6-inch diameter PVC pipe. There should be no perforation within 1 foot of the surface. If the permeable pavement has an underdrain, tie the observation well into any Ts or Ys in the underdrain system. The observation well should extend vertically to the bottom of the reservoir layer and extend upwards to be flush with the surface (or just under pavers) with a lockable cap.

Infiltration Sump (optional, required for enhanced designs with an underdrain)

For unlined permeable pavement systems, an optional upturned elbow or elevated underdrain configuration can be used to promote greater retention for permeable pavement located on marginal soils. The infiltration sump must be installed to create a storage layer below the underdrain or upturned elbow invert. The depth of this layer must be sized so that the design storm can infiltrate into the subsoils in a 48-hour period. The bottom of the infiltration sump must be at least 0.5 feet above the seasonally high water table. The inclusion of an infiltration sump is not permitted for designs with an impermeable liner. In fill soil locations, geotechnical investigations are required to determine if the use of an infiltration sump is permissible.

Filter Layer (optional)
To protect the bottom of the reservoir layer from intrusion by underlying soils, a filter layer can be used. The underlying native soils should be separated from the stone reservoir by a 2- to 4-inch layer of choker stone (e.g., No. 8).

Geotextile (optional)
Geotextile fabric is another option to protect the bottom of the reservoir layer from intrusion by underlying soils, although some practitioners recommend avoiding the use of fabric beneath permeable pavements since it may become a future plane of clogging within the system. Geotextile fabric is still recommended to protect the excavated sides of the reservoir layer, in order to prevent soil piping. An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude higher (10 times) than the soil subgrade permeability must be used.

Impermeable Liner
An impermeable liner is not typically required, although it may be utilized in fill applications where deemed necessary by a geotechnical investigation, on sites with contaminated soils, or on the sides of the practice to protect adjacent structures from seepage. Use a PVC geomembrane liner or equivalent of an appropriate thickness (follow manufacturer's instructions for installation). Field seams must be sealed according to the liner manufacturer's specifications. A minimum 6-inch overlap of material is required at all seams.

Material Specifications
Permeable pavement material specifications vary according to the specific pavement product selected. A general comparison of different permeable pavements is provided in Table 4.13, but designers should consult manufacturer's technical specifications for specific criteria and guidance. Table 4.14 provides general material specifications for the component structures installed beneath the permeable pavement. Note that the size of stone materials used in the reservoir and filter layers may differ depending on the type of surface material.

Table 4.13. Permeable pavement specifications for a variety of typical surface materials.

Material	Specification	Notes
Permeable Pavers (PP)	Void content, thickness, and compressive strength vary based on type and manufacturer Open void fill media: aggregate, topsoil and grass, coarse sand, etc.	Reservoir layer required to support the structural load.
Pervious Concrete (PC)	Void content: 15–20% Thickness: Typically 4–8 inches Compressive strength: 2.8–28 MPa Open void fill media: None	May not require a reservoir layer to support the structural load, but a layer may be included to increase the storage or infiltration. Requires certified supplier and installer.
Porous Asphalt (PA)	Void content: 15–20% Thickness: Typically 3–7 inches (depending on traffic load) Open void fill media: None	Reservoir layer required to support the structural load. Requires certified supplier and installer.

Table 4.14. Material specifications for typical layers beneath the surface of permeable pavements.

Material	Specification	Notes
Bedding Layer	PC: 3–4 inches of No. 57 stone if No. 2 stone is used for Reservoir Layer PA: 3–4 inches of No. 57 stone PP: Follow manufacturer specifications	ASTM D448 size No. 57 stone (i.e., 1/2 to 1 1/2 inches in size). Must be double-washed and clean and free of all fines.
Reservoir Layer	PC: No. 57 stone or No. 2 stone PA: No. 2 stone PP: Follow manufacturer specifications	ASTM D448 size No. 57 stone (i.e., 1/2 to 1 1/2 inches in size); No. 2 Stone (i.e., 3/4 to 3 inches in size). Depth is based on the pavement structural and hydraulic requirements. Must be double-washed and clean and free of all fines. Other appropriate materials may be used if accepted by Beaufort County Public Works Department.
Underdrain	Use 4- to 6-inch diameter perforated PVC pipe (or equivalent corrugated HDPE may be used for smaller load-bearing applications), with 3 or 4 rows of 3/8-inch perforations at 6 inches on center. Perforated pipe installed for the full length of the permeable pavement cell, and non-perforated pipe, as needed, is used to connect with the storm drain system. T's and Y's should be installed as needed, depending on the underdrain configuration. Extend cleanout pipes to the surface.	
Infiltration Sump (optional)	An aggregate storage layer below the underdrain invert. The material specifications are the same as Reservoir Layer.	
Filter Layer (optional)	The underlying native soils should be separated from the stone reservoir by a 2- to 4-inch layer of choker stone (e.g., No. 8).	
Geotextile (optional)	Use an appropriate geotextile fabric for both sides and/or bottom that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude higher than (10 times) the soil subgrade permeability. Low-permeability geotextile fabric may be used as a check dam material.	
Impermeable Liner (optional)	Where appropriate, use PVC geomembrane liner or equivalent.	
Observation Well	Use a perforated 4- to 6-inch vertical PVC pipe (AASHTO M-252) with a lockable cap, installed flush with the surface.	

Permeable Pavement Sizing

The thickness of the reservoir layer is determined by both a structural and hydraulic design analysis. The reservoir layer serves to retain stormwater and to support the design traffic loads for the pavement. Permeable pavement structural and hydraulic sizing criteria are discussed below.

Structural Design

If permeable pavement will be used in a parking lot or other setting that involves vehicles, the pavement surface must be able to support the maximum anticipated traffic load. The structural design process will vary according to the type of pavement selected, and the manufacturer's specific recommendations should be consulted. The thickness of the permeable pavement and reservoir layer must be sized to support structural loads and to temporarily store the design storm volume (i.e., the water quality, channel protection, and/or flood control volumes). On most new development and redevelopment sites, the structural support requirements will dictate the depth of the underlying stone reservoir.

The structural design of permeable pavements involves consideration of four main site elements:

- Total traffic
- In situ soil strength
- Environmental elements
- Bedding and reservoir layer design

The resulting structural requirements may include the thickness of the pavement, filter, and reservoir layer. Designers should note that if the underlying soils have a low California Bearing Ratio (less than 4%), they may need to be compacted to at least 95% of the Standard Proctor Density, which may limit their use for infiltration.

Designers should determine structural design requirements by consulting transportation design guidance sources, such as the following:

- ASCE/T&DI/ICPI 68-18 Permeable Interlocking Concrete Pavement (2018)
- AASHTO Guide for Design of Pavement Structures (1993)
- AASHTO Supplement to the Guide for Design of Pavement Structures (1998)

Hydraulic Design. Permeable pavement is typically sized to store the SWRv or larger design storm volumes in the reservoir layer. The storage volume in the pavements must account for the underlying saturated hydraulic conductivity and outflow through any underdrains. The design storm should be routed through the pavement to accurately determine the required reservoir depth. The depth of the reservoir layer or infiltration sump needed to store the design storm can be determined by using Equation 4.3.

Equation 4.3. Reservoir layer or infiltration sump depth.

$$d_p = \frac{\left(\frac{P \times Rv_I \times CDA}{A_p}\right) - (K_{sat} \times t_f)}{\eta_r}$$

Where:

d_p = Depth of the reservoir layer, or depth of the infiltration sump for enhanced designs with underdrains (ft)

P = Rainfall depth for the SWRv or other design storm (ft)

Rv_I = 0.95 (runoff coefficient for impervious cover)

CDA =	Total contributing drainage area, including permeable pavement surface area (square feet)
A_p =	Permeable pavement surface area (square feet)
K_{sat} =	Field-verified saturated hydraulic conductivity for subgrade soils (ft/day). If an impermeable liner is used in the design, then this value is 0
t_f =	Time to fill the reservoir layer (days; assume 2 hours or 0.083 day)
η_r =	0.4 (effective porosity for the reservoir layer)

This equation makes the following design assumptions:

- The CDA does not contain pervious areas.
- If the subgrade will be compacted to meet structural design requirements of the pavement section, the measured saturated hydraulic conductivity shall be based on measurement of the subgrade soil subjected to the compaction requirements.

The depth of the reservoir layer cannot be less than the depth required to meet the pavement structural requirement. The depth of the reservoir layer may need to be increased to meet structural or larger storage requirements.

For infiltration designs without underdrains or designs with infiltration sumps, the captured volume must drain from the practice within 48 hours. Equation 4.4 can be used to determine the drawdown time in the reservoir layer or infiltration sump.

Equation 4.4. Drawdown time.

$$t_d = \frac{d_p \times \eta_r}{K_{sat}}$$

Where:

t_d =	Drawdown time (days)
d_p =	Depth of the reservoir layer, or depth of the infiltration sump for enhanced designs with underdrains (ft)
η_r =	0.4 (effective porosity for the reservoir layer)
K_{sat} =	Field-verified saturated hydraulic conductivity for subgrade soils (ft/day). If an impermeable liner is used in the design, then this value is 0

For designs with underdrains, the captured volume must drain in 36-48 hours. The drawdown time should be determined using the hydrologic routing or modeling procedures used for detention systems with the depth and head adjusted for the porosity of the aggregate.

The total storage volume provided by the practice, Sv, should be determined using Equation 4.5.

Equation 4.5. Permeable pavement storage volume.

$$Sv = A_p[(d_p \times \eta_r) + K_{sat} \times t_f]$$

Where:

S_v = Storage volume (cubic feet)
d_p = Depth of the reservoir layer, or depth of the infiltration sump for enhanced designs with underdrains (ft)
η_r = 0.4 (effective porosity for the reservoir layer)
A_p = Permeable pavement surface area (square feet)
K_{sat} = Field-verified saturated hydraulic conductivity for subgrade soils (ft/day). If an impermeable liner is used in the design, then this value is 0
t_f = Time to fill the reservoir layer (days; assume 2 hours or 0.083 day)

Detention Storage Design

Permeable pavement can also be designed to address, in whole or in part, the detention storage for larger storm events. The designer can model various approaches by factoring in storage within the stone aggregate layer (including chamber structures that increase the available storage volume), expected infiltration, and any outlet structures used as part of the design. Routing calculations can also be used to provide a more accurate solution of the peak discharge and required storage volume.

Once runoff passes through the surface of the permeable pavement system, designers should calculate outflow pathways to handle subsurface flows. Subsurface flows can be regulated using underdrains, the volume of storage in the reservoir layer, the bed slope of the reservoir layer, and/or a control structure at the outlet (see Section 4.4.2 Permeable Pavement Conveyance Criteria).

4.4.5 Permeable Pavement Landscaping Criteria

Permeable pavement does not have any landscaping needs. However, large-scale permeable pavement applications should be carefully planned to integrate the typical landscaping features of a parking lot, such as trees and islands, in a manner that maximizes runoff treatment and minimizes the risk that sediment, mulch, grass clippings, leaves, and other plant matter will inadvertently clog the paving surface. Bioretention areas (see Section 4.3 Bioretention) may be a good design option to meet these landscaping goals.

4.4.6 Permeable Pavement Construction Sequence

Experience has shown that proper installation is critical to the effective operation of a permeable pavement system.

Soil Erosion and Sediment Controls

The following soil erosion and sediment control guidelines must be followed during construction:

- All permeable pavement areas must be fully protected from sediment intrusion by silt fence or construction fencing, particularly if they are intended to infiltrate runoff.
- Permeable pavement areas intended to infiltrate runoff must remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment and loss of design infiltration rate (unless the area has been determined to have a low California Bearing Ratio and will require compaction during the permeable pavement construction phase). Where it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, there are several possible remedies for the impacted area.
    - If excavation in the proposed permeable pavement areas can be restricted, then remediation can be achieved with deep tilling practices. This is only possible if in situ soils

are not disturbed any deeper than 2 feet above the final design elevation of the bottom of the aggregate reservoir course. In this case, when heavy equipment activity has ceased, the area is excavated to grade, and the impacted area must be tilled to a depth of 12 inches below the bottom of the reservoir layer.

  - Alternatively, if it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, and excavation of the area cannot be restricted, then infiltration tests will be required prior to installation of the permeable pavement to ensure that the design infiltration rate is still present. If tests reveal the loss of design infiltration rates, then deep tilling practices may be used in an effort to restore those rates. In this case, further testing must be done before the permeable pavement can be installed to establish that design rates have been achieved.
  - Finally, if it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, excavation of the area cannot be restricted, and infiltration tests reveal design rates cannot be restored, then a resubmission of the SWMP will be required.

- Permeable pavement areas must be clearly marked on all construction documents and grading plans.
- During construction, care should be taken to avoid tracking sediments onto any permeable pavement surface to avoid post-construction clogging and long-term maintenance issues.
- Any area of the site intended ultimately to be a permeable pavement area with an infiltration component should not be used as the site of a temporary sediment trap or basin. If locating a temporary sediment trap or basin on an area intended for permeable pavement is unavoidable, the remedies are similar to those discussed for heavy equipment compaction.
- If it is possible, restrict the invert of the sediment trap or basin to at least 1 foot above the final design elevation of the bottom of the aggregate reservoir course of the proposed permeable pavement. Then remediation can be achieved with proper removal of trapped sediments and deep tilling practices.
- An alternate approach to deep tilling is to use an impermeable linear to protect the in situ soils from sedimentation while the sediment trap or basin is in use.
- In each case, all sediment deposits in the excavated area must be carefully removed prior to installing the sub-base, base, and surface materials. The plan must also show the proper procedures for converting the temporary sediment control practice to a permeable pavement BMP, including dewatering, cleanout, and stabilization.

<u>Permeable Pavement Installation</u>
The following is a typical construction sequence to properly install permeable pavement, which may need to be modified depending on the particular type of permeable pavement that is being installed.

1. Stabilize Contributing Drainage Area
Construction of the permeable pavement should only begin after the entire CDA has been stabilized. The proposed site should be checked for existing utilities prior to any excavation. Do not install the system in rain.

2. Install Soil Erosion and Sediment Control Measures for the Permeable Pavement
As noted above, temporary soil erosion and sediment controls are needed during installation to divert stormwater away from the permeable pavement area until it is completed. Special protection measures,

such as erosion control fabrics, may be needed to protect vulnerable side slopes from erosion during the excavation process. The proposed permeable pavement area must be kept free from sediment during the entire construction process. Construction materials contaminated by sediment must be removed and replaced with clean material.

3. Minimize Impact of Heavy Installation Equipment
Where possible, excavators or backhoes should work from the sides to excavate the reservoir layer to its appropriate design depth and dimensions. For small pavement applications, excavating equipment should have arms with adequate extension so they do not have to work inside the footprint of the permeable pavement area (to avoid compaction). Contractors can utilize a cell construction approach, whereby the proposed permeable pavement area is split into 500- to 1,000-square foot temporary cells with a 10- to 15-foot-wide earth bridge in between, so cells can be excavated from the side. Excavated material should be placed away from the open excavation so as to not jeopardize the stability of the side walls.

4. Promote Infiltration Rate
The native soils along the bottom of the permeable pavement system should be scarified or tilled to a depth of 3 to 4 inches prior to the placement of the filter layer or geotextile fabric. In large-scale paving applications with weak soils, the soil subgrade may need to be compacted to 95% of the Standard Proctor Density to achieve the desired load-bearing capacity.

Note: This may reduce or eliminate the infiltration function of the installation, and it must be addressed during hydrologic design.

5. Order of Materials
Geotextile fabric should be installed on the sides of the reservoir layer (and the bottom if the design calls for it). Geotextile fabric strips should overlap down-slope by a minimum of 2 feet and be secured a minimum of 4 feet beyond the edge of the excavation. Where the filter layer extends beyond the edge of the pavement (to convey runoff to the reservoir layer), install an additional layer of geotextile fabric 1 foot below the surface to prevent sediment from entering into the reservoir layer. Excess geotextile fabric should not be trimmed until the site is fully stabilized.

6. Install Base Material Components
Provide a minimum of 2 inches of aggregate above and below the underdrains. The up-gradient end of underdrains in the reservoir layer should be capped. Where an underdrain pipe is connected to a structure, there shall be no perforations within 1 foot of the structure. Ensure there are no perforations in clean-outs and observation wells within 1 foot of the surface.

7. Stone Media
Spread 6-inch lifts of the appropriate clean, double-washed stone aggregate (usually No. 2 or No. 57 stone). Place at least 4 inches of additional aggregate above the underdrain, and then compact it using a vibratory roller in static mode until there is no visible movement of the aggregate. Do not crush the aggregate with the roller.

8. Reservoir Media
Install the desired depth of the bedding layer, depending on the type of pavement, as indicated in Table 4.14.

9. Paving Media
Paving materials shall be installed in accordance with manufacturer or industry specifications for the particular type of pavement.

10. Installation of Porous Asphalt

The following has been excerpted from various documents, most notably Jackson (2007):

- Install porous asphalt pavement similarly to regular asphalt pavement. The pavement should be laid in a single lift over the filter course. The laying temperature should be between 230°F and 260°F, with a minimum air temperature of 50°F, to ensure the surface does not stiffen before compaction.
- Complete compaction of the surface course when the surface is cool enough to resist a 10-ton roller. One or two passes of the roller are required for proper compaction. More rolling could cause a reduction in the porosity of the pavement.
- The mixing plant must provide certification of the aggregate mix, abrasion loss factor, and asphalt content in the mix. Test the asphalt mix for its resistance to stripping by water using ASTM D1664. If the estimated coating area is not above 95%, additional anti-stripping agents must be added to the mix.
- Transport the mix to the site in a clean vehicle with smooth dump beds sprayed with a non-petroleum release agent. The mix shall be covered during transportation to control cooling.
- Test the full permeability of the pavement surface by application of clean water at a rate of at least 5 gallons per minute over the entire surface. All water must infiltrate directly, without puddle formation or surface runoff.
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding to determine if the facility is draining properly.

11. Pervious Concrete Installation

The basic installation sequence for pervious concrete is outlined by the National Ready Mixed Concrete Association (NRMCA; NRMCA, 2004). Concrete installers are required to be certified by a recognized pervious concrete installers training program, such as the Pervious Concrete Contractor Certification Program offered by the NRMCA. The basic installation procedure is as follows:

- Drive the concrete truck as close to the project site as possible.
- Water the underlying aggregate (reservoir layer) before the concrete is placed, so the aggregate does not draw moisture from the freshly laid pervious concrete.
- After the concrete is placed, approximately 3/8 to 1/2 inches is struck off, using a vibratory screed. This is to allow for compaction of the concrete pavement.
- Compact the pavement with a steel pipe roller. Care should be taken to ensure over-compaction does not occur.
- Cut joints for the concrete to a depth of 1/4 inch.
- The curing process is very important for pervious concrete. Concrete installers should follow manufacturer specifications to the extent allowed by on-site conditions when curing pervious concrete. This typically requires covering the pavement with plastic sheeting within 20 minutes of the strike-off and may require keeping it covered for at least 7 days. Do not allow traffic on the pavement during the curing period.
- Remove the plastic sheeting only after the proper curing time. Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding, to determine if the facility is draining properly.

12. Permeable Interlocking Concrete Paver Installation

The basic installation process is described in greater detail by Smith (2006):

- Place edge restraints for open-jointed pavement blocks before the bedding layer and pavement blocks are installed. Permeable interlocking concrete pavement systems require edge restraints to prevent vehicle loads from moving the paver blocks. Edge restraints may be standard curbs or gutter pans, or precast or cast-in-place reinforced concrete borders a minimum of 6 inches wide and 18 inches deep, constructed with Class A3 concrete. Edge restraints along the traffic side of a permeable pavement block system are recommended.
- Place the double-washed No. 57 stone in a single lift. Level the filter course and compact it into the reservoir course beneath with at least four passes of a 10-ton steel drum static roller until there is no visible movement. The first two passes are in vibratory mode, with the final two passes in static mode. The filter aggregate should be moist to facilitate movement into the reservoir course.
- Place and screed the bedding course material (typically No. 8 stone).
- Fill gaps at the edge of the paved areas with cut pavers or edge units. When cut pavers are needed, cut the pavers with a paver splitter or masonry saw. Cut pavers no smaller than 1/3 of the full unit size.
- Pavers may be placed by hand or with mechanical installers. Fill the joints and openings with stone. Joint openings must be filled with ASTM D448 No. 8 stone; although, No. 8P or No. 9 stone may be used where needed to fill narrower joints. Remove excess stones from the paver surface.
- Compact and seat the pavers into the bedding course with a minimum low-amplitude 5,000-pound-foot, 75- to 95-Hz plate compactor.
- Do not compact within 6 feet of the unrestrained edges of the pavers.
- The system must be thoroughly swept by a mechanical sweeper or vacuumed immediately after construction to remove any sediment or excess aggregate.
- Inspect the area for settlement. Any blocks that settle must be reset and re-inspected.
- Inspect the facility 18 to 30 hours after a significant rainfall (0.5 inch or greater) or artificial flooding to determine whether the facility is draining properly.

13. Construction Supervision

Supervision before, during, and after construction by a qualified professional is recommended to ensure permeable pavement is built in accordance with these specifications. ASTM test C1781 or C1701 must be performed to ensure initial pavement permeability of at least 6 inches per hour. Inspection checklists that require sign-offs by qualified individuals should be used at critical stages of construction to ensure the contractor's interpretation of the plan is consistent with the designer's intent.

Construction phase inspection checklist for permeable pavement practices can be found in Appendix E Construction Inspection Checklists.

Some common pitfalls can be avoided by careful construction supervision that focuses on the following key aspects of permeable pavement installation:

- Store materials in a protected area to keep them free from mud, dirt, and other foreign materials.
- The CDA should be stabilized prior to directing water to the permeable pavement area.
- Check the aggregate material to confirm it is clean and washed, meets specifications and is installed to the correct depth. Aggregate loads that do not meet the specifications or do not appear to be sufficiently washed may be rejected.
- Check elevations (i.e., the invert of the underdrain, inverts for the inflow, and outflow points) and the surface slope.
- Make sure the permeable pavement surface is even, runoff spreads evenly across it, and the storage bed drains within 48 hours.
- Ensure caps are placed on the upstream (but not the downstream) ends of the underdrains.
- Inspect the pretreatment structures (if applicable) to make sure they are properly installed and working effectively.
- Once the final construction inspection has been completed, log the GPS coordinates for each facility and submit them for entry into the BMP maintenance tracking database.

Runoff diversion structures are recommended to protect larger permeable pavement applications from early runoff-producing storms, particularly when up-gradient conventional asphalt areas drain to the permeable pavement. This can help reduce the input of fine particles often produced shortly after conventional asphalt is laid.

4.4.7 Permeable Pavement Maintenance Criteria

Maintenance is a required and crucial element to ensure the long-term performance of permeable pavement. The most frequently cited maintenance problem is surface clogging caused by organic matter and sediment. Periodic street sweeping will remove accumulated sediment and help prevent clogging; however, it is also critical to ensure that surrounding land areas remain stabilized.

The following tasks must be avoided on all permeable pavements:

- Sanding
- Resealing
- Resurfacing
- Power washing
- Storage of mulch or soil materials
- Construction staging on unprotected pavement

It is difficult to prescribe the specific types or frequency of maintenance tasks that are needed to maintain the hydrologic function of permeable pavement systems over time. The frequency of maintenance will depend largely on the pavement use, traffic loads, and the surrounding land use.

One preventative maintenance task for large-scale applications (e.g., parking lots) involves vacuum sweeping on a frequency consistent with the use and loadings encountered in the site. Many experts consider an annual, dry-weather sweeping in the spring months to be important. The contract for sweeping should specify that a vacuum sweeper be used that does not use water spray, since spraying may lead to subsurface clogging. Typical maintenance tasks are outlined in Table 4.15.

Table 4.15. Typical maintenance tasks for permeable pavement practices.

Frequency	Maintenance Tasks
After installation	▪ For the first 6 months following construction, the practice and CDA should be inspected at least twice after storm events that exceed 0.5 inch of rainfall. Conduct any needed repairs or stabilization.
Once every 1–2 months during the growing season	▪ Mow grass in grid paver applications (clippings should be removed from the pavement area).
As needed	▪ Stabilize the CDA to prevent erosion. ▪ Remove any soil or sediment deposited on pavement. ▪ Replace or repair any pavement surfaces that are degenerating or spalling.
2–4 times per year (depending on use)	▪ Mechanically sweep pavement with a standard street sweeper to prevent clogging.
Annually	▪ Conduct a maintenance inspection ▪ Remove weeds as needed.
Once every 2–3 years	▪ Remove any accumulated sediment in pretreatment cells and inflow points.
If clogged	▪ Conduct maintenance using a regenerative street sweeper or a vacuum sweeper ▪ Replace any necessary joint material.

When permeable pavements are installed on private residential lots, homeowners will need to (1) be educated about their routine maintenance needs and (2) understand the long-term maintenance plan.

It is recommended that a qualified professional conduct a spring maintenance inspection and cleanup at each permeable pavement site, particularly at large-scale applications. Maintenance inspection checklists for permeable pavements and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.4.8 Permeable Pavement Stormwater Compliance Calculations

Permeable pavement retention credit varies depending on the design configuration of the system.

Enhanced Designs

These permeable pavement applications have an infiltration sump and water-quality filter, but no underdrain. Enhanced designs are credited with 100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (Table 4.16).

Table 4.16. Retention and pollutant removal for enhanced permeable pavement practices.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

Note: If using an infiltration sump design, only the volume stored in the sump can be counted as the Enhanced Design Storage Volume (Sv). Any volume stored in the practice above the sump is counted as a standard design. When using the SoLoCo Compliance Calculator, the Sv of the infiltration sump should be entered into the cell “Storage Volume Provided by BMP” in the Permeable Pavement – Enhanced row. Permeable Pavement – Standard should then be selected as the downstream practice. Next, in the Permeable Pavement - Standard row, the Sv provided above the infiltration sump should be entered into the cell “Storage Volume Provided by BMP.”

Standard Designs

These permeable pavement applications have an underdrain, but no infiltration sump or water quality filter. Standard designs are credited with 30% retention for the storage volume (Sv) provided as well as 80% TSS, 45% TN, and 30% bacteria removal. (Table 4.17).

Table 4.17. Retention and pollutant removal for standard permeable pavement practices.

Retention	= 30%
TSS Removal	= 80%
TN Removal	= 45%
Bacteria Removal	= 30%

The practice must be sized using the guidance detailed in Section 4.2.4 Permeable Pavement Design Criteria.

Permeable pavement also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) achieved by the practice from the total runoff volumes for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.5 Infiltration Practices

<table>
<tr><th colspan="6">Infiltration</th></tr>
<tr><td colspan="6">Definition: Practices that capture and temporarily store the design storm volume before allowing it to infiltrate into the soil over a three-day period.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="4">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="4">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th>TSS[1]</th><th colspan="2">Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>100%</td><td colspan="2">100%</td><td>100%</td></tr>
<tr><th colspan="4">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="4">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="4">High</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="4">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><th colspan="2">Basin</th><th colspan="2">Trench</th></tr>
<tr><td>Quarterly</td><td>Every 5-10 years</td><td colspan="2">100%</td><td colspan="2">100%</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="4">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Excellent in impervious CDAs
▪ Helps restore pre-development hydrologic conditions through groundwater recharge
▪ Reduces runoff rates, volumes, and pollutant loads
▪ Attractive landscaping features
▪ Good for small sites with porous soils</td><td colspan="4">▪ CDA should be less than 2 acres.
▪ Potential for groundwater contamination
▪ High clogging potential;
▪ Not for sites with fine soils (clays/silts) in CDA
▪ Geotechnical testing required</td></tr>
<tr><th colspan="2">Components</th><th colspan="4">Design considerations</th></tr>
<tr><td colspan="2">▪ Pretreatment
▪ Conveyance system
▪ Ponding area
▪ Soils/Filter Media/Mulch
▪ Observation Well/Monitoring Port
▪ Plants</td><td colspan="4">▪ Depth to seasonal high water table must be at least 6 inches below bottom of practice
▪ Must infiltrate within 72 hours</td></tr>
<tr><th colspan="6">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Inspect for clogging</td><td colspan="4">▪ Replace soil/stone if it becomes clogged
▪ Clean conveyance system(s)</td></tr>
</table>

[1]*Credited pollutant load removal*

Infiltration practices are suitable for use in residential and other urban areas where field measured soil infiltration rates are sufficient. To prevent possible groundwater contamination, infiltration must not be utilized at sites designated as stormwater hotspots. If properly designed, they can provide significant reductions in post-construction stormwater runoff rates, volumes, and pollutant loads on development sites (Figure 4.16**)**

Figure 4.16. Infiltration practice in median strip.

Definition

Practices that capture and temporarily store the design storm volume before allowing it to infiltrate into the soil over a three-day period. Infiltration practices use temporary surface or underground storage to allow incoming stormwater runoff to exfiltrate into underlying soils. Runoff first passes through multiple pretreatment mechanisms to trap sediment and organic matter before it reaches the practice. As the stormwater penetrates the underlying soil, chemical and physical adsorption processes remove pollutants. Infiltration practices are suitable for use in residential and other urban areas where field-verified saturated hydraulic conductivity is sufficient.

Design variants include the following:

I-1 Infiltration trench

I-2 Infiltration basin

Infiltration Trenches

Infiltration trenches are excavated trenches filled with stone. Stormwater runoff is captured and temporarily stored in the stone reservoir, where it is allowed to infiltrate into the surrounding and underlying native soils. Infiltration trenches can be used to “receive” stormwater runoff from contributing drainage areas of up to 2 acres in size and should only be used on development sites where sediment loads can be kept relatively low (see Figure 4.17 and Figure 4.18).

Infiltration Basins

Infiltration basins are shallow, landscaped excavations filled with an engineered soil mix. They are designed to capture and temporarily store stormwater runoff in the engineered soil mix, where it is subjected to the hydrologic processes of evaporation and transpiration, before being allowed to infiltrate into the surrounding soils. They are essentially non-underdrained bioretention areas and should also only be used on drainage areas up to 5 acres where sediment loads can be kept relatively low (Figure 4.19).

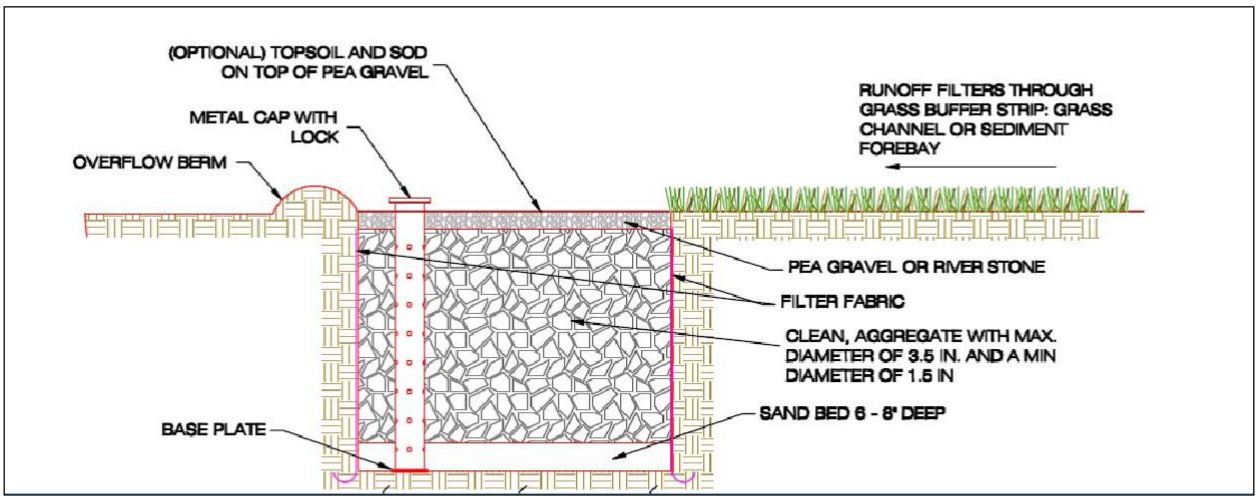


Figure 4.17. Example design of an infiltration trench.

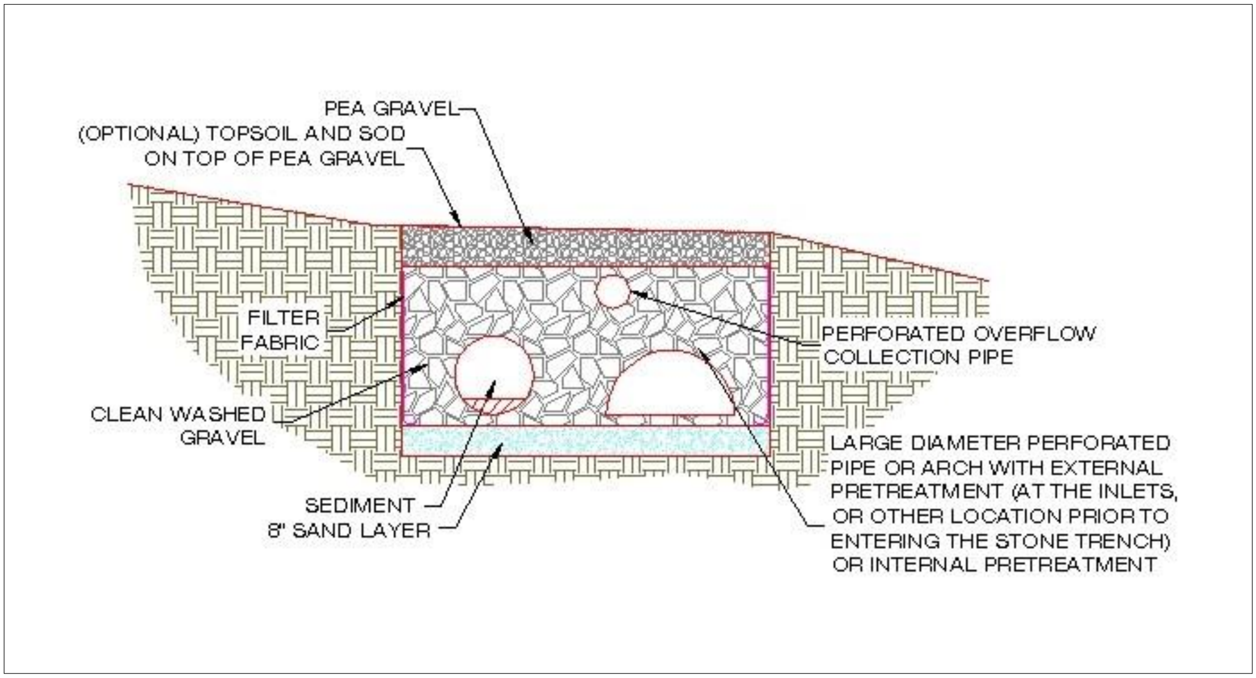


Figure 4.18. Example design of an infiltration practice with supplemental pipe storage.

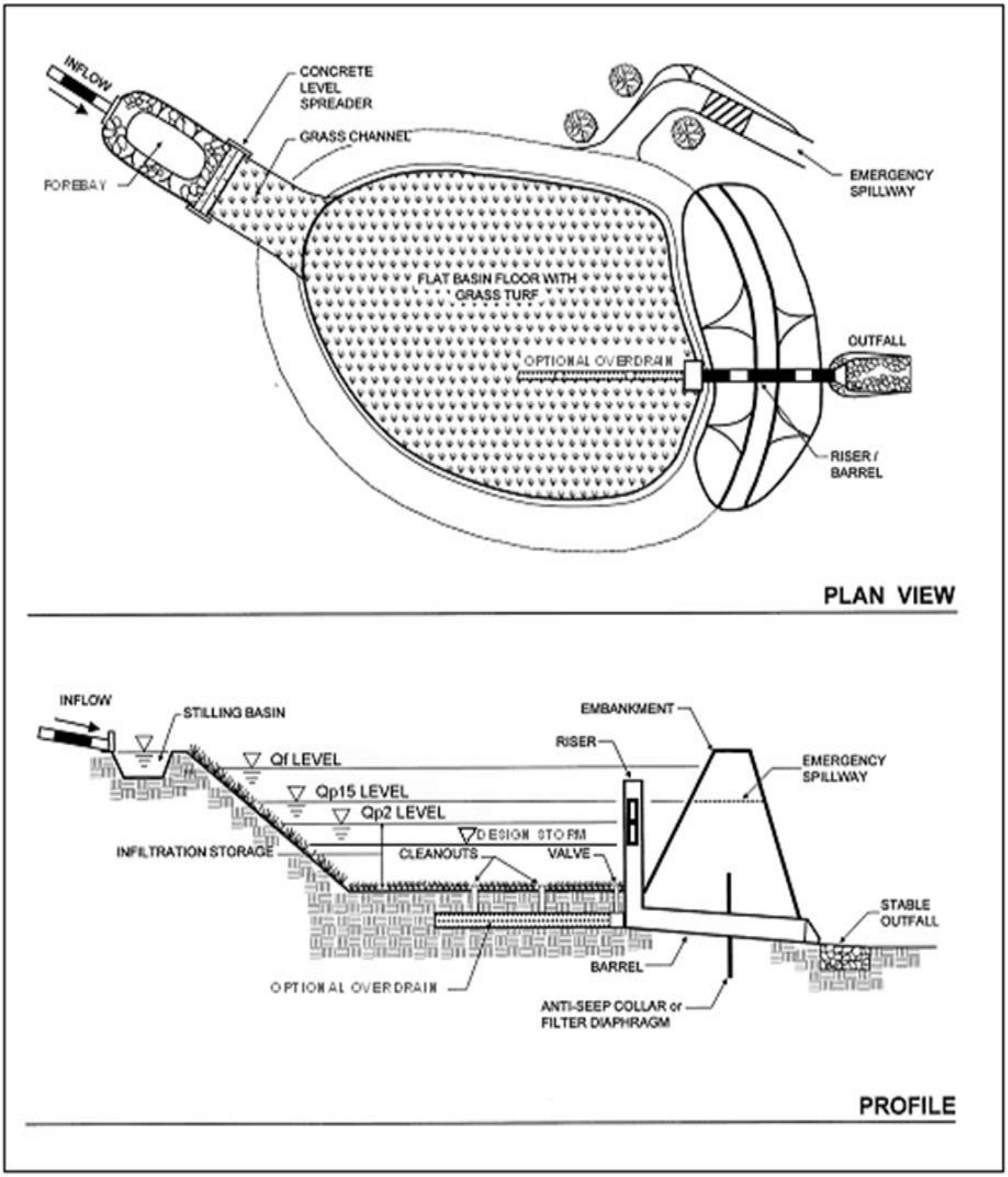


Figure 4.19. Example design of an infiltration basin.

4.5.1 Infiltration Feasibility Criteria

Infiltration practices have very high storage and retention capabilities when sited and designed appropriately. Designers should evaluate the range of soil properties during initial site layout and seek to configure the site to conserve and protect the soils with the greatest recharge and infiltration rates. In particular, areas of HSG A or B soils, shown on the U.S. Department of Agriculture's NRCS soil surveys, should be considered as primary locations for infiltration practices. Additional information about soil and infiltration are described in more detail later in this section. During initial design phases, designers should carefully identify and evaluate constraints on infiltration, as follows:

Underground Injection Control for Class V Wells

In order for an infiltration practice to avoid classification as a Class V well, which is subject to regulation under the Federal Underground Injection Control program, the practice must be wider than the practice is deep. If an infiltration practice is "deeper than its widest surface dimension" or if it includes an underground distribution system, then it will likely be considered a Class V injection well. Class V injection wells are subject to permit approval by the U.S. Environmental Protection Agency (EPA).

Contributing Drainage Area

The maximum CDA to an individual infiltration practice should be less than 2 acres and as close to 100% impervious as possible. The design, pretreatment, and maintenance requirements will differ depending on the size of the infiltration practice.

Site Topography

The infiltration practice shall not be located on slopes greater than 6%, although check dams or other devices may be employed to reduce the effective slope of the practice. Further, unless slope stability calculations demonstrate otherwise, infiltration practices should be located a minimum horizontal distance of 200 feet from down-gradient slopes greater than 20%.

Minimum Hydraulic Head

Two or more feet of head may be needed to promote flow through infiltration practices.

Minimum Depth to Water Table

A minimum vertical distance of 0.5 feet must be provided between the bottom of the infiltration practice.

Tidal Impacts

The bottom of an infiltration practice should be located above the tidal mean high water elevation. Where this is not possible, portions of the practice below the tidal mean high water elevation cannot be included in the volume calculations.

Soils

Initially, soil infiltration rates can be estimated from NRCS soil data for feasibility purposes, but designers must verify soil permeability by using the on-site soil investigation methods provided in Appendix B Geotechnical Information Requirements for Underground BMPs for their design.

Use on Urban Fill Soils/Redevelopment Sites

Sites that have been previously graded or disturbed do not typically retain their original soil permeability due to compaction. Therefore, such sites are often not good candidates for infiltration practices unless the geotechnical investigation shows that a sufficient saturated hydraulic conductivity exists.

Dry Weather Flows

Infiltration practices should not be used on sites receiving regular dry-weather flows from sump pumps, irrigation water, chlorinated wash-water, or flows other than stormwater.

Setbacks

To avoid the risk of seepage, stormwater cannot flow from infiltration practices to traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements. Where the 10-foot setback is not possible, an impermeable liner may be used along the sides and bottom of the infiltration area (extending from the surface to the bottom of the practice and outward to meet the 10-foot setback). Areas where the liner blocks infiltration should be excluded from surface area calculations for the practice. In locations where the surface soil consists of highly permeable soils with little separation of the infiltration trench or basin bottom, the extent of ground water mounding should be considered. Mounding can occur in areas where infiltrating water intersects a groundwater table and the rate of water entering the subsurface is greater than the rate at which water is conveyed away from the infiltration system (MPCA, 2019). Ground water mounding may impact building foundations, soil stability, underground utilities and potentially on-site treatment systems (septic leach beds).

All setbacks must be verified by a professional geotechnical engineer registered in the State of South Carolina.

Proximity to Utilities

Interference with underground utilities should be avoided, if possible. When large site development is undertaken the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the PROW. Consult with each utility company on recommended offsets, which will allow utility maintenance work with minimal disturbance to the infiltration BMP. Infiltration BMPs in the PROW will also conform with the State of South Carolina Department of Transportation design specifications. Where conflicts cannot be avoided, follow these guidelines:

- Consider altering the location or sizing of the infiltration BMP to avoid or minimize the utility conflict. Consider an alternate BMP type to avoid conflict.
- Use design features to mitigate the impacts of conflicts that may arise by allowing the infiltration BMP and the utility to coexist. The infiltration BMP design may need to incorporate impervious areas, through geotextiles or compaction, to protect utility crossings. Other key design features may need to be moved, added, or deleted.
- Evaluate the relocation of the existing utility and install an optimally placed and sized infiltration BMP.
- If utility functionality, longevity and vehicular access to manholes can be assured, accept the infiltration BMP design and location with the existing utility. Incorporate into the infiltration BMP design sufficient soil coverage over the utility or general clearances or other features such as an impermeable linear to assure all entities the conflict is limited to maintenance.

Note: When accepting utility conflict into the infiltration BMP location and design, it is understood the infiltration BMP will be temporarily impacted during utility work. At the conclusion of this work, the utility owner will replace the infiltration BMP or, alternatively, install a functionally comparable infiltration BMP according to the specifications in the current version of this guidebook. If the infiltration BMP is located in the PROW the infiltration BMP restoration will also conform with the State of South Carolina Department of Transportation design specification.

Pollutant Hotspots and High Loading Situations

Infiltration practices are not intended to treat sites with high sediment or trash or debris loads, because such loads will cause the practice to clog and fail. Infiltration practices must be avoided at potential stormwater hotspots that pose a risk of groundwater contamination. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil-water separator or filtering device must be provided. These pretreatment facilities should be monitored and maintained frequently to avoid negative impacts to the infiltration area and groundwater.

On sites with existing contaminated soils, infiltration is not allowed.

Economic Considerations

Infiltration practices do require a designated space on the site, which in space-constrained areas, may reduce available building space. However, infiltration practices have a relatively low construction cost, and high space efficiency. In some cases, they can even be incorporated into the detention design or landscaped areas

4.5.2 Infiltration Conveyance Criteria

The nature of the conveyance and overflow to an infiltration practice depends on the scale of infiltration and whether the facility is on-line or off-line. Where possible, conventional infiltration practices should be designed off-line to avoid damage from the erosive velocities of larger design storms. If runoff is delivered by a storm drain pipe or along the main conveyance system, the infiltration practice shall be designed as an off-line practice. Pretreatment shall be provided for storm drain pipes and conveyance systems discharging directly to infiltration systems.

Off-line Infiltration

Overflows can either be diverted from entering the infiltration practice or dealt with via an overflow inlet. Optional overflow methods include the following:

- Utilize a low-flow diversion or flow splitter at the inlet to allow only the design SWRv to enter the facility. This may be achieved with a weir or curb opening sized for the target flow, in combination with a bypass channel. Using a weir or curb opening helps minimize clogging and reduces the maintenance frequency (further guidance on determining the peak flow rate will be necessary in order to ensure proper design of the diversion structure).
- Use landscaping type inlets or standpipes with trash guards as overflow devices.

On-line Infiltration

An overflow structure must be incorporated into on-line designs to safely convey the 25-year storm through the infiltration area. Mechanisms such as elevated drop inlets and overflow weirs are examples of how to direct high flows to a non-erosive down-slope overflow channel, stabilized water course, or storm sewer system designed to convey the 25-year design storm.

4.5.3 Infiltration Pretreatment Criteria

Every infiltration system shall have pretreatment mechanisms to protect the long-term integrity of the infiltration rate. One of the following techniques must be installed to pretreat 100% of the inflow in every facility:

- Grass channel
- Grass filter strip (minimum 20 feet and only if sheet flow is established and maintained)
- Forebay or sump pit (must accommodate a minimum 15% of the design storm volume)
- Gravel diaphragm (minimum 1 foot deep and 2 feet wide and only if sheet flow is established and maintained)
- Filter system (see Section 4.10 Filtering Systems) If using a filter system as a pretreatment facility, the sand filter will not require its own separate pretreatment facility.
- A proprietary structure with demonstrated capability of reducing sediment and hydrocarbons may be used to provide pretreatment. Refer to Section 0 Proprietary Practices.

If the basin serves a CDA greater than 20,000 square feet, a forebay, sump pit, filter system, or proprietary practice must be used for pretreatment.

Exit velocities from the pretreatment chamber shall not be erosive (above 6 fps) during the 25-year design storm and flow from the pretreatment chamber should be evenly distributed across the width of the practice (e.g., using a level spreader).

4.5.4 Infiltration Design Criteria **<u>Geometry</u>**

Where possible, an infiltration practice should be designed to be wider than it is deep, to avoid classification as a Class V injection well.

<u>Practice Slope</u>

The bottom of an infiltration practice should be flat (i.e., 0% longitudinal and lateral slopes) to enable even distribution and infiltration of stormwater.

<u>Infiltration Basin Geometry</u>

The maximum vertical depth to which runoff may be ponded over an infiltration basin is 24 inches. The side-slopes should be no steeper than 4H:1V.

<u>Surface Cover (optional)</u>

Designers may choose to install a layer of topsoil and grass above the infiltration practice.

<u>Surface Stone</u>

A 3-inch layer of clean, washed river stone or No. 8 or 89 stone should be installed over the stone layer.

<u>Stone Layer</u>

Stone layers must consist of clean, washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches.

<u>Observation Wells</u>

All infiltration practices must include at least one observation well. The observation well is used to observe the rate of drawdown within the infiltration practice following a storm event and to facilitate periodic inspection and maintenance. The observation well should consist of a well-anchored, perforated 4- to 6-inch diameter PVC pipe. There should be no perforation within 1 foot of the surface. The observation well should extend vertically to the bottom of the stone layer and extend upward to the top of ponding.

Underground Storage (optional)
In the underground mode, runoff is stored in the voids of the stones and infiltrates into the underlying soil matrix. Perforated corrugated metal pipe, plastic pipe, concrete arch pipe, or comparable materials can be used in conjunction with the stone to increase the available temporary underground storage. In some instances, a combination of filtration and infiltration cells can be installed in the floor of a dry extended detention (ED) pond.

Overflow Collection Pipe (Overdrain)
An optional overflow collection pipe can be installed in the stone layer to convey collected runoff from larger storm events to a downstream conveyance system.

Trench Bottom
To protect the bottom of an infiltration trench from intrusion by underlying soils, a sand layer must be used. The underlying native soils must be separated from the stone layer by a 6- to 8-inch layer of coarse sand (e.g., ASTM C-33, 0.02–0.04 inches in diameter).

Geotextile Fabric
An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used. This layer should be applied only to the sides of the practice.

Material Specifications
Recommended material specifications for infiltration areas are shown in Table 4.18.

Table 4.18. Infiltration practice material specifications.

Material	Specification	Notes
Surface Layer (optional)	Topsoil and grass layer	
Surface Stone	Install a 3-inch layer of river stone or pea gravel.	Provides an attractive surface cover that can suppress weed growth.
Stone Layer	Clean, double-washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches.	
Observation Well	Install a vertical 6-inch Schedule 40 PVC perforated pipe, with a lockable cap and anchor plate.	Install one per 50 feet of length of infiltration practice.
Overflow Collection Pipe (optional)	Use 4- or 6-inch rigid schedule 40 PVC pipe, with three or four rows of 3/8-inch perforations at 6 inches on center.	
Trench Bottom	Install a 6- to 8-inch sand layer (e.g., ASTM C-33, 0.02–0.04 inches in diameter)	
Geotextile Fabric (sides only)	An appropriate geotextile fabric that complies with AASHTO M-288 Class 2, latest edition, requirements and has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability must be used.	

Practice Sizing

The proper approach for designing infiltration practices is to avoid forcing a large amount of infiltration into a small area. Therefore, individual infiltration practices that are limited in size due to soil permeability and available space need not be sized to achieve the full design storm volume (SWRv) for the CDA, as long as other stormwater treatment practices are applied at the site to meet the remainder of the design storm volume.

Several equations (see following page) are needed to size infiltration practices. The first equations establish the maximum depth of the infiltration practice, depending on whether it is a surface basin (Equation 4.6) or trench with an underground reservoir (Equation 4.7)

Equation 4.6. Maximum surface basin depth for infiltration basins.

$$d_{max} = K_{sat} \times t_d$$

Equation 4.7. Maximum underground reservoir depth for infiltration trenches.

$$d_{max} = \frac{(K_{sat} \times t_d)}{\eta_r}$$

Where:

d_{max} = Maximum depth of the infiltration practice (ft)
K_{sat} = Field-verified saturated hydraulic conductivity for the native soils (ft/day)
t_d = Maximum drawdown time (days, normally 3 days)
η_r = Available porosity of the stone reservoir (assume 0.4)

These equations make the following design assumptions:

- **Stone Layer Porosity**
  A porosity value of 0.4 shall be used in the design of stone reservoirs, although a larger value may be used if perforated corrugated metal pipe, plastic pipe, concrete arch pipe, or comparable materials are installed within the reservoir.
- **Rapid Drawdown**
  Infiltration practices must be sized so that the design volume infiltrates within 72 hours, to prevent nuisance ponding conditions.

Designers should compare these results to the maximum allowable depths in Table 4.19 and use whichever value is less for the subsequent design.

Table 4.19. Maximum facility depth for infiltration practices.

Mode of Entry	**Scale of Infiltration**		
	Micro Infiltration ($250–2,500\ ft^2$)	**Small Scale Infiltration ($2,500–20,000\ ft^2$)**	**Conventional Infiltration ($20,000–100,000\ ft^2$)**
Surface Basin	1.0	1.5	2.0
Underground Reservoir	3.0	5.0	varies

Once the maximum depth is known, calculate the surface area needed for an infiltration practice using Equation 4.8 or Equation 4.9.

Equation 4.8. Surface basin surface area for infiltration basins.

$$SA = \frac{\text{DesignStorm}}{d + (K_{sat} \times t_f)}$$

Equation 4.9. Underground reservoir surface area for infiltration trenches.

$$SA = \frac{\text{DesignStorm}}{(\eta_r \times d) + (0.5 \times K_{sat} \times t_f)}$$

Where:

SA =	Surface area (square feet)
DesignStorm =	SWRv or other design storm volume (e.g., portion of the SWRv; cubic feet)
η_r =	Available porosity of the stone reservoir (assume 0.4)
d =	Infiltration depth (feet; maximum depends on the scale of infiltration and the results of Equation 4.6 or Equation 4.7)
K_{sat} =	Field-verified saturated hydraulic conductivity for the native soils (ft/day)
t_f =	Time to fill the infiltration facility (days; typically 2 hours or 0.083 days)

The storage volume (Sv) captured by the infiltration practice is defined as the volume of water that is fully infiltrated through the practice (i.e., no overflow). Designers may choose to infiltrate less than the full design storm (SWRv). In this case, the design volume captured must be treated as the Sv of the practice (see Section 4.5.4 Infiltration Design Criteria). Sv can be determined by rearranging Equation 4.8 and Equation 4.9 to yield Equation 4.10 and Equation 4.11.

Equation 4.10. Storage volume for surface basin area for infiltration basins.

$$\mathrm{Sv} = \mathrm{SA} \times [\mathrm{d} + (\mathrm{K_{sat}} \times \mathrm{t_f})]$$

Equation 4.11. Storage volume for underground reservoir surface area for infiltration trenches.

$$\mathrm{Sv} = \mathrm{SA} \times [(\eta_r \times \mathrm{d}) + (\mathrm{K_{sat}} \times \mathrm{t_f})]$$

Infiltration practices can also be designed to address, in whole or in part, the detention storage needed to comply with channel protection and/or flood control requirements. The designer can model various approaches by factoring in storage within the stone aggregate layer, any perforated corrugated metal pipe, plastic pipe, concrete arch pipe, or comparable materials installed within the reservoir, expected infiltration, and any outlet structures used as part of the design. Routing calculations can also be used to provide a more accurate solution of the peak discharge and required storage volume.

4.5.5 Infiltration Landscaping Criteria

Infiltration trenches can be effectively integrated into the site plan and aesthetically designed with adjacent native landscaping or turf cover, subject to the following additional design considerations:

- Infiltration practices should not be installed until all up-gradient construction is completed and pervious areas are stabilized with dense and healthy vegetation, unless the practice can be kept off-line so it receives no runoff until construction and stabilization is complete.
- Vegetation associated with the infiltration practice buffers should be regularly maintained to limit organic matter in the infiltration device and maintain enough vegetation to prevent soil erosion from occurring.

4.5.6 Infiltration Construction Sequence

Infiltration practices are particularly vulnerable to failure during the construction phase for two reasons. First, if the construction sequence is not followed correctly, construction sediment can clog the practice. Second, loading from heavy construction equipment can result in compaction of the soil, which can then reduce the soil's infiltration rate. For this reason, a careful construction sequence needs to be followed.

During site construction, the following protective measures are absolutely critical:

- All areas proposed for infiltration practices should be fully protected from sediment intrusion by silt fence or construction fencing, particularly if they are intended to infiltrate runoff.
- Avoid excessive compaction by preventing construction equipment and vehicles from traveling over the proposed location of the infiltration practice. To accomplish this, areas intended to infiltrate runoff must remain outside the limits of disturbance during construction.
- When this is unavoidable, there are several possible remedies for the impacted area.
    - If excavation at the impacted area can be restricted then remediation can be achieved with deep tilling practices. This is only possible if in situ soils are not disturbed below 2 feet above the final design elevation of the bottom of the infiltration practice. In this case, when heavy equipment activity has ceased, the area is excavated to grade, and the impacted area must be tilled a minimum of 12 inches below the bottom of the infiltration practice.

- Alternatively, if it is infeasible to keep the proposed infiltration practice outside of the limits of disturbance, and excavation of the area cannot be restricted, then infiltration tests will be required prior to installation of the infiltration practice to ensure that the design infiltration rate is still present. If tests reveal the loss of design infiltration rates then deep tilling practices may be used in an effort to restore those rates. In this case further testing must be done to establish design rates exist before the infiltration practice can be installed.
- Finally, if it is infeasible to keep the proposed permeable pavement areas outside of the limits of disturbance, excavation of the area cannot be restricted, and infiltration tests reveal design rates cannot be restored, then a resubmission of the SWMP will be required.

- Any area of the site intended ultimately to be an infiltration practice should not be used as the site of a temporary sediment trap or basin. If locating a sediment trap or basin on an area intended for infiltration is unavoidable, the remedies are similar to those discussed for heavy equipment compaction. If it is possible, restrict the invert of the sediment trap or basin to at least 2 feet above the final design elevation of the bottom of the proposed infiltration practice. Then remediation can be achieved with proper removal of trapped sediments and deep tilling practices. An alternate approach to deep tilling is to use an impermeable linear to protect the in situ soils from sedimentation while the sediment trap or basin is in use. In each case, all sediment deposits must be carefully removed prior to installing the infiltration practice.
- Keep the infiltration practice off-line until construction is complete. Prevent sediment from entering the infiltration site by using super silt fence, diversion berms, or other means. In the soil erosion and sediment control plan, indicate the earliest time at which stormwater runoff may be directed to a conventional infiltration basin. The soil erosion and sediment control plan must also indicate the specific methods to be used to temporarily keep runoff from the infiltration site.
- Upland CDAs need to be completely stabilized with a well-established layer of vegetation prior to commencing excavation for an infiltration practice.

<u>Infiltration Installation</u>

The actual installation of an infiltration practice is done using the following steps:

1. Avoid Impact of Heavy Installation Equipment

Excavate the infiltration practice to the design dimensions from the side using a backhoe or excavator. The floor of the pit should be completely level, but equipment should be kept off the floor area to prevent soil compaction.

2. Hang Geotextile Walls

Install geotextile fabric on the trench sides. Large tree roots should be trimmed flush with the sides of infiltration trenches to prevent puncturing or tearing of the geotextile fabric during subsequent installation procedures. When laying out the geotextile, the width should include sufficient material to compensate for perimeter irregularities in the trench and for a 6-inch minimum overlap at the top of the trench. The geotextile fabric itself should be tucked under the sand layer on the bottom of the infiltration trench. Stones or other anchoring objects should be placed on the fabric at the trench sides, to keep the trench open during windy periods. Voids may occur between the fabric and the excavated sides of a trench. Natural soils should be placed in all voids, to ensure the fabric conforms smoothly to the sides of excavation.

3. Promote Infiltration Rate
Scarify the bottom of the infiltration practice and spread 6 inches of sand on the bottom as a filter layer.

4. Observation Wells
Anchor the observation well(s) and add stone to the practice in 1-foot lifts.

5. Stabilize Surrounding Area
Use sod, where applicable, to establish a dense turf cover for at least 10 feet around the sides of the infiltration practice, to reduce erosion and sloughing.

Construction Supervision
Supervision during construction is recommended to ensure that the infiltration practice is built in accordance with the approved design and this specification. Qualified individuals should use detailed inspection checklists to include sign-offs at critical stages of construction, to ensure that the contractor's interpretation of the plan is consistent with the designer's intentions.

4.5.7 Infiltration Maintenance Criteria

Maintenance is a crucial and required element that ensures the long-term performance of infiltration practices. The most frequently cited maintenance problem for infiltration practices is clogging of the stone layer by organic matter and sediment. The following design features can minimize the risk of clogging:

Stabilized CDA
Infiltration systems may not receive runoff until the entire CDA has been completely stabilized.

Observation Well
Infiltration practices must include an observation well to facilitate periodic inspection and maintenance. Design criteria must include an anchored 6-inch diameter perforated PVC pipe fitted with a lockable cap installed flush with the ground surface.

No Geotextile Fabric on Bottom
Avoid installing geotextile fabric along the bottom of infiltration practices. Experience has shown that geotextile fabric is prone to clogging. However, permeable geotextile fabric should be installed on the trench sides to prevent soil piping.

Direct Maintenance Access
Access must be provided to allow personnel and heavy equipment to perform atypical maintenance tasks, such as practice reconstruction or rehabilitation. While a turf cover is permissible for small-scale infiltration practices, the surface must never be covered by an impermeable material, such as asphalt or concrete.

Maintenance Inspections
Effective long-term operation of infiltration practices requires a dedicated and routine maintenance inspection schedule with clear guidelines and schedules, as shown in Table 4.20. Where possible, facility maintenance should be integrated into routine landscaping maintenance tasks.

Table 4.20. Typical maintenance activities for infiltration practices.

Schedule	Maintenance Activity
Quarterly	▪ Ensure that the CDA, inlets, and facility surface are clear of debris. ▪ Ensure that the CDA is stabilized. Perform spot-reseeding if where needed. ▪ Remove sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, and overflow structures. ▪ Repair undercut and eroded areas at inflow and outflow structures.
Semi-annual inspection	▪ Check observation wells 3 days after a storm event in excess of 0.5 inch in depth. Standing water observed in the well after 3 days is a clear indication of clogging. ▪ Inspect pretreatment devices and diversion structures for sediment build-up and structural damage.
Annually	▪ Clean out accumulated sediment from the pretreatment cell.
As needed	▪ Replace pea gravel/topsoil and top surface geotextile fabric (when clogged). ▪ Mow vegetated filter strips as necessary and remove the clippings.

It is highly recommended that a qualified professional conduct annual site inspections for infiltration practices to ensure the practice performance and longevity of infiltration practices.

Beaufort County Public Works Departments's maintenance inspection checklist for infiltration systems and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.5.8 Infiltration Stormwater Compliance Calculations

Infiltration practices are credited with 100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (Table 4.21).

Table 4.21. Retention and pollutant removal for infiltration practices.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

The practice must be sized using the guidance detailed in Section 4.3.4 Infiltration Design Criteria.

Infiltration practices also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) from the total runoff volume for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.6 Green Roofs

Green Roofs
Definition: Practices that capture and store rainfall in an engineered growing media installed over a waterproof membrane that is designed to support plant growth on the roof of a building or other structure.

Site Applicability		BMP Performance Summary		
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High		
▪ Urban ▪ Suburban	**Small**	**TSS[1]**	**Total N[1]**	**Bacteria[1]**
		100%	100%	100%
		Runoff Reduction		
Construction Costs	**Maintenance Burden**	**Volume**		
High	Low	High		
Maintenance Frequency:		***SWRv***		
Routine	**Non-Routine**	100% of *Sv*		
Semi-annually	As needed			

Advantages/Benefits	Disadvantages/Limitation
▪ Reduces runoff volume and pollutant loads ▪ Energy savings: keep buildings cool, prolongs roof life ▪ Possible amenity space for public or users ▪ Sound absorption ▪ Life cycle costs comparable to traditional roof	▪ For retrofits, strengthening structure may be required ▪ If roof leaks occur, may be harder to trace ▪ Design and installation require specialized knowledge ▪ Typically applied on flat roofs (1%–2% pitch) ▪ Installation costs higher than for traditional roof

Components	Design considerations
▪ Vegetation that thrives in rooftop climate. ▪ Engineered planting medium (not soil). ▪ Containment (Modular systems - plant containers; Non-modular systems - barriers at roof perimeter/drainage structures). ▪ Drainage layer, sometimes with built-in water reservoirs. ▪ Water proofing layer or roof membrane with root repellant.	▪ Good waterproofing material and installation are essential. ▪ Materials used must be lightweight. ▪ Building structure must be able to support saturated weight. ▪ Roofs with moderate to flat slopes are most appropriate. Maximum roof slope of 30%.

Maintenance Activities	
▪ Watering and fertilization until well-established ▪ Occasional weeding	▪ Inspection for proper drainage and plant health ▪ Ordinary life cycle roof replacement

[1]*Credited pollutant load removal*

Green roofs are practices that capture and store rainfall in an engineered growing media that is designed to support plant growth (see Figure 4.20**). A portion of the captured rainfall evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. Green roofs typically contain a layered system of roofing, which is designed to support plant growth and retain water for plant uptake while preventing ponding on the roof surface. The roofs are designed so that water drains vertically through the media and then horizontally along a waterproofing layer towards the outlet. Extensive green roofs are designed to have minimal maintenance requirements. Plant species are selected so that the roof does not need supplemental irrigation or fertilization after vegetation is initially established.**

Green roofs are typically not designed to provide stormwater detention of larger storms (e.g., 2 - 25**-year) although some intensive green roof systems may be designed to meet these criteria. Green roof designs should generally be combined with a separate facility to provide large storm controls.**


Figure 4.20. Green roof (photo: Center for Watershed Protection, Inc.)

<u>Definition</u>
Practices that capture and store rainfall in an engineered growing media installed over a waterproof membrane that is designed to support plant growth on the roof of a building or other structure. A portion of the captured rainfall evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites. Green roofs typically contain a layered system of roofing, which is designed to support plant growth and retain water for plant uptake while preventing ponding on the roof surface. The roofs are designed so that water drains vertically through the media and then horizontally along a waterproofing layer towards the outlet. Plant species are selected so that the roof does not need supplemental irrigation and requires minimal, infrequent fertilization after vegetation is initially established.

Design variants include extensive and intensive green roofs.

G-1 Extensive green roofs have a much shallower growing media layer that typically ranges from 3 to 8 inches thick and are designed to have minimal maintenance requirements.

G-2 Intensive green roofs have a growing media layer that typically ranges from 8 to 48 inches thick.

Green roofs are typically not designed to provide stormwater detention of larger storms (e.g., 2 - 25-year) although some intensive green roof systems may be designed to meet these criteria. Most green roof designs shall generally be combined with a separate facility to provide large storm controls.

This specification is intended for situations where the primary design objective of the green roof is stormwater management and, unless specified otherwise, addresses the design of extensive roof systems. While rooftop practices such as urban agriculture may provide some retention, their primary design objective is not stormwater management and is not addressed in this specification.

4.6.1 Green Roof Feasibility Criteria

Green roofs are ideal for use on commercial, institutional, municipal, and multi-family residential buildings. They are particularly well-suited for use on ultra-urban development and redevelopment sites. Key constraints with green roofs include the following:

<u>**Structural Capacity of the Roof**</u>

When designing a green roof, designers must not only consider the stormwater storage capacity of the green roof but also its structural capacity to support the weight of the additional water. A conventional rooftop should typically be designed to support an additional 15 to 30 pounds per square foot (psf) for an extensive green roof. As a result, a structural engineer, architect, or other qualified professional should be involved with all green roof designs to ensure that the building has enough structural capacity to support a green roof. See Section 4.6.4 Green Roof Design Criteria for more information on structural design considerations.

<u>**Hurricane-Prone Areas**</u>

As South Carolina is subject to hurricanes, some may be concerned about the durability of green roofs in high winds. Having good vegetative cover and root growth in the growing media is the most effective way to reduce wind erosion of the media during high winds. New green roofs where the plants have not yet deeply rooted are the most susceptible to plant damage and media blow-off in a hurricane. Therefore, it is best to install a green roof three or more months prior to hurricane season, to allow enough time for the plants to be established.

<u>**Roof Pitch**</u>

Green roof storage volume is maximized on relatively flat roofs (a pitch of 1% to 2%). Some pitch is needed to promote positive drainage and prevent ponding and/or saturation of the growing media. Green roofs can be installed on rooftops with slopes up to 30% if baffles, grids, or strips are used to prevent slippage of the media. These baffles must be designed to ensure the roof provides adequate storage for the design storm. Slopes greater than 30% would be considered a green wall, which is not specifically identified as a stormwater BMP. Green walls can be used to receive cistern discharge (calculations are necessary to determine demand).

Roof Access
Adequate, permanent access to the roof must be available to deliver construction materials and perform routine maintenance. A temporary ladder is not sufficient for access to the roof. Roof access can be achieved either by an interior stairway through a penthouse or by an alternating tread device with a roof hatch or trap door not less than 16 square feet in area and with a minimum dimension of 24 inches (NVRC, 2007). Designers should also consider how they will get construction materials up to the roof (e.g., by elevator or crane) and how the roof structure can accommodate material stockpiles and equipment loads. If material and equipment storage is required, rooftop storage areas must be identified and clearly marked based on structural load capacity of the roof.

Roof Type
Green roofs can be applied to most roof surfaces. Certain roof materials, such as exposed treated wood and uncoated galvanized metal, may not be appropriate for green rooftops due to pollutant leaching through the media (Clark et al., 2008).

Setbacks
Green roofs should not be located near rooftop electrical and HVAC systems. A 2-foot-wide vegetation-free zone is recommended along the perimeter of the roof with a 1-foot vegetation-free zone around all roof penetrations, to act as a firebreak. The 2-foot setback may be relaxed for small or low green roof applications where parapets have been properly designed.

Contributing Drainage Area
It is recommended that the contributing drainage area (CDA) to a green roof be limited to the green roof itself. In cases where there will be additional CDA, the designer must provide sufficient design detail showing distribution of this additional runoff throughout the green roof area to prevent erosion or overloading of the roof growing media with the use of level spreaders, splash pads, perforated piping, or other flow dissipation techniques. The absolute maximum CDA to a green roof shall be no more than 100% larger than the area of the green roof (e.g., a 1,000-square-foot green roof can have no more than 1,000 square feet of additional impervious cover draining to it).

Local Building Codes
The green roof design must comply with the local building codes with respect to roof drains and emergency overflow devices. Additionally, a structural engineer should certify that the design complies with structural building codes. For green roofs installed on historic buildings or in historic districts, consult local building codes and architectural review criteria to determine if any special requirements exist for green roof design or maintenance.

Additionally, a State of South Carolina registered structural engineer must certify that the design complies with State building structural codes. This is true for new construction as well as retrofit projects.

Economic Considerations
Green roofs tend to be one of the most expensive BMPs on a per cubic foot captured basis. However, a green roof allows stormwater management to be achieved in otherwise unused space, a major benefit in space-constrained locations. Further, green roofs provide many other non-stormwater services with economic benefits, including increased insulation and roof life expectancy

4.6.2 Green Roof Conveyance Criteria

The green roof drainage layer (refer to Section 4.6.4 Green Roof Design Criteria) must convey flow from under the growing media directly to an outlet or overflow system such as a traditional rooftop downspout drainage system. The green roof drainage layer must be adequate to convey the volume of stormwater equal to the flow capacity of the overflow or downspout system without backing water up onto the rooftop or into the green roof media. Roof drains immediately adjacent to the growing media should be boxed and protected by flashing extending at least 3 inches above the growing media to prevent clogging. However, an adequate number of roof drains that are not immediately adjacent to the growing media must be provided so as to allow the roof to drain without 3 inches of ponding above the growing media.

4.6.3 Green Roof Pretreatment Criteria

Pretreatment is not necessary for green roofs.

4.6.4 Green Roof Design Criteria

<u>Structural Capacity of the Roof</u>

Green roofs can be limited by the additional weight of the fully saturated soil and plants, in terms of the physical capacity of the roof to bear structural loads. The designer shall consult with a licensed structural engineer to ensure that the building will be able to support the additional live and dead structural load and to determine the maximum depth of the green roof system and any needed structural reinforcement. Typically, the green roof manufacturer can provide specific background specifications and information on their product for planning and design.

In most cases, fully saturated extensive green roofs have loads of about 15 to 30 pounds per square foot, which is fairly similar to traditional new rooftops (12 to 15 pounds per square foot) that have a waterproofing layer anchored with stone ballast.

<u>Functional Elements of a Green Roof System</u>

A green roof is composed of up to nine different systems or layers that combine to protect the roof and maintain a vigorous cover (see Figure 4.21).

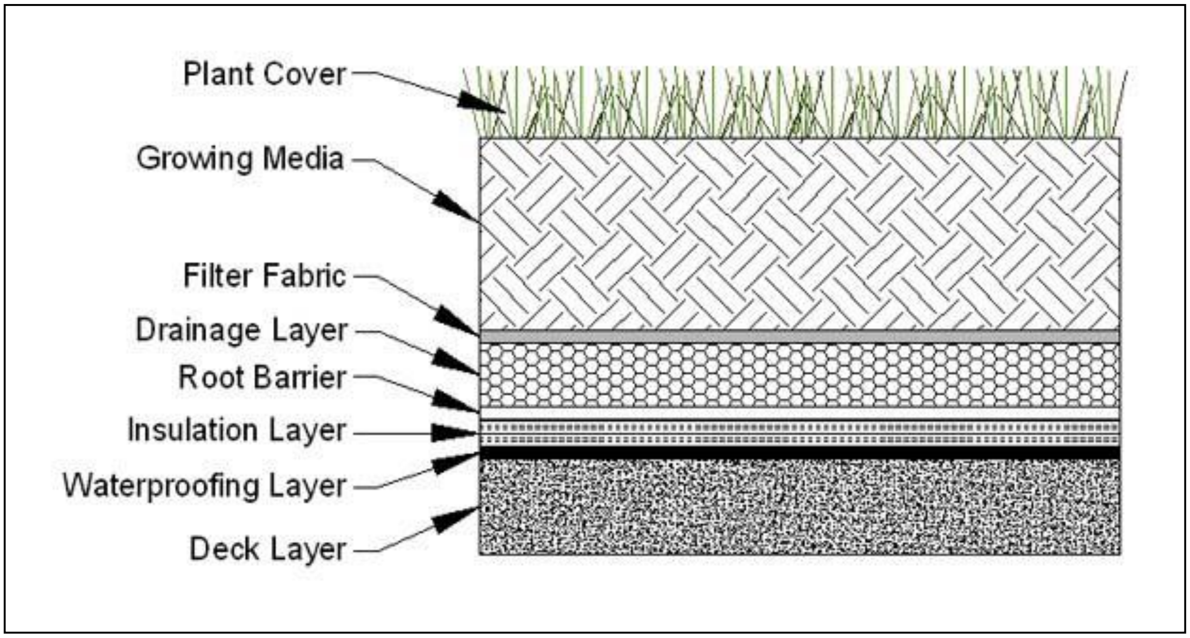


Figure 4.21. Green roof layers (note: the relative placement of various layers may vary depending on the type and design of the green roof system).

The design layers include the following:

1. **Deck Layer.** The roof deck layer is the foundation of a green roof. It may be composed of concrete, wood, metal, plastic, gypsum, or a composite material. The type of deck material determines the strength, load bearing capacity, longevity, and potential need for insulation in the green roof system.
2. **Leak Detection System (optional).** Leak detection systems are often installed above the deck layer to identify leaks, minimize leak damage through timely detection, and locate leak locations. Electric Field Vector Mapping (EFVM®) or other leak detection techniques are strongly recommended as part of the green roof installation process. In the case of EFVM, the deck material must be conductive. If it is not, an additional conductive medium may need to be added on top of the deck. Other leak detection systems may require additional materials between the deck layer and the waterproofing layer.
3. **Waterproofing Layer.** All green roof systems must include an effective and reliable waterproofing layer to prevent water damage through the deck layer. A wide range of waterproofing materials can be used, including hot applied rubberized asphalt, built up bitumen, modified bitumen, thermoplastic membranes, polyvinyl chloride (PVC), thermoplastic olefin membrane (TPO), and elastomeric membranes (EPDM) (see Weiler and Scholz-Barth, 2009, and Snodgrass and Snodgrass, 2006). The waterproofing layer must be 100% waterproof and have an expected life span as long as any other element of the green roof system. The waterproofing material may be loose laid or bonded (recommended). If loose laid, overlapping and additional construction techniques should be used to avoid water migration.
4. **Insulation Layer.** Many green rooftops contain an insulation layer, usually located above, but sometimes below, the waterproofing layer. The insulation increases the energy efficiency of the building and/or protects the roof deck (particularly for metal roofs). According to Snodgrass and Snodgrass (2006), the trend is to install insulation on the outside of the building, in part to avoid

mildew problems. The designer should consider the use of open or closed cell insulation depending on whether the insulation layer is above or below the waterproofing layer (and thus exposed to wetness), with closed cell insulation recommended for use above the waterproofing layer.

5. **Root Barrier.** Another layer of a green roof system, which can be either above or below the insulation layer depending on the system, is a root barrier that protects the waterproofing membrane from root penetration. Chemical root barriers or physical root barriers that have been impregnated with pesticides, metals, or other chemicals that could leach into stormwater runoff must be avoided in systems where the root barrier layer will come in contact with water or allow water to pass through the barrier.

6. **Drainage Layer and Drainage System.** A drainage layer is placed between the root barrier and the growing media to quickly remove excess water from the vegetation root zone. The selection and thickness of the drainage layer type is an important design decision that is governed by the desired stormwater storage capacity, the required conveyance capacity, and the structural capacity of the rooftop. The effective depth of the drainage layer is generally 0.25–1.5 inches thick for extensive green roof system and increases for intensive designs. The drainage layer should consist of synthetic or inorganic materials (e.g., 1–2-inch layer of clean, washed granular material (ASTM D448 size No. 8 stone or lightweight granular mix), high density polyethylene (HDPE)) that are capable of retaining water and providing efficient drainage (ASTM, 2017). A wide range of prefabricated water cups or plastic modules can be used, as well as a traditional system of protected roof drains, conductors, and roof leaders. ASTM E2396 and E2398 can be used to evaluate alternative material specifications (ASTM E2396, 2015 and ASTM E2398, 2015).

7. **Root-Permeable Filter Fabric.** A semi-permeable needled polypropylene filter fabric is normally placed between the drainage layer and the growing media to prevent the media from migrating into the drainage layer and clogging it. The filter fabric must not impede the downward migration of water into the drainage layer.

8. **Growing Media.** The next layer in an extensive green roof is the growing media, which is typically 3–8 inches deep. The recommended growing media for extensive green roofs is typically composed of approximately 70%–80% lightweight inorganic materials, such as expanded slates, shales or clays; pumice; scoria; or other similar materials. The media must contain no more than 30% organic matter, normally well-aged compost (see Appendix C Soil Compost Amendment Requirements). The percentage of organic matter should be limited, since it can leach nutrients into the runoff from the roof and clog the permeable filter fabric. It is advisable to mix the media in a batch facility prior to delivery to the roof. Manufacturer's specifications should be followed for all proprietary roof systems.

   The composition of growing media for intensive green roofs may be different (although the organic material limit still applies), and it is often much greater in depth (e.g., 8–48 inches). If trees are included in the green roof planting plan, the growing media must be sufficient to provide enough soil volume for the root structure of mature trees.

9. **Plant Cover.** The top layer of an extensive green roof typically consists of plants that are slow-growing, shallow-rooted, perennial, and succulent. These plants are chosen for their ability to withstand harsh conditions at the roof surface. Guidance on selecting the appropriate green roof plants can often be provided by green roof manufacturers and can also be found in Snodgrass and Snodgrass (2006). A mix of base ground covers (usually *Sedum* species) and accent plants can be used to enhance the visual amenity value of a green roof. See Section 4.6.4 Green Roof Design Criteria for additional plant information. The design must provide for temporary, manual, and/or

permanent irrigation or watering systems, depending on the green roof system and types of plants. For most applications, some type of watering system should be accessible for initial establishment or drought periods. The use of water efficient designs and/or use of non-potable sources are strongly encouraged.

Material Specifications

Standard specifications for North American green roofs continue to evolve, and no universal material specifications exist that cover the wide range of roof types and system components currently available. The ASTM has recently issued several overarching green roof standards, which are described and referenced in Table 4.22 below.

Designers and reviewers should also fully understand manufacturer specifications for each system component, particularly if they choose to install proprietary "complete" green roof systems or modules.

Table 4.22. Extensive Green Roof Material Specifications

Material	Specification
Roof	Structural capacity must conform to ASTM E2397, *Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems*. In addition, use standard test methods ASTM E2398, *Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetated (Green) Roof Systems* and ASTM E2399, *Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems*.
Leak Detection System	Optional system to detect and locate leaks in the waterproof membrane.
Waterproof Membrane	See Chapter 6 of Weiler and Scholz-Barth (2009) for waterproofing options that are designed to convey water horizontally across the roof surface to drains or gutter. This layer may sometimes act as a root barrier.
Root Barrier	Impermeable liner that impedes root penetration of the membrane.
Drainage Layer	Depth of the drainage layer is generally 0.25–1.5 inches thick for extensive designs. The drainage layer should consist of synthetic or inorganic materials (e.g., gravel, HDPE, etc.) that are capable of retaining water and providing efficient drainage. A wide range of prefabricated water cups or plastic modules can be used, as well as a traditional system of protected roof drains, conductors, and roof leaders. Designers should consult the material specifications as outlined in ASTM E2396 and E2398. Roof drains and emergency overflow must be designed in accordance with the local construction codes.

Material	Specification
Filter Fabric	Generally, needle-punched, non-woven, polypropylene geotextile, with the following qualities: ▪ Strong enough and adequate puncture resistance to withstand stresses of installing other layers of the green roof. Density as per ASTM D3776 ≥ 8 oz/yd^2. Puncture resistance as per ASTM D4833 ≥ 130 lb. These values can be reduced with submission of a Product Data Sheet and other documentation that demonstrates applicability for the intended use. ▪ Adequate tensile strength and tear resistance for long-term performance. ▪ Allows a good flow of water to the drainage layer. Apparent Opening Size, as per ASTM D4751, of ≥ 0.06mm ≤ 0.2mm, with other values based on Product Data Sheet and other documentation as noted above. ▪ Allows at least fine roots to penetrate. ▪ Adequate resistance to soil borne chemicals or microbial growth both during construction and after completion since the fabric will be in contact with moisture and possibly fertilizer compounds.
Growth Media	70%–80% lightweight inorganic materials and a maximum of 30% organic matter (e.g., well-aged compost). Material makeup of the growing media must be provided. Media must provide sufficient nutrient and water holding capacity to support the proposed plant materials. Determine acceptable saturated water permeability using ASTM E2396. An acceptable emerging industry practice combines the drainage layer with the growing media layer.
Plant Materials	*Sedum*, herbaceous plants, and perennial grasses that are shallow-rooted, low maintenance, and tolerant of full and direct sunlight, drought, wind, and frost. See ASTM E2400, *Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems*.

Solar Panels and Other Structures

Occasionally, structures such as solar panels or HVAC systems must be installed above a green roof. These structures can be incorporated into a green roof design with no adverse effects to the retention credit assigned to the green roof if specific design requirements for runoff disbursement, maintenance access, and sun/wind exposure are incorporated, including the following:

- **Structures above the green roof must be no more than 6.5 feet wide.**
- **Structures must have a minimum 3-foot separation between them.**
- **The lower edge of the structure must be at least 1 foot above the top of the green roof, and the upper edge must be at least 2.5 feet above the top of the green roof. This allows for at least a 15-degree tilt. For flatter installations, the lower edge would need to be raised to ensure that the 2.5-foot minimum for the upper edge is met.**

These design requirements are illustrated in Figure 4.22**.**

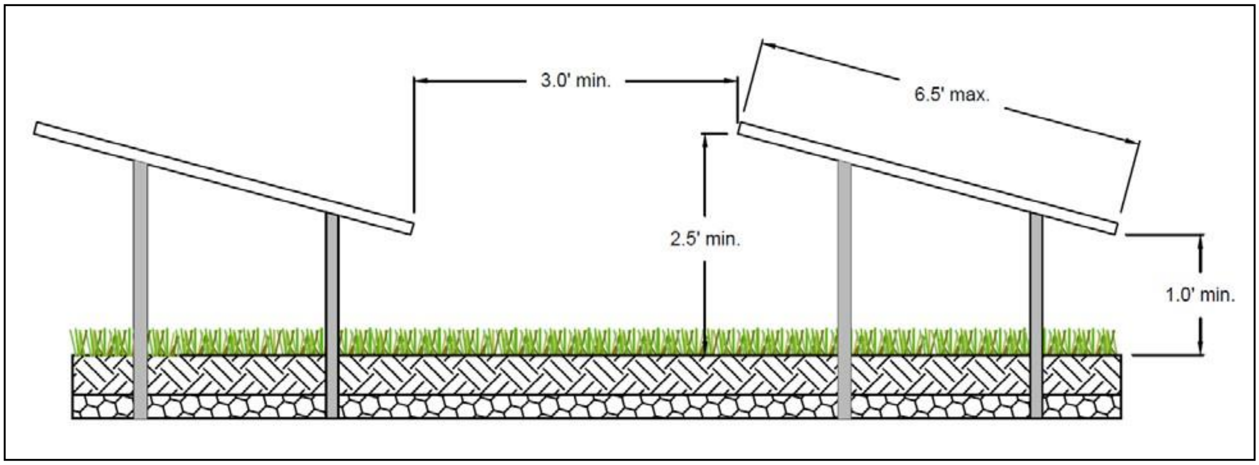


Figure 4.22. Design requirements for structures constructed above green roofs.

Green Roof Sizing

Green roof areas can be designed to capture the entire Stormwater Retention Volume (SWRv). In some cases, they could be designed to capture larger design storm volumes as well. The required size of a green roof will depend on several factors, including maximum water retention of the growing media and the underlying drainage and storage layer materials, if present (e.g., prefabricated water cups or plastic modules). As maximum water retention can vary significantly between green roof products, verification of this value must be included with the Stormwater Management Plan (SWMP). Verification shall be provided by an ASTM-certified lab using the methods described by ASTM tests E2396, E2397, E2398, or E2399, as appropriate. In the absence of laboratory test results, the baseline default values must be used. Equation 4.12 below shall be used to determine the storage volume retained by a green roof.

Equation 4.12. Storage Volume for Green Roofs

$$\mathrm{Sv} = \frac{\mathrm{SA} \times [(\mathrm{d} \times \mathrm{MWR}_1) + (\mathrm{DL} \times \mathrm{MWR}_2)]}{12} \times \mathrm{IF}$$

Where:

Sv	=	green roof storage volume (ft^3)
SA	=	green roof area (ft^2)
d	=	media depth (in.) (minimum 3 in.)
MWR_1	=	verified media maximum water retention (use 0.10 as a baseline default in the absence of verification data)
DL	=	drainage layer depth (in.) (if the drainage layer is combined with the media layer, then this value is 0)
MWR_2	=	verified drainage layer maximum water retention (use 0.0 as a baseline default in the absence of verification data)
IF	=	irrigation factor (0.5 for irrigated green roofs, 1.0 for unirrigated green roofs)

The appropriate Sv can then be compared to the required SWRv for the entire rooftop area (including all conventional roof areas) to determine the portion of the design storm captured.

Green roofs can have dramatic rate attenuation effects on larger storm events and may be used, in part, to manage a portion of the 2- to 25-year events. Designers can model various approaches by factoring in storage within the drainage layer. Routing calculations can also be used to provide a more accurate solution of the peak discharge and required storage volume.

4.6.5 Green Roof Landscaping Criteria

Plant selection, landscaping, and maintenance are critical to the performance and function of green roofs. Therefore, a landscaping plan shall be provided for green roofs.

A planting plan must be prepared for a green roof by a landscape architect, botanist, or other professional experienced with green roofs and submitted with the SWMP.

Plant selection for green roofs is an integral design consideration, which is governed by local climate and design objectives. The primary ground cover for most green roof installations is a hardy, low-growing succulent, such as *Sedum*, *Delosperma*, *Talinum*, *Semperivum*, or *Hieracium* that is matched to the local climate conditions and can tolerate the difficult growing conditions found on building rooftops (Snodgrass and Snodgrass, 2006).

A list of some common green roof plant species that work well in the can South Lowcountry region be found in Table 4.23 below.

Table 4.23. Ground Covers Appropriate for Green Roofs in the State of South Carolina

Plant	**Light**	**Moisture Requirement**	**Notes**
Delosperma cooperii	Full Sun	Dry	Pink flowers; grows rapidly
Delosperma 'Kelaidis'	Full Sun	Dry	Salmon flowers; grows rapidly
Delosperma nubigenum 'Basutoland'	Full Sun	Moist-Dry	Yellow flowers; very hardy
Sedum album	Full Sun	Dry	White flowers; hardy
Sedum lanceolatum	Full Sun	Dry	Yellow flowers; native to U.S.
Sedum oreganum	Part Shade	Moist	Yellow flowers; native to U.S.
Sedum stoloniferum	Sun	Moist	Pink flowers; drought tolerant
Sedum telephiodes	Sun	Dry	Blue green foliage; native to region
Sedum ternatum	Part Shade	Dry-Moist	White flowers; grows in shade
Talinum calycinum	Sun	Dry	Pink flowers; self-sows

Note: Designers should choose species based on shade tolerance, ability to sow or not, foliage height, and spreading rate. See Snodgrass and Snodgrass (2006) for a definitive list of green roof plants, including accent plants.

- Plant choices can be much more diverse for deeper intensive green roof systems. Herbs, forbs, grasses, shrubs, and even trees can be used, but designers should understand they may have higher watering, weeding, and landscape maintenance requirements.
- The species and layout of the planting plan must reflect the location of the building, in terms of its height, exposure to wind, heat stress, orientation to the sun, and impacts from surrounding buildings. Wind scour and solar burning have been observed on green roof installations that failed to adequately account for neighboring building heights and surrounding window reflectivity. In addition, plants must be selected that are fire resistant and able to withstand heat, cold, and high winds.
- Designers should also match species to the expected rooting depth of the growing media, which can also provide enough lateral growth to stabilize the growing media surface. The planting plan should usually include several accent plants to provide diversity and seasonal color. For a comprehensive resource on green roof plant selection, consult Snodgrass and Snodgrass (2006).
- It is also important to note that most green roof plant species will not be native to the Chesapeake Bay watershed (which contrasts with native plant recommendations for other stormwater practices, such as bioretention and constructed wetlands).
- Given the limited number of green roof plant nurseries in the region, it may be necessary for designers to order plants 6 to 12 months prior to the expected planting date. It is also advisable to have plant materials contract grown.
- Plants can be established using cuttings, plugs, mats, and, more rarely, containers. Several vendors also sell mats, rolls, or proprietary green roof planting modules. For the pros and cons of each method, see Snodgrass and Snodgrass (2006). To achieve 50% coverage after 1 year and 80% coverage after 2 years, the recommended minimum spacing for succulent plantings is 2 plugs per square foot and 10 pounds per 100 square feet.
- When planting cuttings, plugs, and mats, the planting window extends from the spring to early fall; although, it is important to allow plants to root thoroughly before the first killing frost. Green roof manufacturers and plant suppliers may provide guidance on planting windows as well as winter care. Proper planting and care may also be required for plant warranty eligibility.
- When appropriate species are selected, most green roofs will not require supplemental irrigation, except for temporary irrigation during drought or initial establishment. The use of water-efficient designs and/or use of non-potable sources is strongly encouraged. Permanent irrigation of extensive roof designs is prohibited. For intensive roofs, permanent irrigation may be included. However, permanent irrigation can adversely impact the rainfall retention capacity of the green roof. For this reason, soil moisture monitors are a required part of the irrigation system for all irrigated green roofs, and the calculated storage volume for green roofs with permanent irrigation must be reduced by 50%.
- The goal for green roof systems designed for stormwater management is to establish a full and vigorous cover of low-maintenance vegetation that is self-sustaining (not requiring fertilizer inputs) and requires minimal mowing, trimming, and weeding.

The green roof design should include non-vegetated walkways (e.g., paver blocks) to allow for easy access to the roof for weeding and making spot repairs (see Section 4.6.4 Green Roof Design Criteria).

4.6.6 Green Roof Construction Sequence **Green Roof Installation**

Given the diversity of extensive vegetated roof designs, there is no typical step-by-step construction sequence for proper installation. The following general construction considerations are noted:

- Construct the roof deck with the appropriate slope and material.
- Install the waterproofing method, according to manufacturer's specifications.
- Conduct electric field vector mapping (EVFM®) or flood testing to ensure the system is watertight. Where possible, EVFM® is strongly recommended over the flood test, but not all impermeable membranes and deck systems are compatible with this method. Problems have been noted with the use of EFVM on black ethylene propylene diene terpolymer (EPDM) and with aluminized protective coatings commonly used in conjunction with modified bituminous membranes. If EVFM® or other leak detection systems are not possible, a flood test should be performed instead. The flood test is done by placing at least 2 inches of water over the membrane for 48 hours to confirm the integrity of the waterproofing system.
- Add additional system components (e.g., insulation, root barrier, drainage layer and interior drainage system, and filter fabric) per the manufacturer's specifications, taking care not to damage the waterproofing. Any damage occurring must be reported immediately. Drain collars and protective flashing should be installed to ensure free flow of excess stormwater.
- The growing media should be mixed prior to delivery to the site. Media must be spread evenly over the filter fabric surface as required by the manufacturer. If a delay between the installation of the growing media and the plants is required, adequate efforts must be taken to secure the growing media from erosion and the seeding of weeds. The growing media must be covered and anchored in place until planting. Sheets of exterior grade plywood can also be laid over the growing media to accommodate foot or wheelbarrow traffic. Foot traffic and equipment traffic should be limited over the growing media to reduce compaction beyond manufacturer's recommendations.
- The growing media should be moistened prior to planting, and then planted with the ground cover and other plant materials, per the planting plan or in accordance with ASTM E2400 (2015). Plants should be watered immediately after installation and routinely during establishment.
- It generally takes 2 to 3 growing seasons to fully establish the vegetated roof. The growing medium should contain enough organic matter to support plants for the first growing season, so initial fertilization is not required. Extensive green roofs may require supplemental irrigation during the first few months of establishment. Hand weeding is also critical in the first 2 years (see Table 10.1 of Weiler & Scholz-Barth (2009) for a photo guide of common rooftop weeds).
- Most construction contracts should contain a care and replacement warranty that specifies at least 50% coverage after 1 year and 80% coverage after 2 years for plugs and cuttings, and 90% coverage after 1 year for *Sedum* carpet/tile.

Construction Supervision

Supervision during construction is recommended to ensure that the vegetated roof is built in accordance with these specifications. Inspection checklists should be used that include sign-offs by qualified individuals at critical stages of construction and confirm that the contractor's interpretation of the plan is consistent with the intent of the designer and/or manufacturer.

An experienced installer should be retained to construct the vegetated roof system. The vegetated roof should be constructed in sections for easier inspection and maintenance access to the membrane and roof drains. Careful construction supervision/inspection is needed throughout the installation of a vegetated roof, as follows:

- During placement of the waterproofing layer, to ensure that it is properly installed and watertight.
- During placement of the drainage layer and drainage system.
- During placement of the growing media, to confirm that it meets the specifications and is applied to the correct depth (certification for vendor or source should be provided).
- Upon installation of plants, to ensure they conform to the planting plan (certification from vendor or source should be provided).
- Before issuing use and occupancy approvals.
- At the end of the first or second growing season to ensure desired surface cover specified in the Care and Replacement Warranty has been achieved.

Construction phase inspection checklist for green roof practices can be found in Appendix E Construction Inspection Checklists.

4.6.7 Green Roof Maintenance Criteria

Maintenance Inspections

A green roof should be inspected by a qualified professional twice a year during the growing season to assess vegetative cover and to look for leaks, drainage problems, and any rooftop structural concerns (see Table 4.24). In addition, the green roof should be hand weeded to remove invasive or volunteer plants, and plants and/or media should be added to repair bare areas (refer to ASTM E2400; ASTM, 2015).

If a roof leak is suspected, it is advisable to perform an electric leak survey (e.g., EVFM®), if applicable, to pinpoint the exact location, make localized repairs, and then reestablish system components and ground cover.

The use of herbicides, insecticides, and fungicides should be avoided, since their presence could hasten degradation of some waterproofing membranes. Check with the membrane manufacturer for approval and warranty information. Also, power washing and other exterior maintenance operations should be avoided so that cleaning agents and other chemicals do not harm the green roof plant communities.

Fertilization is generally not recommended due to the potential for leaching of nutrients from the green roof. Supplemental fertilization may be required following the first growing season, but only if plants show signs of nutrient deficiencies and a media test indicates a specific deficiency. Addressing this issue with the holder of the vegetation warranty is recommended. If fertilizer is to be applied, it must be a slow-release type, rather than liquid or gaseous form.

Maintenance inspection checklist for green roofs and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Table 4.24. Typical Maintenance Activities Associated with Green Roofs

Schedule (following construction)	**Activity**
As needed or As required by manufacturer	▪ Water to promote plant growth and survival. ▪ Inspect the green roof and replace any dead or dying vegetation.
Semi-annually	▪ Inspect the waterproof membrane for leaks and cracks. ▪ Weed to remove invasive plants and tree seedlings (do not dig or use pointed tools where there is potential to harm the root barrier or waterproof membrane). ▪ Inspect roof drains, scuppers, and gutters to ensure they are not overgrown and have not accumulated organic matter deposits. Remove any accumulated organic matter or debris. ▪ Inspect the green roof for dead, dying, or invasive vegetation. Plant replacement vegetation as needed.

<u>Waste Material</u>

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.6.8 Green Roof Stormwater Compliance Calculations

Green roofs are credited with 100% retention for the storage volume (Sv) provided by the practice as well as 100% TSS, TN, and bacteria removal (see Table 4.25).

Table 4.25. Retention and pollutant removal of green roofs.

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

The practice must be designed using the guidance detailed in Section 4.6.4 Green Roof Design Criteria.

Green roofs also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume (Sv) from the total runoff volume for the design storms. The resulting reduced runoff volumes can then be used to calculate a reduced Natural Resource Conservation Service (NRCS) curve number (CN) for the site or site drainage area (SDA). The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.7 Rainwater Harvesting

Rainwater Harvesting

Definition: Rainwater harvesting systems store rainfall and release it for future use. Rainwater that falls on a rooftop or other impervious surface is collected and conveyed into an above- or below-ground tank (also referred to as a cistern) or settling pond, where it is stored for non-potable uses.

Site Applicability		BMP Performance Summary		
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High		
▪ Urban ▪ Suburban ▪ Rural	**Small**	**TSS[1]**	**Total N[1]**	**Bacteria[1]**
		Varies*	Varies*	Varies*
		Runoff Reduction		
Construction Costs	**Maintenance Burden**	**Volume**		
Low to Moderate	Moderate	Varies*		
Maintenance Frequency:		***SWRv***		
Routine	**Non-Routine**	100% of Available Storage Volume		
Quarterly	Every 3 years			

Advantages/Benefits	Disadvantages/Limitation
▪ Reduces runoff rates and volume ▪ Can provide for/supplement irrigation needs	▪ Stored water must be used on regular basis to maintain capacity ▪ Stagnant water can breed mosquitos

Components	Design considerations
▪ Pretreatment ▪ Conveyance ▪ First flush diverter ▪ Cistern (storage tank) ▪ Overflow ▪ Low water cutoff	▪ Plumbing codes (for indoor tanks) ▪ Size based on CDA, local rainfall patterns, and projected harvest rainwater demand ▪ Location and elevation of cistern ▪ Tank manufacturer's specifications ▪ Irrigation system and application rates

Maintenance Activities	
▪ Inspect/clean pretreatment devices and first flush diverts ▪ Clear gutter/downspouts	▪ Inspect and clean storage tank ▪ Maintenance log required

[1]*Credited pollutant load removal*

**Varies according to rainwater harvesting storage capacity and demand*

Rainwater harvesting systems store rainfall for future, non-potable water uses and on-site stormwater disposal/infiltration. By providing a reliable and renewable source of water to end users, rainwater harvesting systems can also have environmental and economic benefits beyond stormwater management (e.g. increased water conservation, water supply during drought and mandatory municipal water supply restrictions, decreased demand on municipal or groundwater supply, decreased water costs for the end-user, potential for increased groundwater recharge, supply of water post storm/hurricane in case of failed municipal infrastructure etc.).

Definition

Rainwater harvesting systems store rainfall and release it for future use. Rainwater that falls on a rooftop or other impervious surface is collected and conveyed into an above- or below-ground tank (also referred to as a cistern) or settling pond where it is stored for non-potable uses or for on-site disposal or infiltration as stormwater. Cisterns can be sized for commercial as well as residential purposes (see Figure 4.23). Residential cisterns are commonly called rain barrels.

Figure 4.23. Example cistern application (photo: Marty Morganello).

The design includes the following:

R-1 Rainwater harvesting for non-potable uses

Non-potable uses of harvested rainwater may include the following:

- Landscape irrigation,
- Exterior washing (e.g., car washes, building facades, sidewalks, street sweepers, and fire trucks),
- Flushing of toilets and urinals,
- Fire suppression (e.g., sprinkler systems),
- Supply for cooling towers, evaporative coolers, fluid coolers, and chillers,
- Supplemental water for closed loop systems and steam boilers,
- Replenishment of water features and water fountains,
- Distribution to a green wall or living wall system, and
- Laundry.

Rainwater stored in a settling pond may only be used for landscape irrigation. Pond design criteria in Section 4.10 and landscaping criteria of Section 4.5.5 shall be followed.

The seven primary components of an enclosed rainwater harvesting system are discussed in detail in Section 4.5.4 Rainwater Harvesting Design Criteria. Some are depicted in Figure 4.25 . The components include the following:

- CDA surface,
- Collection and conveyance system (e.g., gutter and downspouts; number 1 in Figure 4.24)
- Pretreatment, including prescreening and first flush diverters (number 2 in Figure 4.24)
- Cistern (no number, but depicted in Figure 4.24)
- Water quality treatment (as required by Appendix J Rainwater Harvesting Treatment and Management Requirements)
- Distribution system
- Overflow, filter path, or secondary stormwater retention practice (number 8 in Figure 4.24)

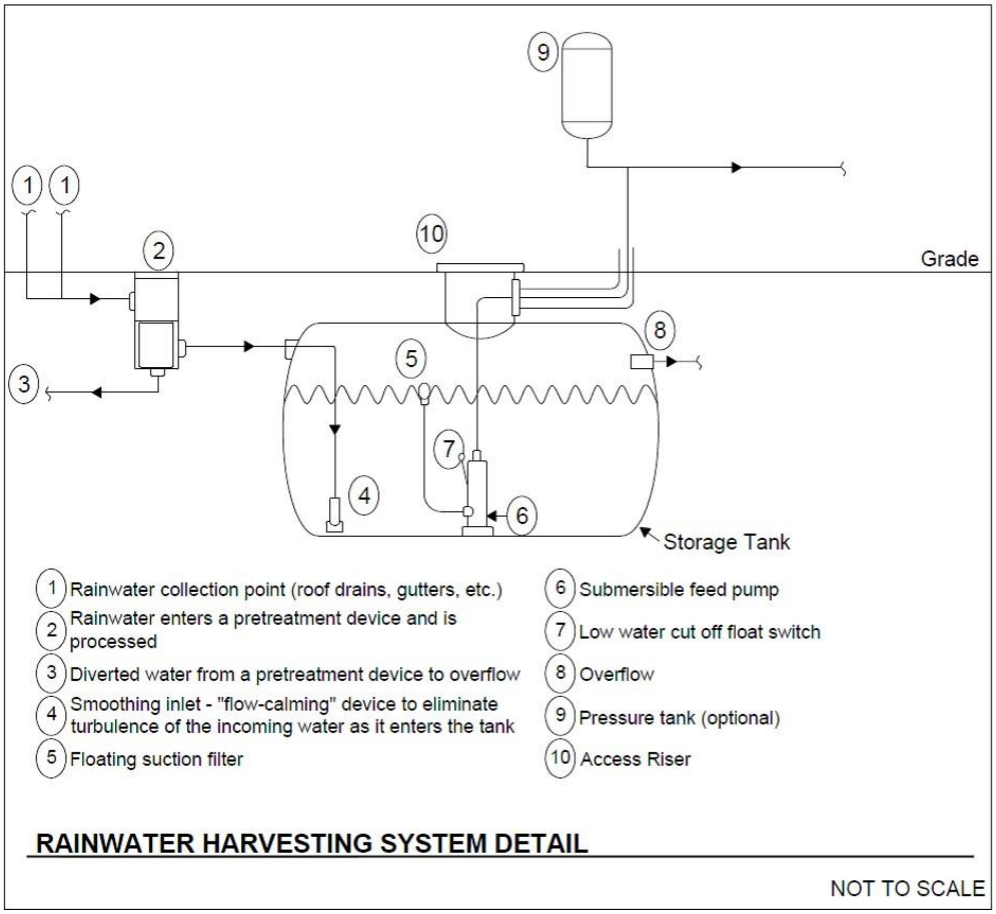


Figure 4.24. Example of a rainwater harvesting system detail.

4.7.1 Rainwater Harvesting Feasibility Criteria

Several site-specific features influence how rainwater harvesting systems are designed and/or utilized. The following are key considerations for rainwater harvesting feasibility. They are not comprehensive or conclusive; rather, they are recommendations to consider during the planning process to incorporate rainwater harvesting systems into the site design.

<u>Plumbing Code</u>

Designers and plan reviewers should consult with local construction codes to determine the allowable indoor uses and required treatment for harvested rainwater. This specification does not address indoor plumbing or disinfection issues. Designers and plan reviewers should refer to the 2012 Uniform Plumbing Code - Chapter 17 Non-potable Rainwater Catchment Systems, or local plumbing codes, as applicable.

<u>Mechanical, Electrical, Plumbing</u>

For systems that call for indoor use of harvested rainwater, the seal of a mechanical, electrical, and plumbing engineer is required.

<u>Water Use</u>

When rainwater harvesting will be used, the requirements in Appendix J Rainwater Harvesting Treatment and Management Requirements must be followed. This will outline the design assumptions and provide water quality end use standards.

Available Space
Adequate space is needed to house the cistern and any overflow. Space limitations are rarely a concern with rainwater harvesting systems if they are considered during the initial building design and site layout of a residential or commercial development. Cisterns can be placed underground, indoors, adjacent to buildings, and on rooftops that are structurally designed to support the added weight. Designers can work with architects and landscape architects to creatively site the cisterns. Underground utilities or other obstructions should always be identified prior to final determination of the cistern location.

Site Topography
Site topography and cistern location should be considered as they relate to every inlet and outlet invert elevation in the rainwater harvesting system.

The final invert of the cistern outlet pipe at the discharge point must match the invert of the receiving mechanism (e.g., natural channel, storm drain system) and be sufficiently sloped to adequately convey this overflow. The elevation drops associated with the various components of a rainwater harvesting system and the resulting invert elevations should be considered early in the design, to ensure that the rainwater harvesting system is feasible for the particular site.

Site topography and cistern location will also affect pumping requirements. Locating cisterns in low areas will make it easier to get water into the cisterns; however, it will increase the amount of pumping needed to distribute the harvested rainwater back into the building or to irrigated areas situated on higher ground. Conversely, placing cisterns at higher elevations may require larger diameter pipes with smaller slopes but will generally reduce the amount of pumping needed for distribution. It is often best to locate a cistern close to the building or SDA, to limit the amount of pipe needed.

Available Hydraulic Head
The required hydraulic head depends on the intended use of the water. For residential landscaping uses, the cistern may be sited up-gradient of the landscaping areas or on a raised stand. Pumps are commonly used to convey stored rainwater to the end use to provide the required head. When the water is being routed from the cistern to the inside of a building for non-potable use, often a pump is used to feed a much smaller pressure tank inside the building, which then serves the internal water demands. Cisterns can also use gravity to accomplish indoor residential uses (e.g., laundry) that do not require high water pressure.

Water Table
Underground storage tanks are most appropriate in areas where the tank can be buried above the water table. The tank should be located in a manner that does not subject it to flooding. In areas where the tank is to be buried partially below the water table, special design features must be employed, such as sufficiently securing the tank (to keep it from floating) and conducting buoyancy calculations when the tank is empty. The tank may need to be secured appropriately with fasteners or weighted to avoid uplift buoyancy. The combined weight of the tank and hold-down ballast must meet or exceed the buoyancy force of the cistern. The cistern must also be installed according to the cistern manufacturer’s specifications.

Soils
Cisterns should only be placed on native soils or on fill in accordance with the manufacturer's guidelines. The bearing capacity of the soil upon which the cistern will be placed must be considered, as full cisterns can be very heavy. This is particularly important for above-ground cisterns, as significant settling could

cause the cistern to lean or in some cases to potentially topple. A sufficient aggregate, or concrete foundation, may be appropriate depending on the soils and cistern characteristics. Where the installation requires a foundation, the foundation must be designed to support the cistern's weight when the cistern is full, consistent with the bearing capacity of the soil and good engineering practice. The pH of the soil should also be considered in relation to its interaction with the cistern material.

Proximity of Underground Utilities

All underground utilities must be taken into consideration during the design of underground rainwater harvesting systems, treating all of the rainwater harvesting system components and storm drains as typical stormwater facilities and pipes. The underground utilities must be marked and avoided during the installation of underground cisterns and piping associated with the system.

Contributing Drainage Area

The CDA to the cistern is the area draining to the cistern. Rooftop surfaces are what typically make up the CDA, but paved areas can be used with appropriate treatment (oil/water separators and/or debris excluders).

Contributing Drainage Area Material

The quality of the harvested rainwater will vary according to the roof material or CDA over which it flows. Water harvested from certain types of rooftops and CDAs, such as asphalt sealcoats, tar and gravel, painted roofs, galvanized metal roofs, sheet metal, or any material that may contain asbestos may leach trace metals and other toxic compounds. In general, harvesting rainwater from such surfaces should be avoided. If harvesting from a sealed or painted roof surface is desired, it is recommended that the sealant or paint be certified for such purposes to the NSF International NSF Protocol P151 standard.

Water Quality of Rainwater

Designers should also note that the pH of rainfall in the State tends to be acidic (ranging from 4.5 to 5.0), which may result in leaching of metals from roof surfaces, cistern lining, or water laterals, to interior connections. Once rainfall leaves rooftop surfaces, pH levels tend to be slightly higher, ranging from 5.5 to 6.0. Limestone or other materials may be added in the cistern to buffer acidity, if desired.

Pollutant Hotspot Land Uses

Harvesting rainwater can be an effective method to prevent contamination of rooftop runoff that would result from its mixing with ground-level runoff from a stormwater hotspot operation.

Setbacks from Buildings

Cistern overflow devices must be designed to avoid causing ponding or soil saturation within 10 feet of building foundations. While most systems are generally sited underground and more than 10 feet laterally from the building foundation wall, some cisterns are incorporated into the basement of a building or underground parking areas. In any case, cisterns must be designed to be watertight to prevent water damage when placed near building foundations.

Vehicle Loading

Whenever possible, underground rainwater harvesting systems should be placed in areas without vehicle traffic or other heavy loading, such as deep earth fill. If site constraints dictate otherwise, systems must be designed to support the loads to which they will be subjected.

Feasibility
Rainwater harvesting systems are very well suited to the warm environment of South Carolina and may help to relieve some of the pressure on drinking water aquifers, if applied on a wide scale. In areas with a high-water table, above ground installations will often be more appropriate.

Economic Considerations
Rainwater harvesting systems can provide cost savings by replacing or augmenting municipal water supply needs.

4.7.2 Rainwater Harvesting Conveyance Criteria Collection and Conveyance
The collection and conveyance systems consist of the gutters, downspouts, and pipes that channel rainfall into cisterns. Gutters and downspouts should be designed as they would for a building without a rainwater harvesting system.

Pipes, which connect downspouts to the cistern, should be at a minimum slope of 1.5% and sized/designed to convey the intended design storm, as specified above. In some cases, a steeper slope and larger sizes may be recommended and/or necessary to convey the required runoff, depending on the design objective and design storm intensity. Gutters and downspouts should be kept clean and free of debris and rust.

Overflow
An overflow mechanism must be included in the rainwater harvesting system design in order to handle an individual storm event or multiple storms in succession that exceed the capacity of the cistern. The overflow pipe(s) must have a capacity greater than or equal to the inflow pipe(s) and have a diameter and slope sufficient to drain the cistern while maintaining an adequate freeboard height. The overflow pipe(s) must be screened to prevent access to the cistern by small mammals and birds and must include a backflow preventer if it connects directly to the combined sewer or storm sewer. All overflow from the system must be directed to an acceptable flow path that will not cause erosion during a 2-year storm event.

4.7.3 Rainwater Harvesting Pretreatment Criteria
Prefiltration is required to keep sediment, leaves, contaminants, and other debris from the system. Leaf screens and gutter guards meet the minimal requirement for prefiltration of small systems, although direct water filtration is preferred. The purpose of prefiltration is to significantly cut down on maintenance by preventing organic buildup in the cistern, thereby decreasing microbial food sources.

Various pretreatment devices are described below. In addition to the initial first flush diversion, filters have an associated efficiency curve that estimates the percentage of rooftop runoff that will be conveyed through the filter to the cistern. If filters are not sized properly, a large portion of the rooftop runoff may be diverted and not conveyed to the cistern at all. A design intensity of 1 inch per hour (for design storm = SWRv) must be used for the purposes of sizing pre-cistern conveyance and filter components. This design intensity captures a significant portion of the total rainfall during a large majority of rainfall events (NOAA, 2004). If the system will be used for channel and flood protection, the 2- to 25-year storm intensities must be used for the design of the conveyance and pretreatment portion of the system. The Appendix K Rainwater Harvesting Storage Volume Calculator, discussed in Section 4.7.4 Rainwater Harvesting Design Criteria, allows for input of variable filter efficiency rates for the design storm. To meet the requirements to manage the 2- to 25-year storms, a minimum filter efficiency of 90% must be met.

- **First Flush Diverters.** First flush diverters (see Figure 4.25) direct the initial pulse of rainfall away from the cistern. While leaf screens effectively remove larger debris such as leaves, twigs, and blooms from harvested rainwater, first flush diverters can be used to remove smaller contaminants such as dust, pollen, and bird and rodent feces.
- **Leaf Screens.** Leaf screens are mesh screens installed over either the gutter or downspout to separate leaves and other large debris from rooftop runoff. Leaf screens must be regularly cleaned to be effective; if not maintained, they can become clogged and prevent rainwater from flowing into the cisterns. Built-up debris can also harbor bacterial growth within gutters or downspouts (Texas Water Development Board, 2005).
- **Roof Washers.** Roof washers are placed just ahead of cisterns and are used to filter small debris from harvested rainwater (see Figure 4.26). Roof washers consist of a cistern, usually between 25 and 50 gallons in size, with leaf strainers and a filter with openings as small as 30 microns. The filter functions to remove very small particulate matter from harvested rainwater. All roof washers must be cleaned on a regular basis.
- **Hydrodynamic Separator.** For large-scale applications, hydrodynamic separators and other devices can be used to filter rainwater from larger CDAs.

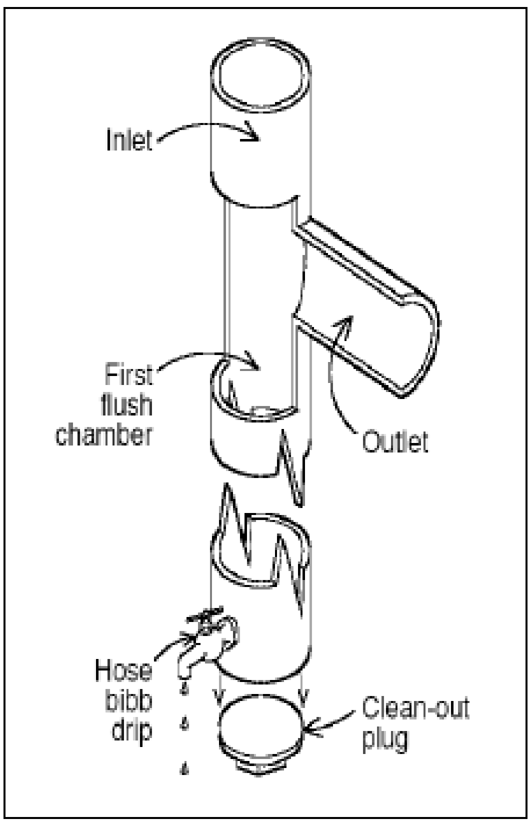


Figure 4.25. Diagram of a first flush diverter (photo: Texas Water Development Board, 2005).

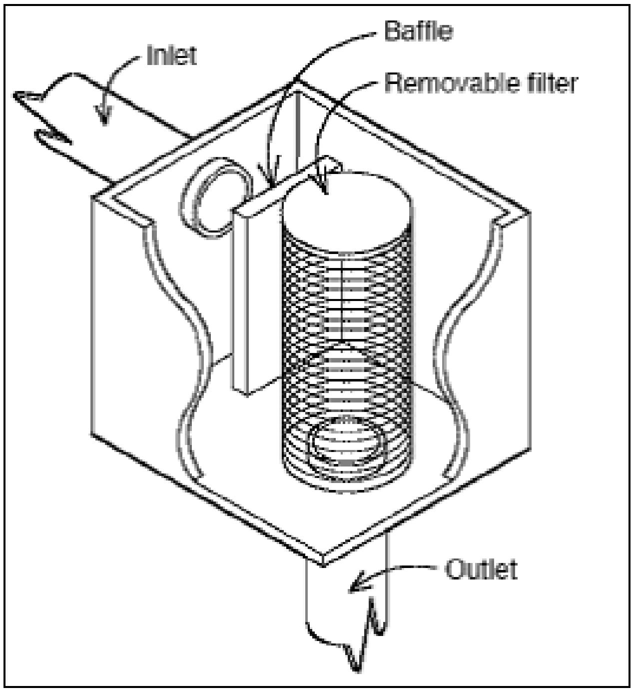


Figure 4.26. Diagram of a roof washer (photo: Texas Water Development Board, 2005).

4.7.4 Rainwater Harvesting Design Criteria

System Components: Seven primary components of a rainwater harvesting system require special considerations:

- CDA or CDA surface
- Collection and conveyance system (i.e., gutter and downspouts)
- Cisterns (Storage Tank)
- Pretreatment, including prescreening and first flush diverters
- Water quality treatment (as described in Appendix J Rainwater Harvesting Treatment and Management Requirements)
- Distribution systems
- Overflow, filter path, or secondary stormwater retention practice

The system components are discussed below:

CDA Surface

When considering CDA surfaces, smooth, non-porous materials will drain more efficiently. Slow drainage of the CDA leads to poor rinsing and a prolonged first flush, which can decrease water quality.

Rainwater can also be harvested from other impervious surfaces, such as parking lots and driveways; however, this practice requires more extensive pretreatment and treatment prior to use.

Collection and Conveyance System
See Section 1544.7.2 Rainwater Harvesting Conveyance Criteria.

Pretreatment
See Section 4.7.3 Rainwater Harvesting Pretreatment Criteria.

Cisterns (Storage Tank)
Also known as the storage tank, the cistern is the most important and typically the most expensive component of a rainwater harvesting system. Cistern capacities generally range from 250 to 30,000 gallons, but they can be as large as 100,000 gallons or more for larger projects. Multiple cisterns can be placed adjacent to each other and connected with pipes to balance water levels and to tailor the storage volume needed. Typical rainwater harvesting system capacities for residential use range from 1,500 to 5,000 gallons. Cistern volumes are calculated to meet the water demand and stormwater storage volume retention objectives, as described further below in this specification.

While many of the graphics and photos in this specification depict cisterns with a cylindrical shape, the cisterns can be made of many materials and configured in various shapes, depending on the type used and the site conditions where the cisterns will be installed. For example, configurations can be rectangular, L-shaped, or step vertically to match the topography of a site. The following factors should be considered when designing a rainwater harvesting system and selecting a cistern:

- Aboveground cisterns should be ultraviolet and impact resistant.
- Underground cisterns must be designed to support the overlying sediment and any other anticipated loads (e.g., vehicles, pedestrian traffic).
- Underground rainwater harvesting systems must have a standard size manhole or equivalent opening to allow access for cleaning, inspection, and maintenance purposes. The access opening must be installed in such a way as to prevent surface- or groundwater from entering through the top of any fittings, and it must be secured/locked to prevent unwanted entry. Confined space safety precautions/requirements should be observed during cleaning, inspection, and maintenance.
- All rainwater harvesting systems must be sealed using a water-safe, non-toxic substance.
- Rainwater harvesting systems may be ordered from a manufacturer or can be constructed on site from a variety of materials. Table 4. 26 compares the advantages and disadvantages of different cistern materials.
- Cisterns must be opaque or otherwise protected from direct sunlight to inhibit growth of algae, and they must be screened to discourage mosquito breeding.
- Dead storage below the outlet to the distribution system and an air gap at the top of the cistern must be included in the total cistern volume. For gravity-fed systems, a minimum of 6 inches of dead storage must be provided. For systems using a pump, the dead storage depth will be based on the pump specifications.
- Any hookup to a municipal backup water supply must have a backflow prevention device to keep municipal water separate from stored rainwater; this may include incorporating an air gap to separate the two supplies.

Table 4. 26. Advantages and Disadvantages of Typical Cistern Materials

Cistern Material	Advantages	Disadvantages
Fiberglass	Commercially available, alterable and moveable; durable with little maintenance; light weight; integral fittings (no leaks); broad application	Must be installed on smooth, solid, level footing; pressure proof for below-ground installation; expensive in smaller sizes
Polyethylene	Commercially available, alterable, moveable, affordable; available in wide range of sizes; can install above or below ground; little maintenance; broad application	Can be UV-degradable; must be painted or tinted for above-ground installations; pressure-proof for below-ground installation
Modular Storage	Can modify to topography; can alter footprint and create various shapes to fit site; relatively inexpensive	Longevity may be less than other materials; higher risk of puncturing of watertight membrane during construction
Plastic Barrels	Commercially available; inexpensive	Low storage capacity (20–50 gallons); limited application
Galvanized Steel	Commercially available, alterable, and moveable; available in a range of sizes; film develops inside to prevent corrosion	Possible external corrosion and rust; must be lined for potable use; can only install above ground; soil pH may limit underground applications
Steel Drums	Commercially available, alterable, and moveable	Small storage capacity; prone to corrosion, and rust can lead to leaching of metals; verify prior to reuse for toxics; water pH and soil pH may also limit applications
FerroConcrete	Durable and immoveable; suitable for above or below ground installations; neutralizes acid rain	Potential to crack and leak; expensive
Cast-in-Place Concrete	Durable, immoveable, and versatile; suitable for above or below ground installations; neutralizes acid rain	Potential to crack and leak; permanent; will need to provide adequate platform and design for placement in clay soils
Stone or Concrete Block	Durable and immoveable; keeps water cool in summer months	Difficult to maintain; expensive to build

Source: Cabell Brand Center, 2007; Cabell Brand Center, 2009

- **Water Quality Treatment**
  Depending upon the collection surface, method of dispersal, and proposed use for the harvested rainwater, a water quality treatment device may be required. Treatment requirements are described in Appendix J Rainwater Harvesting Treatment and Management Requirements.

- **Distribution Systems**
  Most distribution systems require a pump to convey harvested rainwater from the cistern to its final destination, whether inside the building, an automated irrigation system, or gradually discharged to a secondary stormwater treatment practice. The rainwater harvesting system should be equipped with an appropriately sized pump that produces sufficient pressure for all end-uses.

The typical pump and pressure tank arrangement consists of a multi-stage, centrifugal pump, which draws water out of the cistern and sends it into the pressure tank, where it is stored for distribution. Some systems will not require this two-tank arrangement (e.g., low-pressure and gravel systems). When water is drawn out of the pressure tank, the pump activates to supply additional water to the distribution system. The backflow preventer is required to separate harvested rainwater from the main potable water distribution lines.

A drain plug or cleanout sump must be installed to allow the system to be completely emptied, if needed. Above-ground outdoor pipes must be insulated or heat-wrapped to prevent freezing and ensure uninterrupted operation during winter if winter use is planned.

- **Overflow**
  See Section 4.7.2 Rainwater Harvesting Conveyance Criteria.

Rainwater Harvesting Material Specifications

The basic material specifications for rainwater harvesting systems are presented in Table 4.27. Designers should consult with experienced rainwater harvesting system and irrigation installers on the choice of recommended manufacturers of prefabricated cisterns and other system components.

Table 4.27. Design Specifications for Rainwater Harvesting Systems

Item	Specification
Gutters and Downspouts	Materials commonly used for gutters and downspouts include polyvinylchloride (PVC) pipe, vinyl, aluminum, and galvanized steel. Lead must not be used as gutter and downspout solder, since rainwater can dissolve the lead and contaminate the water supply. ▪ The length of gutters and downspouts is determined by the size and layout of the catchment and the location of the cisterns. ▪ Include needed bends and tees.
Pretreatment	At least one of the following (all rainwater to pass through pretreatment): ▪ First flush diverter ▪ Hydrodynamic separator ▪ Roof washer ▪ Leaf and mosquito screen (1 mm mesh size)
Cisterns	▪ Materials used to construct cisterns must be structurally sound. ▪ Cisterns should be constructed in areas of the site where soils can support the load associated with stored water. ▪ Cisterns must be watertight and sealed using a water-safe, non-toxic substance. ▪ Cisterns must be opaque or otherwise shielded to prevent the growth of algae. ▪ The size of the rainwater harvesting system(s) is determined through design calculations.

Note: This table does not address indoor systems or pumps.

Design Objectives and System Configuration

Rainwater harvesting systems can have many design variations that meet user demand and stormwater objectives. This specification provides a design framework to achieve the SWRv objectives that are required to comply with the regulations, and it adheres to the following concepts:

- Give preference to use of rainwater as a resource to meet on-site demand or in conjunction with other stormwater retention practices.
- Reduce peak flow by achieving volume reduction and temporary storage of runoff.

Based on these concepts, this specification focuses on system design configurations that harvest rainwater for internal building uses, seasonal irrigation, and other activities, such as cooling tower use and vehicle washing. While harvested rainwater will be in year-round demand for many internal building uses, some other uses will have varied demand depending on the time of year (e.g., cooling towers and seasonal irrigation). Thus, a lower retention volume is assigned to a type of use that has reduced demand.

Design Objectives & Cistern Design Set-Ups

Prefabricated rainwater harvesting cisterns typically range in size from 250 to over 30,000 gallons. Three basic cistern designs meet the various rainwater harvesting system configurations in this section.

Cistern Design 1. The first cistern set-up (Figure 4.27) maximizes the available storage volume to meet the desired level of stormwater retention. This layout also maximizes the storage that can be used to meet a demand. An emergency overflow exists near the top of the cistern as the only gravity release outlet device (not including the pump, manway, or inlets). It should be noted that it is possible to address 2- to 25-year storm volumes with this cistern configuration, but the primary purpose is to address the smaller SWRv design storm.

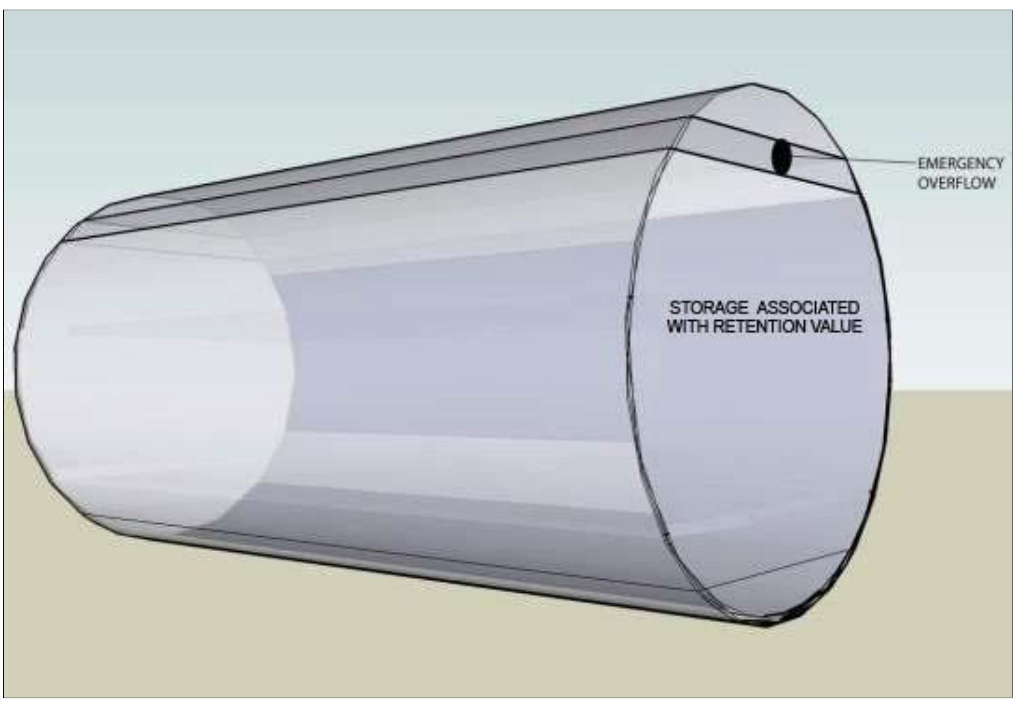


Figure 4.27. Cistern Design 1: Storage associated with the design storm volume only.

Cistern Design 2. The second cistern set-up (Figure 4.28) uses cistern storage to meet the SWRv retention objectives and also uses additional detention volume to meet some or all of the 2- to 25-year storm volume requirements. An orifice outlet is provided at the top of the design storage for the SWRv level, and an emergency overflow is located at the top of the detention volume level.

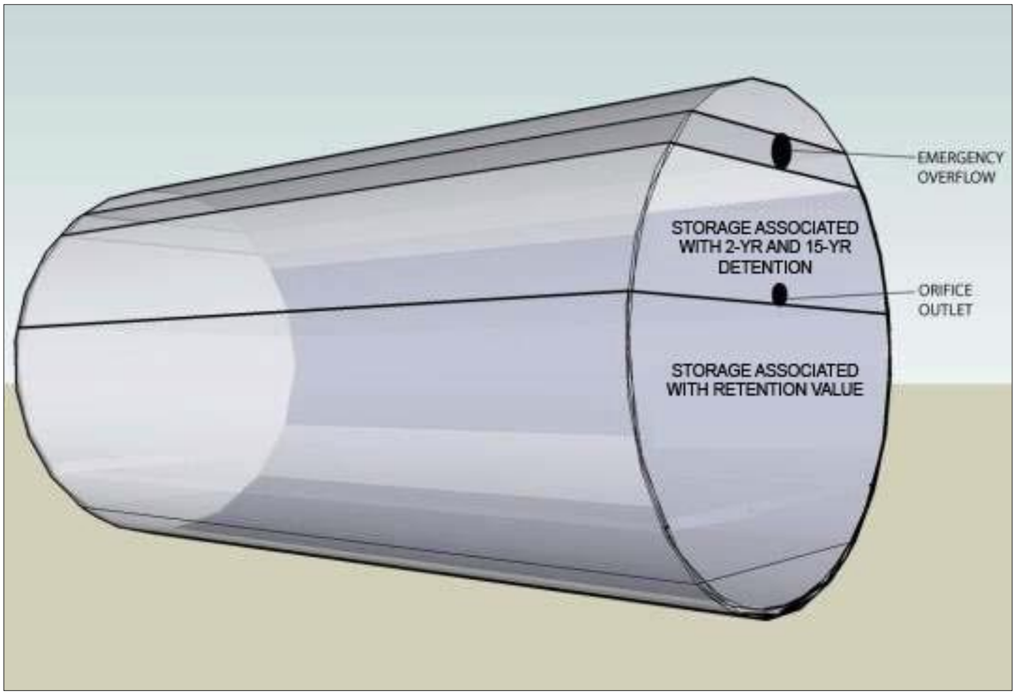


Figure 4.28. Cistern Design 2: Storage associated with design storm, channel protection, and flood volume.

Cistern Design 3. The third cistern set-up (Figure 4.29) creates a constant drawdown within the system. The small orifice at the bottom of the cistern needs to be routed to an appropriately designed secondary practice (i.e., bioretention, stormwater infiltration) that will allow the rainwater to be treated and allow for groundwater recharge over time. The release must not be discharged to a receiving channel or storm drain without treatment, and maximum specified drawdown rates from this constant drawdown should be adhered to, since the primary function of the system is not intended to be detention.

While a small orifice is shown at the bottom of the cistern in Figure 4.29, the orifice could be replaced with a pump that would serve the same purpose, conveying a limited amount of water to a secondary practice on a routine basis.

For this design, the secondary practice must be considered a component of the rainwater harvesting system with regard to the storage volume calculated in the General Retention Compliance Calculator in Appendix H. In other words, the storage volume associated with the secondary practice must not be included as a separate BMP because the secondary practice is an integral part of a rainwater harvesting system with a constant drawdown.

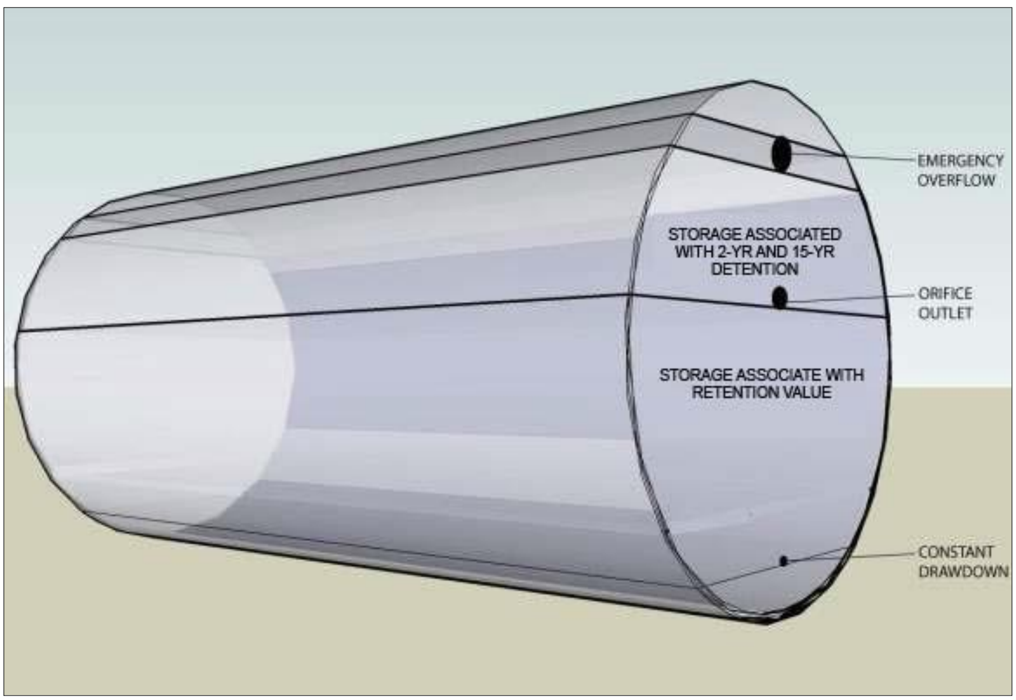


Figure 4.29. Cistern Design 3: Constant drawdown version where storage is associated with design storm, channel protection, and flood volume.

Sizing of Rainwater Harvesting Systems

The rainwater harvesting cistern sizing criteria presented in this section were developed using a spreadsheet model that used best estimates of indoor and outdoor water demand, long-term rainfall data, and CDA capture area data (Forasté 2011). The Rainwater Harvesting Storage Volume Calculator in Appendix J1 is used for cistern sizing guidance and to quantify the available storage volume achieved. This storage volume value is required for input into the General Retention Compliance Calculator and is part of the submission of a SWMP using rainwater harvesting systems for compliance. A secondary objective of the spreadsheet is to increase the beneficial uses of the stored stormwater, treating it as a valuable natural resource.

Rainwater Harvesting Storage Volume Calculator

The design specification provided in this section is follows the Rainwater Harvesting Storage Volume Calculator Appendix J1. The spreadsheet uses daily rainfall data from January 1, 2007 to December 31, 2019 to model performance parameters of the cistern under varying CDAs, demands on the system and cistern size.

The size of ponds used for irrigation, their irrigation area and characteristics of soil and land use can be entered in the calculator to determine stormwater volume retained. The runoff that reaches the cistern each day is added to the water level that existed in the cistern the previous day, with all of the total demands subtracted on a daily basis. If any overflow is realized, the volume is quantified and recorded. If the cistern runs dry (reaches the cut-off volume level), then the volume in the cistern is fixed at the low level. A summary of the water balance for the system is provided below.

Incremental Design Volumes within Cistern

Rainwater cistern sizing is determined by accounting for varying precipitation levels, captured CDA runoff, first flush diversion (through filters) and filter efficiency, low water cut-off volume, dynamic water levels at the beginning of various storms, storage needed for the design storm (permanent storage), storage needed for 2- to 25-year volume (temporary detention storage), seasonal and year-round demand use and objectives, overflow volume, and freeboard volumes above high water levels during very large storms. See Figure 4. 30 for a graphical representation of these various incremental design volumes.

The design specification described in this section does not provide guidance for sizing larger storms, but rather provides guidance on sizing for the 85th and 95th percentile design storms.

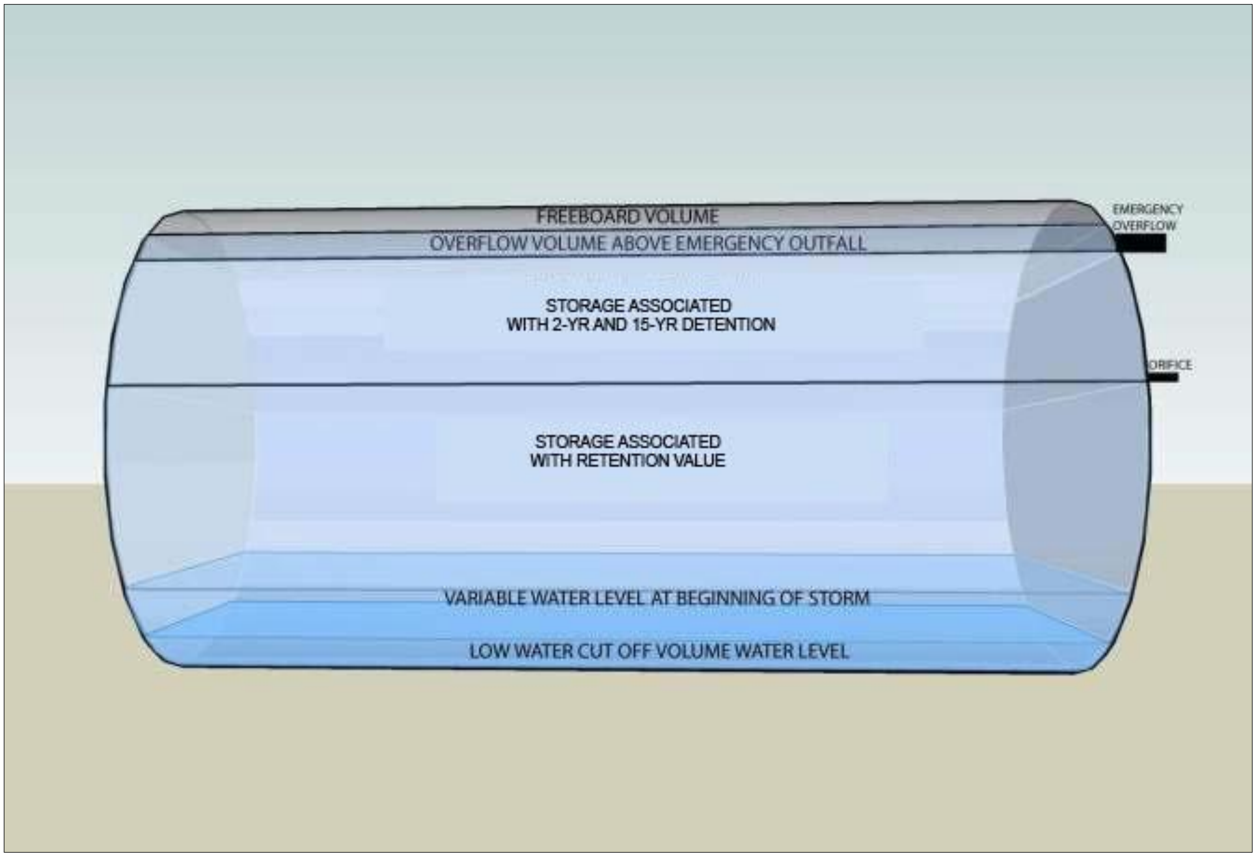


Figure 4.30. Incremental design volumes associated with cistern sizing.

The "Average Available Storage Volume" is the average storage within the cistern that is modeled and available to retain rainfall. While the SWRv will remain the same for a specific CDA, the "Average Available Storage Volume" is dependent on demand and cistern volume. It is the available space in the cistern between the average level at the beginning of a storm and the orifice outflow.

Water Contribution

- **Precipitation**
  The volume of water contributing to the rainwater harvesting system is a function of the rainfall and CDA, as defined by the designer.
- **Municipal Backup (optional)**
  In some cases, the designer may choose to install a municipal backup water supply to supplement cistern levels. Note that municipal backups may also be connected post-cistern (i.e., a connection is made to the non-potable water line that is used for pumping water from the cistern for reuse), thereby not contributing any additional volume to the cistern. Municipal backup designs that supply water directly to the cistern are not accounted for in the Rainwater Harvesting Storage Volume Calculator.

Water Losses

- **Contributing Drainage Area Runoff Coefficient**
  The CDA is assumed to convey 95% of the rainfall that lands on its surface (i.e., $RRRR = 0.95$).
- **First Flush Diversion**
  The first 0.02 to 0.06 inches of rainfall that is directed to filters is diverted from the system in order to prevent clogging it with debris. This value is assumed to be contained within the filter efficiency rate.
- **Filter Efficiency**
  It is assumed that, after the first flush diversion and loss of water due to filter inefficiencies, the remainder of the design storm will be captured successfully. For the 85th or 95th percentile storms, a minimum of 95% of the runoff should be conveyed into the cistern. The minimum values are included as the filter efficiencies in the Rainwater Harvesting Storage Volume Calculator, although they can be altered (increased) if appropriate. The Rainwater Harvesting Storage Volume Calculator applies these filter efficiencies, or interpolated values, to the daily rainfall record to determine the volume of runoff that reaches the cistern. For the purposes of selecting an appropriately sized filter, a rainfall intensity of 1 inch per hour shall be used when the design storm is the SWRv. The appropriate rainfall intensity values for the 2- to 25-year storms shall be used when designing for larger storm events.
- **Drawdown (Storage Volume)**
  This is the stored water within the cistern that is reused or directed to a secondary stormwater practice. It is the volume of runoff that is reduced from the CDA. This is the water loss that translates into the achievable storage volume retention.

Overflow

For the purposes of addressing the SWRv (not for addressing larger storm volumes), orifice outlets for both detention and emergency overflows are treated the same. This is the volume of water that may be lost during large storm events or successive precipitation events.

Storage Volume Results

The Rainwater Harvesting Storage Volume Calculator determines the average daily volume of water in the cistern for a range of cistern sizes. From this value, the available storage volume for the 85th and 95th percentile storm can be calculated; it is simply the difference between the cistern size and the average daily volume. The available storage volume for the selected cistern size should be used as an input to the General Retention Compliance Calculator. Similarly, the pond used for irrigation stormwater volume is entered in the General Retention Compliance Calculator in the rainwater harvesting row rather than the stormwater pond row to produce runoff reduction and pollutant removal credit with the other BMPs for the stormwater plan.

- **Available Storage Volume (Sv)**
  The volume available for storage of the 85th and 95th percentile storm is calculated for multiple sizes of cisterns. A trade-off curve plots these results, which allows for a comparison of the retention achieved versus cistern size. While larger cisterns yield more retention, they are more expensive. The curve helps the user to choose the appropriate cistern size, based on the design objectives and site needs.

- **Overflow Volume**
  The volume of the overflows resulting from the 85th or 95th percentile precipitation event is also reported in this sheet. The overflow volume is also plotted to illustrate the effects of cistern size on overflow volume. An example chart is shown in Figure 4.31. The effect of diminishing returns is clear. Beyond a cistern size of 9,000 gallons, the overflow volume drops to zero. So, while the available storage continues to increase, the 85th or95th percentile storm is entirely retained, and no additional retention will be possible.

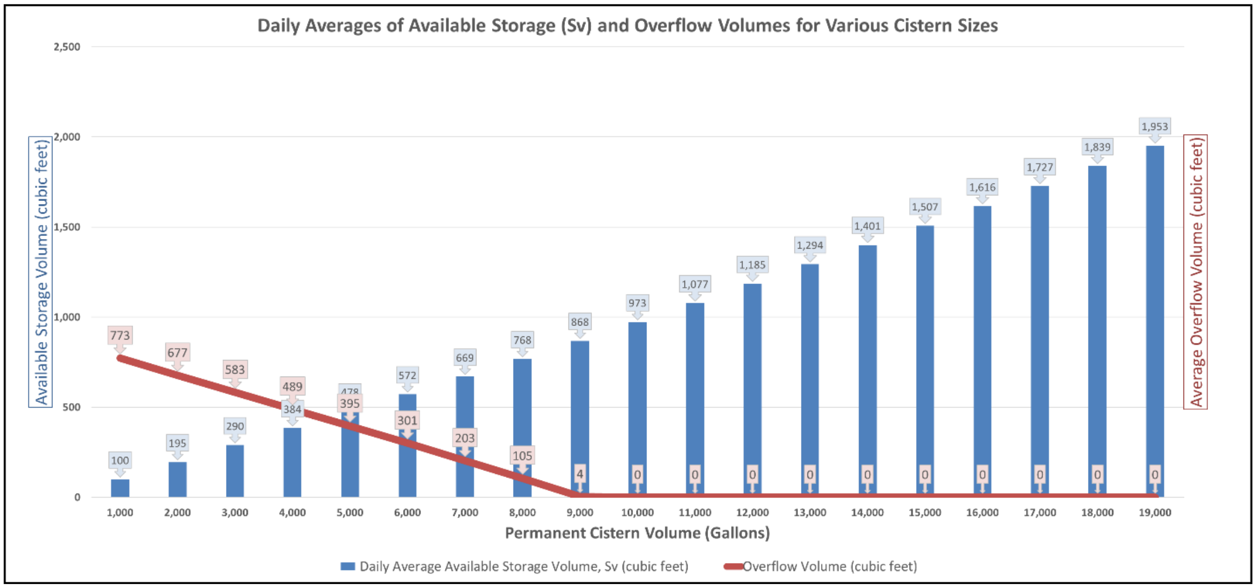


Figure 4.31. Example of graph showing Average Available Storage Volume and Overflow Volume for an example cistern design.

Results from the Rainwater Harvesting Storage Volume Calculator to be Transferred to the Compliance Calculator

There are two results from the Rainwater Harvesting Storage Volume Calculator that are to be transferred to the Compliance Calculator as follows:

- **Contributing Drainage Area**
  Enter the CDA that was used in the Rainwater Harvesting Storage Volume Calculator into the appropriate columns in the “Rainwater Harvesting” row of the Compliance Calculator BMP sheet.

- **Available Storage Volume**
  Once a cistern has been selected, enter the Available Storage Volume (ft^3) associated with that cistern into the Compliance Calculator column called “Storage Volume Provided by BMP” in the “Rainwater Harvesting” row of the BMP sheet.

Completing the Sizing Design of the Cistern

The total size of the cistern is the sum of the following four volume components:

- **Low Water Cutoff Volume (Included)**
  A dead storage area must be included so the pump will not run the cistern dry. This volume is included in the Rainwater Harvesting Storage Volume Calculator’s modeled volume.

- **Cistern Storage Associated with Design Volume (Included)**
  This is the cistern design volume from the Rainwater Harvesting Storage Volume Calculator.
- **Adding Channel Protection and Flood Volumes (Optional)**
  Additional detention volume may be added above and beyond the cistern storage associated with the design storm volumes for the 2- to 25-year events. Typical routing software programs may be used to design for this additional volume.
- **Adding Overflow and Freeboard Volumes (Required)**
  An additional volume above the emergency overflow must be provided in order for the cistern to allow very large storms to pass. Above this overflow water level, there will be an associated freeboard volume that should account for at least 5% of the overall cistern size. Sufficient freeboard must be verified for large storms, and these volumes must be included in the overall size of the cistern.

4.7.5 Rainwater Harvesting Landscaping Criteria

If the harvested water is to be used for irrigation, the design plan elements must include the proposed delineation of planting areas to be irrigated, the planting plan, and quantification of the expected water demand. The default water demand for irrigation is 1.0 inches per week over the area to be irrigated during the months of May through October only. Justification must be provided if larger volumes are to be used.

4.7.6 Rainwater Harvesting Construction Sequence <u>Installation</u>

It is advisable to have a single contractor to install the rainwater harvesting system, outdoor irrigation system, and secondary retention practices. The contractor should be familiar with rainwater harvesting system sizing, installation, and placement. A licensed plumber is required to install the rainwater harvesting system components to the plumbing system.

A standard construction sequence for proper rainwater harvesting system installation is provided below. This can be modified to reflect different rainwater harvesting system applications or expected site conditions.

1. Choose the cistern location on the site.
2. Route all downspouts or pipes to prescreening devices and first flush diverters.
3. Properly install the cistern.
4. Install the pump (if needed) and piping to end uses (indoor, outdoor irrigation, or cistern dewatering release).
5. Route all pipes to the cistern.
6. Stormwater must not be diverted to the rainwater harvesting system until the overflow filter path has been stabilized with vegetation.

<u>Construction Supervision</u>

The following items should be inspected by a qualified professional in the mechanical, electrical, or plumbing fields prior to final sign-off and acceptance of a rainwater harvesting system:

- Rooftop area matches plans

- Diversion system is properly sized and installed
- Pretreatment system is installed
- Mosquito screens are installed on all openings
- Overflow device is directed as shown on plans
- Rainwater harvesting system foundation is constructed as shown on plans
- Catchment area and overflow area are stabilized
- Secondary stormwater treatment practice(s) is installed as shown on plans
- System commissioning

Construction phase inspection checklist for rainwater harvesting practices and the Stormwater Facility Leak Test form can be found in Appendix E Construction Inspection Checklists.

4.7.7 Rainwater Harvesting Maintenance Criteria **Maintenance Inspections**

Periodic inspections and maintenance shall be conducted for each system by a qualified professional.

Maintenance inspection checklists for rainwater harvesting systems and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Maintenance Schedule

Maintenance requirements for rainwater harvesting systems vary according to use. Systems that are used to provide supplemental irrigation water have relatively low maintenance requirements, while systems designed for indoor uses have much higher maintenance requirements. Table 4.28 describes routine maintenance tasks necessary to keep rainwater harvesting systems in working condition. It is recommended that maintenance tasks be performed by an "Inspector Specialist," certified by the American Rainwater Catchment Association. Maintenance tasks must be documented and substantially comply with the maintenance responsibilities outlined in the maintenance agreement.

Table 4.28. Typical Maintenance Tasks for Rainwater Harvesting Systems

Responsible Person	Frequency	Activity
Owner	Four times a year	Inspect and clean prescreening devices and first flush diverters
	Twice a year	Keep gutters and downspouts free of leaves and other debris
	Once a year	▪ Inspect and clean storage cistern lids, paying special attention to vents and screens on inflow and outflow spigots. Check mosquito screens and patch holes or gaps immediately ▪ Inspect condition of overflow pipes, overflow filter path, and/or secondary stormwater treatment practices
	Every third year	Clear overhanging vegetation and trees over roof surface
Qualified	According to Manufacturer	Inspect water quality devices

Responsible Person	Frequency	Activity
Third-Party Inspector	As indicated in Appendix J Rainwater Harvesting Treatment and Management Requirements	Field verification and data logs must be available at all times and annual reports should be sent to the Public Works Department.
	Every third year	▪ Inspect cistern for sediment buildup ▪ Check integrity of backflow preventer ▪ Inspect structural integrity of cistern, pump, pipe and electrical system ▪ Replace damaged or defective system components

Mosquitoes

In some situations, poorly designed rainwater harvesting systems can create habitat suitable for mosquito breeding. Designers must provide screens on above- and below-ground cisterns to prevent mosquitoes and other insects from entering the cisterns. If screening is not sufficient in deterring mosquitoes, dunks or pellets containing larvicide can be added to cisterns when water is intended for landscaping use.

Waste Material

Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.7.8 Rainwater Harvesting Stormwater Compliance Calculations

Rainwater harvesting practices are credited with 100% retention for the average available storage volume (Sv) available in the cistern as well as 100% TSS, TN, and bacteria removal (see Table 4.29). This average available storage volume is determined by using the Rainwater Harvesting Storage Volume Calculator, as described in Section 4.5.4 Rainwater Harvesting Design Criteria.

Table 4.29. Rainwater Harvesting Retention and Pollutant Removal

Retention	= 100%
TSS Removal	= 100%
TN Removal	= 100%
Bacteria Removal	= 100%

Rainwater harvesting practices also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume from the total runoff volume for the 2-year through the 100-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.8 Impervious Surface Disconnection

Impervious Surface Disconnection				
Definition: This strategy involves managing runoff close to its source by directing it from rooftops and other impervious surfaces to pervious areas.				
Site Applicability		**BMP Performance Summary**		
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High		
		TSS[1]	**Total N[1]**	**Bacteria[1]**
▪ Suburban ▪ Rural	**Small**	80%	40%	40%
		Runoff Reduction		
Construction Costs	**Maintenance Burden**	**Volume**		
Low	Low	Low		
Maintenance Frequency:		***SWRv***		
Routine	**Non-Routine**	**40%**		
At least annually	As needed			
Advantages/Benefits		**Disadvantages/Limitation**		
▪ Low cost construction and maintenance ▪ Reduces runoff volume ▪ Helps restore pre-development hydrologic conditions		▪ Only applicable to small drainage areas ▪ Difficult to apply to treatment trains ▪ Requires pervious receiving area		
Components		**Design considerations**		
▪ Conveyance ▪ Receiving area ▪ Vegetation ▪ Receiving soils		▪ Maximum CDA of 1,000 ft^2 per disconnection ▪ Disconnection area should be at least 35 feet long and 10 feet wide. ▪ Slope of receiving area should be < 2% (with turf reinforcement, <5%) ▪ Building setback for areas with < 1% slope		
Maintenance Activities				
▪ Typical lawn/landscaping maintenance		▪ Ensure receiving area remains uncompacted and pervious		

[1]*Credited pollutant load removal*

In this practice, runoff from a rooftop or other small impervious surface is directed to a pervious surface or small practice to provide infiltration, filtering, or reuse (Figure 4.32**)**

Figure 4.32. Rooftop disconnection (photo: Center for Watershed Protection, Inc.)

Definition

This strategy involves managing runoff close to its source by directing it from rooftops and other impervious surfaces to pervious areas. Disconnection practices can be used to reduce the volume of runoff that enters the combined or separate sewer systems. Applicable practices include the following:

D-1 Disconnection to pervious areas with the compacted cover designation

D-2 Disconnection to conservation areas

Disconnection practices reduce a portion of the SWRv. In order to fully meet retention requirements, , disconnection practices must be combined with additional practices.

4.8.1 Impervious Surface Disconnection Feasibility Criteria

Impervious surface disconnections are ideal for use on commercial, institutional, municipal, multi-family residential, and single-family residential buildings. Key constraints with impervious surface disconnections include available space, soil permeability, and soil compaction. These and other feasibility criteria are described below and summarized in Table 4. 30.

- **Contributing Drainage Area.** For rooftop impervious areas, the maximum impervious area treated cannot exceed 1,000 square feet per disconnection. For impervious areas other than rooftop, the longest contributing impervious area flow path cannot exceed 75 feet.
- **Sizing.** The available disconnection area must be at least 10 feet wide and 35 feet long. For sheet flow from impervious areas, the disconnection area must be as wide as the area draining to it.
- **Site Topography.** Disconnection is best applied when the grade of the receiving pervious area is less than 2%, or less than 5% with turf reinforcement. The slope of the receiving areas must be graded away from any building foundations. Turf reinforcement may include erosion control matting or other appropriate reinforcing materials that are confirmed by the designer to be erosion resistant for the specific characteristics and flow rates anticipated at each individual application, and acceptable to the plan-approving authority.

- **Soils.** Impervious surface disconnection can be used on any post-construction hydrologic soil group (HSG). The disconnection area must be kept well-vegetated with minimal bare spots—at least 95% soil cover.
- **Building Setbacks.** If the grade of the receiving area is less than 1%, downspouts must be extended 5 feet away from building.

Discharge Across Property Lines. Disconnection areas must be designed such that runoff is not directed across property lines toward other sites.

Economic Considerations. Disconnection is one of the least expensive BMPs available.

Table 4.30. Feasibility Criteria for Disconnection

Design Factor	Disconnection Design
Contributing Drainage Area	1,000 square feet per rooftop disconnection. For impervious areas other than rooftop, the longest contributing impervious area flow path cannot exceed 75 feet.
Sizing	The available disconnection area must be at least 10 feet wide and 35 feet long. For sheet flow from impervious areas, the disconnection area must be as wide as the area draining to it.
Site Topography	Grade of the receiving pervious area is less than 2%, or less than 5% with turf reinforcement. The slope of the receiving areas must be graded away from any building foundations.
Soils	Impervious surface disconnection can be used on any post-construction HSG. The disconnection area must be kept well-vegetated with minimal bare spots.
Building Setbacks	5 feet away from building if the grade of the receiving area is less than 1%.

4.8.2 Impervious Surface Disconnection Conveyance Criteria
Receiving areas in disconnection practices (D-1, D-2, and D-3) require a design that safely conveys the 2- to 25-year storm events over the receiving area without causing erosion. In some applications, erosion control matting or other appropriate reinforcing materials may be needed to control flow rates anticipated for these larger design storms.

4.8.3 Impervious Surface Disconnection Pretreatment Criteria
Pretreatment is not needed for impervious surface disconnection.

4.8.4 Impervious Surface Disconnection Design Criteria
If the feasibility criteria presented in Section 4.6.1 are met for a disconnection area, the storage volume is equal to the SWRv for the impervious area draining to it. The disconnection area itself should be considered Compacted Cover or Open Space rather than BMP area and should not be considered as part of the contributing drainage area to the impervious surface disconnection.

The following additional design criteria apply to Disconnection to Conservation Areas:

- **(D-2) Disconnection to a Conservation Area.** Disconnection area cannot include regulated wetlands and buffer areas.

- Inflow must be conveyed via sheet flow or via a level spreader.
- If inflow is conveyed via a level spreader, the maximum flow path is 150 feet, and the level spreader must be designed with an appropriate width as specified below.

Level Spreaders. A level spreader can be used to disperse or "spread" concentrated flow thinly over a vegetated or forested area to promote greater runoff infiltration in the receiving area. A level spreader consists of a permanent linear structure constructed at a 0% grade that transects the slope. The influent concentrated runoff must be spread over an area wide enough area so that erosion of the receiving area does not result. Detailed information on the design and function of level spreaders can be found in Hathaway and Hunt (2006) and NCDWQ (2010).

The minimum required width of the level spreader is

- 13 linear feet per each 1 cubic foot/second of inflow if the receiving conservation area has a minimum 90% ground cover
- 40 linear feet per 1 cubic foot/second of inflow if the receiving conservation area is forested

4.8.5 Impervious Surface Disconnection Landscaping Criteria

All receiving disconnection areas must be stabilized to prevent erosion or transport of sediment to receiving practices or drainage systems according to the Erosion and Sediment Control seeding and vegetation requirements. Designers must ensure that the maximum flow velocities do not exceed the acceptable values for the selected grass species and the specific site slope.

4.8.6 Impervious Surface Disconnection Construction Sequence

Construction Sequence for Disconnection to Pervious Areas. For disconnection to a pervious area, the pervious area can be within the limits of disturbance (LOD) during construction. The following procedures should be followed during construction:

- Before site work begins, the receiving pervious disconnection area boundaries should be clearly marked.
- Construction traffic in the disconnection area should be limited to avoid compaction. The material stockpile area shall not be located in the disconnection area.
- Construction runoff should be directed away from the proposed disconnection area, using perimeter silt fence, or, preferably, a diversion dike.
- If existing topsoil is stripped during grading, it shall be stockpiled for later use.
- The disconnection area may require light grading to achieve desired elevations and slopes. This should be done with tracked vehicles to prevent compaction.
- Topsoil and or compost amendments should be incorporated evenly across the disconnection area, stabilized with seed, and protected by biodegradable erosion control matting or blankets.
- Stormwater must not be diverted into any topsoil or compost amended areas until the area is stabilized (establishment of 95% or greater groundcover).

Construction Sequence for Disconnection to Conservation Areas. For disconnection to a conservation area, the conservation area must be fully protected during the construction stage of development and kept outside the LOD on the soil erosion and sediment control plan.

- No staging, parking, clearing, grading, or heavy equipment access is allowed in the conservation area except temporary disturbances associated with incidental utility construction, restoration operations, or management of nuisance vegetation. Incidental utility construction includes protecting existing utilities, removing abandoned utilities, rearranging service lines, temporarily rearranging utilities, and adjusting utility appurtenances.
- Any conservation areas shall be protected by super silt fence, chain link fence, orange safety fence, or other measures to prevent sediment discharge consistent with soil erosion and sediment control standards and specifications.
- The LOD must be clearly shown on all construction drawings and identified and protected in the field by acceptable signage, silt fence or other protective barrier.
- If a level spreader is to be used in the design, construction of the level spreader shall not commence until the CDA has been stabilized and perimeter soil erosion and sediment control measures have been removed and cleaned out. Stormwater must not be diverted into the disconnection area until the level spreader is installed and stabilized.

Construction Supervision. Construction supervision is recommended to ensure compliance with design standards. A qualified professional should evaluate the performance of the disconnection after the first significant rainfall event to look for evidence of gullies, outflanking, undercutting, or sparse vegetative cover. Spot repairs should be made as needed.

Construction phase inspection checklist for impervious cover disconnection can be found in Appendix E Construction Inspection Checklists.

4.8.7 Impervious Surface Disconnection Maintenance Criteria
Maintenance of disconnected downspouts usually involves regular lawn or landscaping maintenance in the filter path from the roof to the street. In some cases, runoff from a disconnection may be directed to a more natural, undisturbed setting (i.e., where lot grading and clearing is “fingerprinted” and the proposed filter path is protected). Typical maintenance activities include erosion control of the receiving area and ensuring the receiving area remains uncompacted and pervious.

Maintenance inspection checklists for disconnection can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.8.8 Impervious Surface Disconnection Stormwater Compliance Calculations Disconnection practices are credited with 40% retention for the SWRv as well as 80% TSS, 40% TN, and 40% bacteria removal (see Table 4.31).

Table 4.31. Disconnection Retention and Pollutant Removal

Retention	= 40%
TSS Removal	= 80%

TN Removal	= 40%
Bacteria Removal	= 40%

Impervious surface disconnection also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume from the total runoff volume for the 2- to 25-year, and 100-year storms. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.9 Open Channel Systems

Open Channel Systems							
Definition: Vegetated open channels that are designed to capture and treat or convey the design storm volume (SWRv).							

Site Applicability		BMP Performance Summary		
Land Uses	**Required Footprint**	**WQ Improvement:** Moderate to High		
		TSS[1]	**Total N[1]**	**Bacteria[1]**
▪ Suburban ▪ Rural	**Moderate**	50-80%	25-70%	30-80%
		Runoff Reduction		
Construction Costs	**Maintenance Burden**	**Volume**		
Low	Low	Low		

Maintenance Frequency:		*SWRv*				
Routine	**Non-Routine**	**O-1a**	**O-1b**	**O-2**	**O-3**	**O-4**
Quarterly	Every 10-15 years	10%	20%	60%	0%	0%

Advantages/Benefits	Disadvantages/Limitation
▪ Less expensive than curb and gutter ▪ Relatively low maintenance requirements ▪ Provides pretreatment if used as part of runoff conveyance system ▪ Provides partial infiltration of runoff in some soils ▪ Good for small drainage areas	▪ Must be carefully designed to achieve low flow rates in the channel (< 1.0 ft/s) ▪ May re-suspend sediment ▪ May not be acceptable for some areas because of standing water in channel

Components	Design considerations
▪ Channel geometry ▪ Dense vegetation ▪ Check dams, as needed)	▪ Maximum drainage area of 2.5 acres ▪ Slopes (<4% unless using O-4) ▪ Runoff velocities must be non-erosive ▪ Vegetation must withstand both relatively high velocity flows and wet/dry periods.

Maintenance Activities	
▪ Mow grass to 3 or 4 inches high ▪ Inspect for, and correct, formation of rills and gullies	▪ Clean out sediment accumulation in channel ▪ Ensure that vegetation remains well established

[1]*Credited pollutant load removal*

Often found along roadsides, parking lots, and property boundaries, open channels can provide stormwater conveyance, capture and/or treatment (Figure 4.33**). One of the most visible stormwater BMPs, they are often part of stormwater conveyance systems.**

Figure 4.33. Open channel (photo: Center for Watershed Protection, Inc.)

Definition. Vegetated open channels that are designed to capture and treat or convey the design storm volume (SWRv). Design variants include the following:

O-1 Grass channels

O-2 Dry swales/bioswales

O-3 Wet swales

O-4 Regenerative stormwater conveyance (RSC)

Open channel systems shall not be designed to provide stormwater detention except under extremely unusual conditions. Open channel systems must generally be combined with a separate facility to meet detention requirements.

Grass channels (O-1) can provide a modest amount of runoff filtering and volume attenuation within the stormwater conveyance system resulting in the delivery of less runoff and pollutants than a traditional system of curb and gutter, storm drain inlets, and pipes (see Figure 4.34). The performance of grass channels will vary depending on the underlying soil permeability. Grass channels, however, are not capable of providing the same stormwater functions as dry swales as they lack the storage volume associated with the engineered filter media. Their retention performance can be boosted when compost amendments are added to the bottom of the swale (see Appendix C Soil Compost Amendment Requirements). Grass channels are a preferable alternative to both curb and gutter and storm drains as a stormwater conveyance system, where development density, topography, and soils permit.

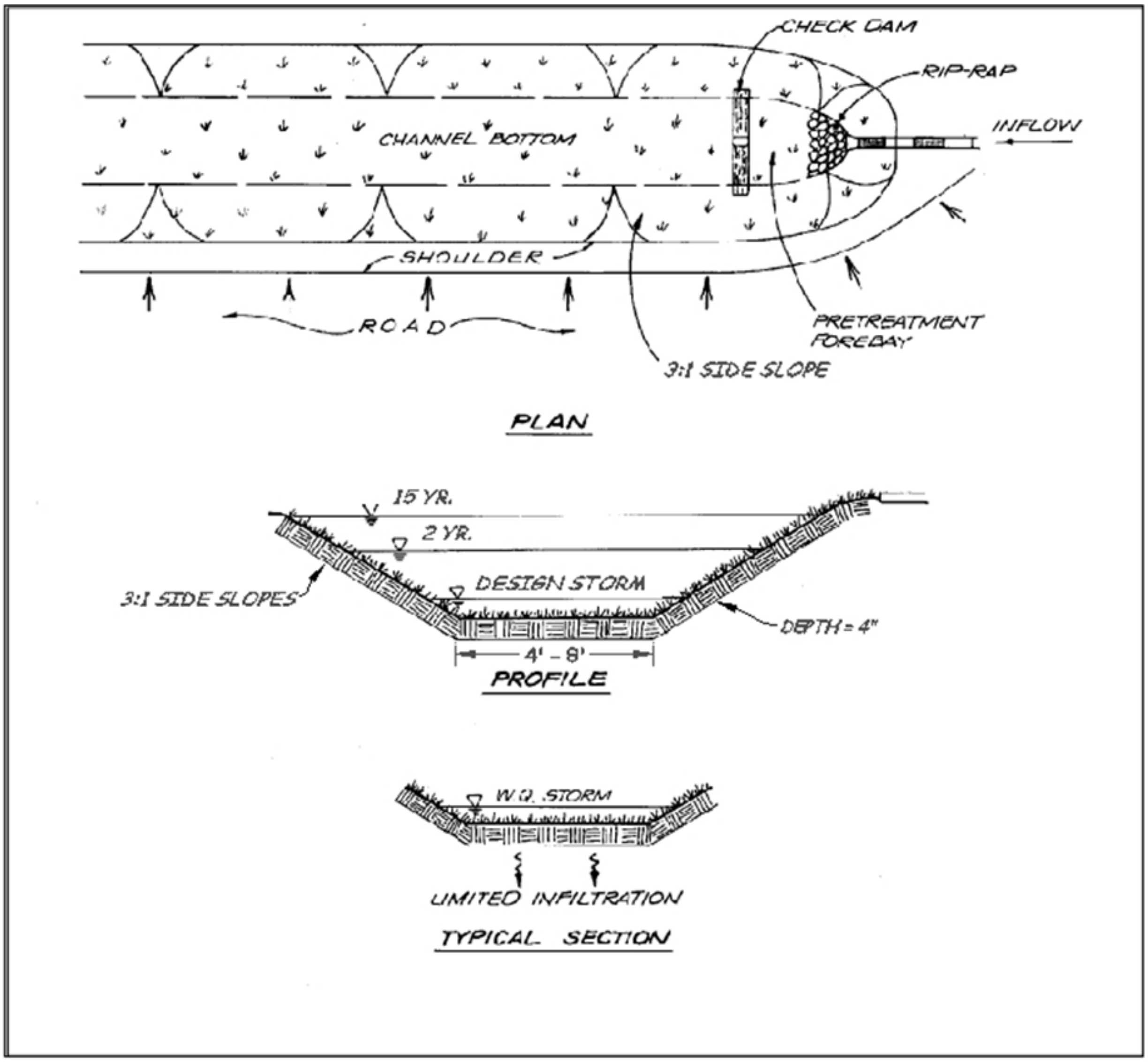


Figure 4.34. Grass channel typical plan, profile, and section views (O-1).

Dry swales (O-2), also known as bioswales, are essentially bioretention cells that are shallower, configured as linear channels, and covered with turf or other surface material (other than mulch and ornamental plants). The dry swale is a soil filter system that temporarily stores and then filters the desired design storm volume. Dry swales rely on a premixed filter media below the channel that is identical to that used for bioretention. In most cases, the runoff treated by the filter media flows into an underdrain, which conveys treated runoff back to the conveyance system further downstream. The underdrain system consists of a perforated pipe within a gravel layer on the bottom of the swale, beneath the filter media. However, if soils are permeable, runoff infiltrates into underlying soils and the dry swale can be designed without an underdrain as if it were an enhanced bioretention. In either case, check dams should be constructed to encourage ponding (see Site Topography). Dry swales may appear as simple grass channels with the same shape and turf cover, while others may have more elaborate landscaping. Swales can be planted with turf grass, tall meadow grasses, decorative herbaceous cover, or trees.

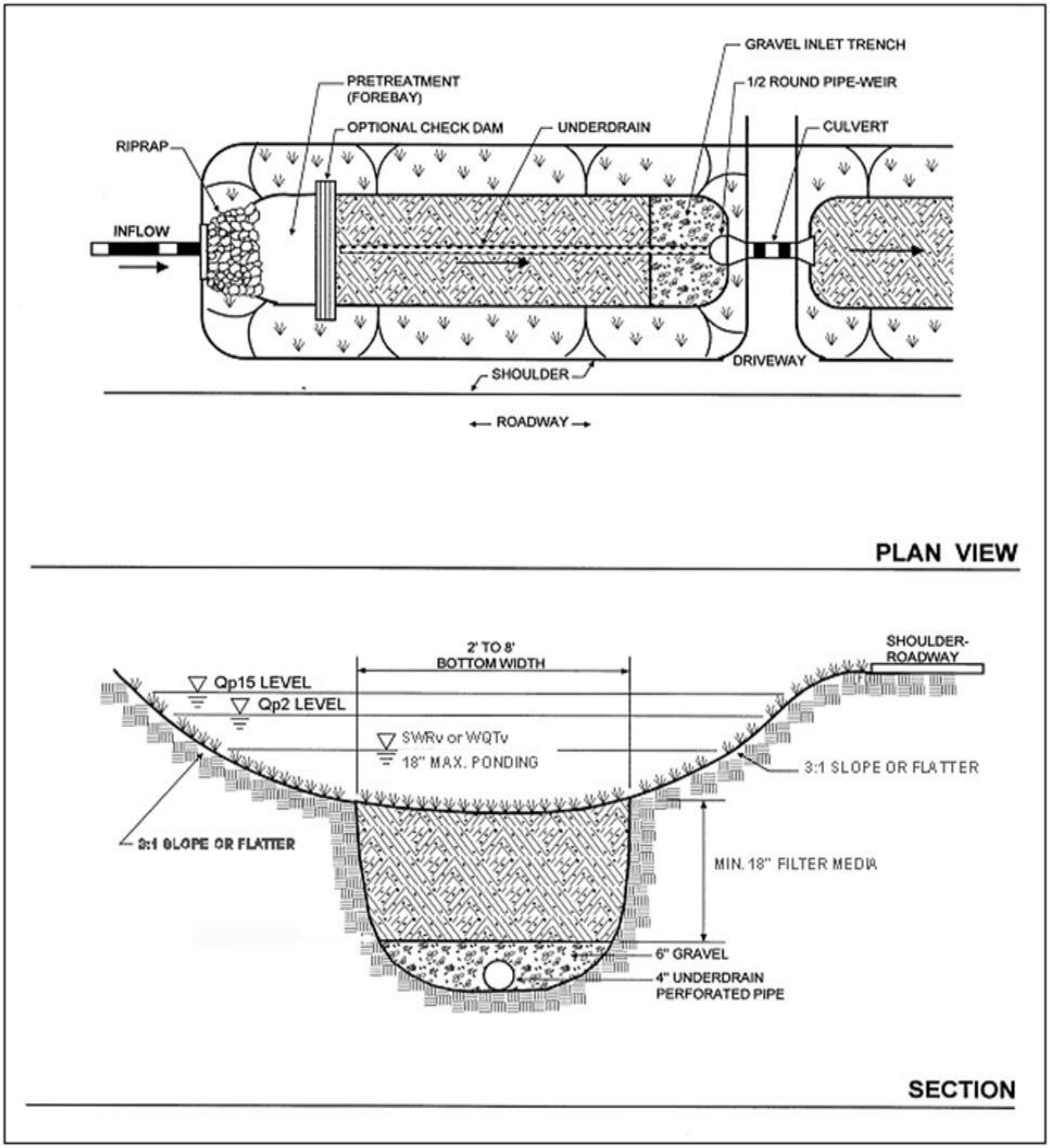


Figure 4.35. Example of a dry swale/bioswale (O-2).

Wet swales (O-3) can provide a modest amount of runoff filtering within the conveyance (see Figure 4.36). These linear wetland cells often intercept shallow groundwater to maintain a wetland plant community. The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity. On-line or off-line cells are formed within the channel to create saturated soil or shallow standing water conditions (typically less than 6 inches deep).

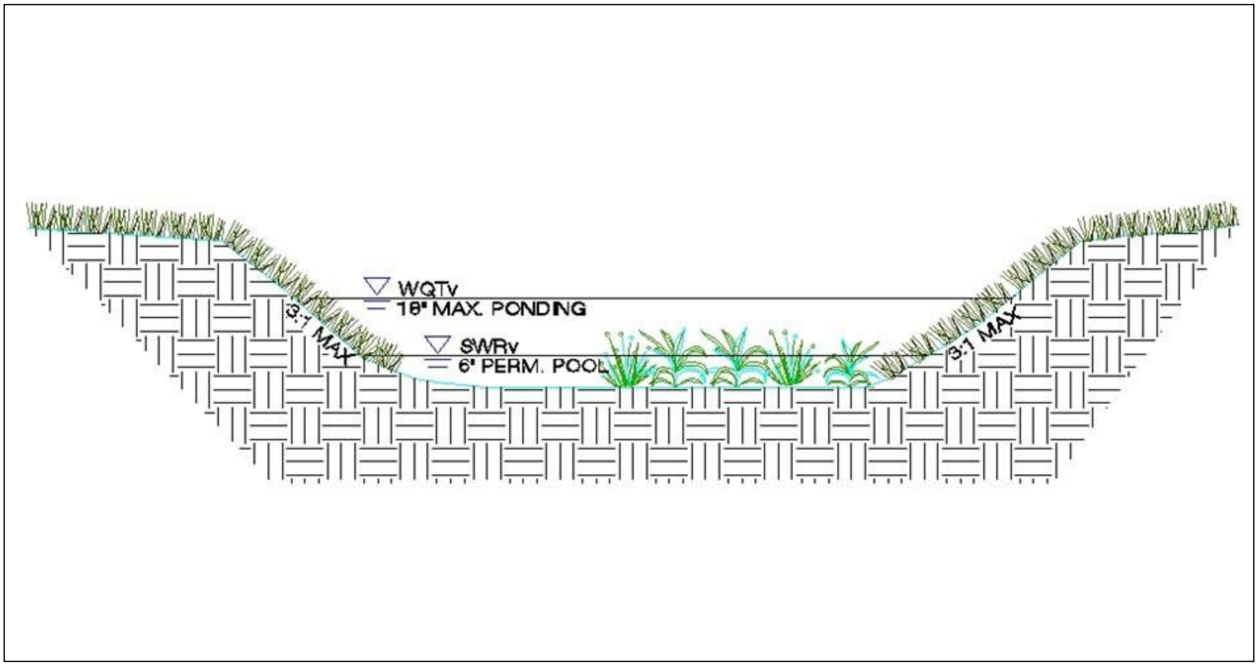


Figure 4.36. Example of a wet swale (O-3).

Regenerative Stormwater Conveyance (O-4). RSC is a unique conveyance practice that can be used in locations where other conveyance practices are infeasible, or as a restoration practice for eroded or degraded outfalls and drainage channels (Figure 4.37). RSC utilizes a series of shallow aquatic pools, riffle weir grade controls, native vegetation and underlying sand and woodchip beds to treat, detain, and convey storm flow. It can be used in places where grades make traditional stormwater practices difficult to implement. Because of the regional topography and waters of the state limitations, RSC Systems will have limited application in the Southern Lowcountry. RSC Systems combine features and treatment benefits of Swales, Infiltration, Filtering and Wetland practices. In addition, they are designed to convey flows associated with larger storm events in a non-erosive manner, which results in a reduction of channel erosion impacts commonly encountered at conventional stormwater outfalls and headwater stream channels.

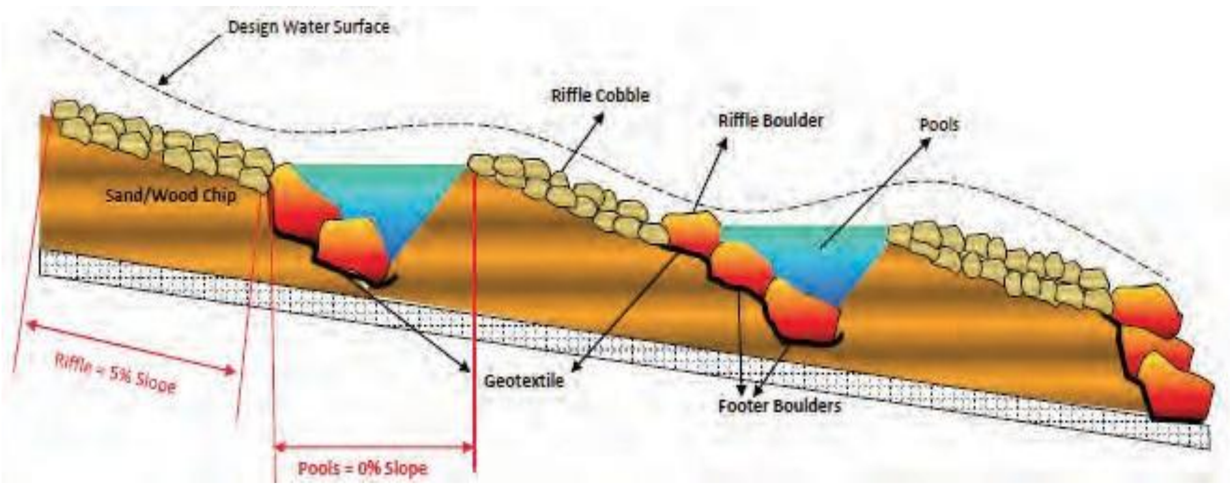


Figure 4.37. Example of Regenerative Stormwater Conveyance (O-4).

4.9.1 Open Channel Feasibility Criteria

Open channel systems are primarily applicable for land uses, such as roads, highways, and residential development. Some key feasibility issues for open channels include the following:

Contributing Drainage Area. The maximum CDA to an open channel should be 2.5 acres, preferably less. When open channels treat and convey runoff from CDAs greater than 2.5 acres, the velocity and flow depth through the channel often becomes too great to treat runoff or prevent erosion in the channel. The design criteria for maximum channel velocity and depth are applied along the entire length (see Section 4.9.4 Open Channel Design Criteria). Dry Swales should be approximately 3%–10% of the size of the CDA, depending on the amount of impervious cover. Wet swale footprints usually cover about 5%–15% of their CDA.

Available Space. Open channel footprints can fit into relatively narrow corridors between utilities, roads, parking areas, or other site constraints. Grass channels can be incorporated into linear development applications (e.g., roadways) by utilizing the footprint typically required for an open section drainage feature. The footprint required will likely be greater than that of a typical conveyance channel. However, the benefit of the retention may reduce the footprint requirements for stormwater management elsewhere on the development site.

Site Topography. Grass channels and wet swales should be used on sites with longitudinal slopes of less than 4%. Check dams can be used to reduce the effective slope of the channel and lengthen the contact time to enhance filtering and/or infiltration. Longitudinal slopes of less than 2% are ideal and may eliminate the need for check dams. However, channels designed with longitudinal slopes of less than 1% should be monitored carefully during construction to ensure a continuous grade so as to avoid flat areas with pockets of standing water.

For dry swales, check dams will be necessary regardless of the longitudinal slope to create the necessary ponding volume.

Land Uses. Open channels can be used in residential, commercial, or institutional development settings.

When open channels are used for both conveyance and water quality treatment, they should be applied only in linear configurations parallel to the contributing impervious cover, such as roads and small parking areas. The linear nature of open channels makes them well-suited to treat highway or low- and medium-density residential road runoff, if there is adequate right-of-way width and distance between driveways. Typical applications of open channels include the following, as long as CDA limitations and design criteria can be met:

- Within a roadway or bicycle path right-of-way;
- Along the margins of small parking lots;
- Oriented from the roof (downspout discharge) to the street;
- Disconnecting small impervious areas; and
- Used to treat the managed turf areas of parkland, sports fields, golf courses, and other turf-intensive land uses, or to treat CDAs with both impervious and managed turf cover (such as residential streets and yards).

Open channels are not recommended when residential density exceeds more than four (4) dwelling units per acre, due to a lack of available land and the frequency of driveway crossings along the channel.

Open channels can also provide pretreatment for other stormwater treatment practices.

Available Hydraulic Head. A minimum amount of hydraulic head is needed to implement open channels in order to ensure positive drainage and conveyance through the channel. The hydraulic head for wet swales and grass channels is measured as the elevation difference between the channel inflow and outflow point. The hydraulic head for dry swales is measured as the elevation difference between the inflow point and the storm drain invert (unless an infiltration-based design will be used). Dry swales typically require 3 to 5 feet of hydraulic head since they have both a filter bed and underdrain.

Hydraulic Capacity. Open channels are typically designed as on-line practices that must be designed with enough capacity to (1) convey runoff from the 25-year design storm at non-erosive velocities, and (2) contain the 25-year flow within the banks of the swale. This means that the swale's surface dimensions are more often determined by the need to pass the 25-year storm events, which can be a constraint in the siting of open channels within existing rights-of-way (e.g., constrained by sidewalks).

Depth to Water Table. The bottom of dry swales and grass channels must be at least 0.5 feet above the seasonally high groundwater table, to ensure that groundwater does not intersect the filter bed, since this could lead to groundwater contamination or practice failure. It is permissible for wet swales to intersect the water table.

Soils. Soil conditions do not constrain the use of open channels, although they do dictate some design considerations:

- Dry swales in soils with low infiltration rates may need an underdrain. Designers must verify site-specific soil permeability at the proposed location using the methods for on-site soil investigation presented in Appendix B Geotechnical Information Requirements for Underground BMPs to eliminate the requirements for a dry swale underdrain.
- Grass channels situated on low-permeability soils may incorporate compost amendments to improve performance (see Appendix C Soil Compost Amendment Requirements).
- Wet swales work best on the more impermeable HSG C or D soils.
- At infill soil locations, geotechnical investigations are required to determine if the use of an impermeable liner and underdrain are necessary for open channel designs.

Utilities. Typically, utilities can cross linear channels if they are specially protected (e.g., double-casing). Interference with underground utilities should be avoided, if possible. When large site development is undertaken, the expectation of achieving avoidance will be high. Conflicts may be commonplace on smaller sites and in the PROW. Where conflicts cannot be avoided, these guidelines shall be followed:

- Consult with each utility company on recommended offsets that will allow utility maintenance work with minimal disturbance to the BMP.
- Whenever possible, coordinate with utility companies to allow them to replace or relocate their aging infrastructure while BMPs are being implemented.
- BMP and utility conflicts will be a common occurrence in PROW projects. However, the standard solution to utility conflict should be the acceptance of conflict provided sufficient soil coverage over the utility can be assured.
- Additionally, when accepting utility conflict into the BMP design, it is understood that the BMP will be temporarily impacted during utility maintenance but restored to its original condition.

Avoidance of Irrigation or Baseflow. Open channels should be located so as to avoid inputs of springs, irrigation systems, chlorinated wash-water, or other dry weather flows.

Setbacks. To avoid the risk of seepage, stormwater cannot flow from the open channel reservoir layer or via baseflow to the traditional pavement base layer, existing structure foundations, or future foundations which may be built on adjacent properties Open channels should be set back at least 10 feet down-gradient from building foundations and property lines, 50 feet from septic system fields and 150 feet from public or private drinking water wells. The 10-foot building setback may be relaxed if an impermeable building liner is installed.

Pollutant Hotspot Land Use. In areas where higher pollutant loading is likely (i.e. oils and greases from fueling stations or vehicle storage areas, sediment from un-stabilized pervious areas, or other pollutants from industrial processes), appropriate pretreatment, such as an oil- water separator or filtering device must be provided. These pretreatment facilities should be monitored and maintained frequently to avoid negative impacts to the channel and subsequent water bodies.

Runoff from hotspot land uses must not be treated with infiltrating dry swales due to the potential interaction with the water table and the risk that hydrocarbons, trace metals, and other toxic pollutants could migrate into the groundwater. An impermeable liner must be used for filtration of hotspot runoff for dry swales.

Grass channels can typically be used to convey runoff from stormwater hotspots, but they do not qualify as a hotspot treatment mechanism. Wet swales are not recommended to treat stormwater hotspots, due to the potential interaction with the water table and the risk that hydrocarbons, trace metals, and other toxic pollutants could migrate into the groundwater.

On sites with existing contaminated soils, infiltration is not allowed; dry and wet swales on these hotspots must include an impermeable liner.

Feasibility. Open channels are ideally suited to the Southern Lowcountry environment, since open channel drainage is often the norm due to the flat topography. Depending on underlying soil and other characteristics, however, a specific open channel option may be the most appropriate. For example, the wet swale design option is most suited to areas with elevated groundwater tables, while dry swales and grassed channels are best suited for sandy soils of the coastal plain.

Economic Considerations. While most open channel designs provide relatively small water quality credits when compared with other stormwater practices, they nevertheless provide greater quality benefits than traditional conveyance designs, such as curb and gutter.

4.9.2 Open Channel Conveyance Criteria

The bottom width and slope of a grass channel must be designed such that the velocity of flow from the design storm provides a minimum hydraulic residence time (average travel time for a particle of water through a waterbody) of 9 minutes for the peak flows from the SWRv or design storm. Check dams may be used to achieve the needed retention volume, as well as to reduce the flow velocity. Check dams must be spaced based on channel slope and ponding requirements, consistent with the criteria in Section 4.9.4 Open Channel Design Criteria.

Open channels must also convey the 25-year storm at non-erosive velocities (generally less than 6 feet per second) for the soil and vegetative cover provided. The final designed channel shall provide 6 inches minimum freeboard above the designated water surface profile of the channel. The analysis must evaluate the flow profile through the channel at normal depth, as well as the flow depth over top of the check dams.

RSC systems are typically designed to convey larger storm events, up to and including the 100- year storm event.

4.9.3 Open Channel Pretreatment Criteria

Pretreatment is required for open channels to dissipate energy, trap sediments, and slow down the runoff velocity.

The selection of a pretreatment method depends on whether the channel will experience sheet flow or concentrated flow. Several options are as follows:

- **Check Dams (channel flow).** These energy dissipation devices are acceptable as pretreatment on small open channels with CDAs of less than 1 acre. The most common form is the use of wooden or stone check dams. The pretreatment volume stored must be 15% of the design volume.
- **Tree Check Dams (channel flow).** These are street tree mounds that are placed within the bottom of grass channels up to an elevation of 9 to 12 inches above the channel invert. One side has a gravel or river stone bypass to allow runoff to percolate through (Cappiella et al, 2006). The pretreatment volume stored must be 15% of the design volume.
- **Grass Filter Strip (sheet flow).** Grass filter strips extend from the edge of the pavement to the bottom of the open channel at a slope of 5H:1V or flatter. Alternatively, provide a combined 5 feet of grass filter strip at a maximum 5% (20H:1V) cross slope and 3H:1V or flatter side slopes on the open channel.
- **Gravel or Stone Diaphragm (sheet flow).** The gravel diaphragm is located at the edge of the pavement or the edge of the roadway shoulder and extends the length of the channel to pretreat lateral runoff. This requires a 2- to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The stone must be sized according to the expected rate of discharge.
- **Gravel or Stone Flow Spreaders (concentrated flow).** The gravel flow spreader is located at curb cuts, downspouts, or other concentrated inflow points, and should have a 2- to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The gravel should extend the entire width of the opening and create a level stone weir at the bottom or treatment elevation of the channel.
- **Initial Sediment Forebay (channel flow).** This grassed cell is located at the upper end of the open channel segment with a recommended 2:1 length to width ratio and a storage volume equivalent to at least 15% of the total design storm volume. If the volume of the forebay will be included as part of the dry swale storage volume, the forebay must de-water between storm events. It cannot have a permanent ponded volume.

4.9.4 Open Channel Design Criteria

Channel Geometry. Design guidance regarding the geometry and layout of open channels is provided below:

- Open channels should generally be aligned adjacent to and the same length as the CDA identified for treatment.
- Open channels should be designed with a trapezoidal or parabolic cross section. A parabolic shape is preferred for aesthetic, maintenance, and hydraulic reasons.
- The bottom width of the channel should be between 4 to 8 feet wide to ensure that an adequate surface area exists along the bottom of the swale for filtering. If a channel will be wider than 8 feet, the designer must incorporate benches, check dams, level spreaders, or multi-level cross sections to prevent braiding and erosion along the channel bottom.
- Open-channel side slopes should be no steeper than 3H:1V for ease of mowing and routine maintenance. Flatter slopes are encouraged, where adequate space is available, to enhance pretreatment of sheet flows entering the channel.
- RSC has several specific geometry requirements, which are outlined in RSC Sizing below.

Check dams. Check dams may be used for pretreatment, to break up slopes, and to increase the hydraulic residence time in the channel. Design requirements for check dams are as follows:

- Check dams should be spaced based on the channel slope, as needed to increase residence time, provide design storm storage volume, or any additional volume attenuation requirements. In typical spacing, the ponded water at a downhill check dam should not touch the toe of the upstream check dam. More frequent spacing may be desirable in dry swales to increase the ponding volume.
- The maximum desired check dam height is 12 inches, for maintenance purposes. However, for some sites, a maximum of 18 inches can be allowed, with additional design elements to ensure the stability of the check dam and the adjacent and underlying soils.
- Armoring may be needed at the downstream toe of the check dam to prevent erosion.
- Check dams must be firmly anchored into the side-slopes to prevent outflanking; check dams must also be anchored into the channel bottom so as to prevent hydrostatic head from pushing out the underlying soils.
- Check dams must be designed with a center weir sized to pass the channel design storm peak flow (25-year storm event for man-made channels).
- For grass channels, each check dam must have a weep hole, or similar drainage feature, so it can dewater after storms. This is not appropriate for dry swales.
- Check dams should be composed of wood, concrete, stone, compacted soil, or other non-erodible material, or should be configured with elevated driveway culverts.
- Individual channel segments formed by check dams or driveways should generally be at least 25 to 40 feet in length.

Check dams for grass channels must be spaced to reduce the effective slope to less than 2%, as indicated in Table 4.32.

Table 4.32. Typical Check Dam Spacing to Achieve Effective Channel Slope

Channel Longitudinal Slope (%)	Check Dam Spacing to Achieve Effective Slope [a, b, c]	
	Effective Slope of 2% (ft)	Effective Slope of 0%–1% (ft)
0.5	–	
1.0	–	
1.5	–	67–200
2.0	–	50–100
2.5	200	40–67
3.0	100	33–50
3.5	67	30–40
4.0	50	25–33

4.5[d]	40	20–30
5.0[d]	40	20–30

[a] All check dams require a stone energy dissipator at the downstream toe.
[b] Check dams require weep holes at the channel invert. Swales with slopes less than 2% will require multiple weep holes (at least 3) in each check dam.
[c] Assumed check dam height is 12 inches. The spacing dimension is half of the above distances if a 6-inch check dam is used.
[d] Open channels with slopes greater than 4% require special design considerations, such as drop structures to accommodate greater than 12-inch high check dams (and therefore a flatter effective slope), in order to ensure non-erosive flows.

Ponding Depth. Check dams must be used in dry swales to create ponding cells along the length of the channel. The maximum ponding depth in a dry swale must not exceed 18 inches. Minimum surface ponding depth is 3 inches (averaged over the surface area of the open channel). In order to increase the ponding depth, it may be necessary or desirable to space check dams more frequently than is shown in Table 4.32.

Dry Swale Filter Media. Dry swales require replacement of native soils with a prepared filter media. The filter media provides adequate drainage, supports plant growth, and facilitates pollutant removal within the dry swale. At least 18 inches of filter media must be added above the choker stone layer (and no more than 6 feet) to create an acceptable filter. The recipe for the filter media is identical to that used for bioretention and is provided in Section 4.1 Bioretention. The batch receipt confirming the source of the filter media should be submitted to the Beaufort County Public Works Department inspector. One acceptable design adaptation is to use 100% sand for the first 18 inches of the filter and add a combination of topsoil and compost, as specified in Appendix C Soil Compost Amendment Requirements, for the top 4 inches, where turf cover will be maintained.

Dry Swale Drawdown. Dry swales must be designed so that the desired design storm volume is completely filtered within 72 hours, using the equations specified in Section 4.9.6 Open Channel Construction Sequence.

Dry Swale Underdrain. Some dry swale designs will not use an underdrain (where soil infiltration rates meet minimum standards). See Section 4.9.1 Open Channel Feasibility Criteria for more details. When underdrains are necessary, they should have a minimum diameter of 4 to 6 inches and be encased in a 12-inch deep gravel bed. Two layers of stone should be used. A choker stone layer, consisting of No. 8 or No. 89 stone at least 3 inches deep, must be installed immediately below the filter media. Below the choker stone layer, the underdrain must be encased (a minimum of 2 inches above and below the underdrain) in a layer of clean, double-washed ASTM D448 No.57 or smaller (No. 68, 8, or 89) stone. The maximum depth of the underdrain stone layer combined with the choking layer is 12 inches, and it cannot extend beyond the surface dimensions of the dry swale filter media.

Impermeable Liner. An impermeable liner is not typically required, although it may be utilized in fill applications where deemed necessary by a geotechnical investigation, on sites with contaminated soils, or on the sides of the practice to protect adjacent structures from seepage. Use a PVC geomembrane liner or an equivalent of an appropriate thickness (follow manufacturer's instructions for installation). Field seams must be sealed according to the liner manufacturer's specifications. A minimum 6-inch overlap of material is required at all seams.

Dry Swale Observation Well. A dry swale must include well-anchored, 4- to 6-inch diameter PVC pipe observation wells along the length of the swale. For a dry swale with an underdrain, the wells should be tied into any Ts or Ys in the underdrain system and must extend upward above the surface of the ponding. These observation wells may double as clean outs. For an infiltrating dry swale, the observation well should be perforated in the gravel layer only.

Grass Channel Material Specifications. The basic material specifications for grass channels are outlined in Table 4.33.

Table 4.33. Grass Channel Material Specifications

Component	Specification
Grass	A dense cover of water-tolerant, erosion-resistant grass. The selection of an appropriate species or mixture of species is based on several factors including climate, soil type, topography, and sun or shade tolerance. Grass species should have the following characteristics: ▪ A deep root system to resist scouring; ▪ A high stem density with well-branched top growth; ▪ Water-tolerance; ▪ Resistance to being flattened by runoff; ▪ An ability to recover growth following inundation; and
Check Dams	Check dams should be constructed of a non-erodible material such as wood, gabions, riprap, or concrete. Wood used for check dams should consist of pressure-treated logs or timbers or water-resistant tree species such as cedar, hemlock, swamp oak, or locust. Computation of check dam material is necessary, based on the surface area and depth used in the design computations.
Diaphragm	Pea gravel used to construct pretreatment diaphragms must consist of washed, open-graded, course aggregate between 3 and 10 mm in diameter.
Erosion Control Fabric	Where flow velocities dictate, biodegradable erosion control netting or mats that are durable enough to last at least two growing seasons must be used.

Dry Swale Material Specifications. For additional material specifications pertaining to dry swales, designers should consult Section 4.1.4 Bioretention Design Criteria and Table 4.34.

Table 4.34. Dry Swale Material Specifications

Material	Specification	Notes
Filter Media Composition	Filter Media to contain: ? 80%–90% sand ? 10%–20% soil fines ? Maximum 10% clay	To account for settling/compaction, it is recommended that 110% of the plan volume be utilized.

Material	Specification	Notes
	3%–5% organic matter	
Filter Media Testing	P content = 5 to 15 mg/kg (Mehlich I) or 18 to 40 mg/kg (Mehlich III) CEC > 5 milliequivalents per 100 grams	See Section 4.3.4 Bioretention, for additional filter media information.
Geotextile	Geotextile fabric meeting the following specifications: AASHTO M-288 Class 2, latest edition Has a permeability of at least an order of magnitude (10 times) higher than the soil subgrade permeability. Apply along sides of the filter media only and do not apply along the swale bottom.	
Choking Layer	A 2- to 4-inch layer of choker stone (typically No. 8 or No. 89 washed gravel) laid above the underdrain stone.	
Underdrain Stone Layer	Stone must be double-washed and clean and free of all fines (ASTM D448 No. 57 or smaller stone).	
Underdrains and Cleanouts	4-inch or 6-inch rigid schedule 40 PVC pipe, with 3 or 4 rows of 3/8-inch perforations at 6 inches on center.	Install perforated pipe for the full length of the dry swale cell. Use non-perforated pipe, as needed, to connect with the storm drain system.
Observation Wells	4-inch or 6-inch rigid schedule 40 PVC pipe	For dry swales with underdrains, tie the non-perforated observation well to the underdrain via T or Y connection. This observation well can double as a cleanout. For dry swales without an underdrain, the pipe should only be perforated in the gravel layer. The observation wells should extend to the top of ponding.
Impermeable Liner	Where appropriate, use a PVC geomembrane liner or equivalent.	
Vegetation	Plant species as specified on the landscaping plan.	
Check Dams	Use non-erosive material, such as wood, gabions, riprap, or concrete. Wood used for check dams should consist of pressure-treated logs or timbers, or water-resistant tree species, such as cedar, hemlock, swamp oak, or locust.	
Erosion Control Fabric	Where flow velocities dictate, use woven biodegradable erosion control fabric or mats (EC2) that are durable enough to last at least 2 growing seasons.	

RSC Material Specifications. RSC has several design elements that are unique to this practice. The practice includes riffle and pool segments, underlain with a sand/ wood chip bed, and with a top dressing of compost and plant material. Table 4.35 outlines the materials needed for this practice.

Table 4.35. Regenerative Stormwater Conveyance System Material Specifications

Material	Specification
Footer Boulders	Should have a natural appearance and be equivalent in size to Class 3 Rip Rap (aver- age diameter 26.4 inches)
Cobble	Should have a natural appearance and a minimum diameter of 6”
Sand/ Woodchip Bed	The sand component of the sand/wood chip bed should meet the AASHTO- M-6 or ASTM-C-33, 0.02 inches to 0.04 inches in size. Sand shall be a silica-based coarse aggregate. Substitutions such as Diabase and Gray- stone (AASHTO) #10 are not acceptable. No calcium carbonate or dolomitic sand substitutions are acceptable. No “rock dust” can be used for sand. Locally-approved pulverized glass may be substituted if the local authority undertakes testing to verify compliance with the particle size specification. No art glass shall be used for a pulverized glass material. For woodchips, use aged, shredded hardwood chips/mulch. The woodchips should be added to the sand mix, approximately 20 percent by volume, to increase the organic content and promote plant growth and sustainability.
Choker Stone	The choker stone layer between the sand bed and the bank run gravel should be clean, washed #8 or #78 stone.
Bank Run Gravel	The bank run gravel layer that is placed beneath and above the sand bed/choker stone layers should be constructed using clean, washed # 5 or # 57 coarse aggregate.
Compost	The compost used as a top dressing over the RSC System should consist of a 100% organic compost, with a pH of between 6.0 and 7.0, a moisture content of between 30 and 55%, and a particle size of 0.25 inches or less. (See Appendix C for compost specifications)
Wood Chips	The wood chips used within the sand bed should consist of double-shredded or double-ground hardwood mulch that is free of dyes, chromated copper arsenate and other preservatives.
Plant Materials	Plants should be native species, appropriate to the planting/wetness zone where they are located.

Wet Swale Design Issues. The following criteria apply to the design of wet swales:

- The average normal pool depth (dry weather) throughout the swale must be 6 inches or less.
- The maximum temporary ponding depth in any single wet swale cell must not exceed 18 inches at the most downstream point (e.g., at a check dam or driveway culvert).
- Check dams should be spaced as needed to maintain the effective longitudinal slope.

- Individual wet swale segments formed by check dams or driveways should generally be at least 25 to 40 feet in length.
- Wet swale side slopes should be no steeper than 4H:1V to enable wetland plant growth. Flatter slopes are encouraged where adequate space is available, to enhance pretreatment of sheet flows entering the channel. Under no circumstances are side slopes to steeper than 3H:1V.

Grass Channel Enhancement using Compost Soil Amendments. Soil compost amendments serve to increase the retention capability of a grass channel. The following design criteria apply when compost amendments are used:

- The compost-amended strip must extend over the length and width of the channel bottom, and the compost must be incorporated to a depth as outlined in Appendix C Soil Compost Amendment Requirements.
- For grass channels on steep slopes, it may be necessary to install a protective biodegradable erosion control mat to protect the compost-amended soils. Care must be taken to consider the erosive characteristics of the amended soils when selecting an appropriate erosion control mat.

Grass Channel Sizing. Unlike other BMPs, grass channels are designed based on a peak rate of flow. Designers must demonstrate channel conveyance and treatment capacity in accordance with the following guidelines:

- Hydraulic capacity should be verified using Manning's Equation or an accepted equivalent method, such as erodibility factors and vegetal retardance.
- The flow depth for the peak flow generated by the SWRv must be maintained at 4 inches or less.
- Manning's "n" value for grass channels is 0.2 for flow depths up to 4 inches, decreasing to 0.03 at a depth of 12 inches and above, which would apply to the 2- to 25-year storms if an on-line application (Haan et. al, 1994).
- Peak flow rates for the 25-year frequency storm must be non-erosive, in accordance with Table 4. 37 (see Section 4.9.5 Open Channel Landscaping Criteria), or subject to a site-specific analysis of the channel lining material and vegetation; and the 25-year peak flow rate must be contained within the channel banks (with a minimum of 6 inches of freeboard).
- Calculations for peak flow depth and velocity must reflect any increase in flow along the length of the channel, as appropriate. If a single flow is used, the flow at the outlet must be used.
- The hydraulic residence time (e.g., the average travel time for a particle of water through a waterbody) must be a minimum of 9 minutes for the peak flows from the SWRv or design storm (Mar et al., 1982; Barrett et al., 1998; Washington State Department of Ecology, 2005). If flow enters the swale at several locations, a 9-minute minimum hydraulic residence time must be demonstrated for each entry point, using Equation 4.13 through Equation 4. 17.

The bottom width of the grass channel is therefore sized to maintain the appropriate flow geometry as follows:

Equation 4. 13 Manning's Equation

$$VV = (\frac{1.49}{DD}) \times DD^{2/3} \times SS^{1/2}$$

Where:

V	=	flow velocity (ft/s)
n	=	roughness coefficient (0.2, or as appropriate)
D	=	flow depth (ft) (Note: D approximates hydraulic radius for shallow flows)
S	=	channel slope (ft/ft)

Equation 4. 14 Continuity Equation

$$QQ = VV \times (WW + 3 \times DD) \times DD$$

where:

Q	=	design storm peak flow rate (cfs)
V	=	design storm flow velocity (ft/s)
W	=	channel bottom width (ft)
D	=	flow depth (ft)

(Note: Channel width (W) plus 3 times the depth (D) represents the average width of a trapezoidal channel with 3H:1V side slopes. Average width multiplied by depth equals the cross-sectional flow area.)

Combining Equation 4.13 and Equation 4.14, and rewriting them provides a solution for the minimum width (Equation 4.15):

Equation 4. 15 Minimum Width

$$WW = \frac{DD \times QQ}{1.49 \times DD^{5/3} \times SS^{1/2}} - (3 \times DD)$$

where:

W	=	channel bottom width (ft)
n	=	roughness coefficient (0.2, or as appropriate)
Q	=	design storm peak flow rate (cfs)
D	=	flow depth (ft)
S	=	channel slope (ft/ft)

Equation 4.16 provides the corresponding velocity:

Equation 4. 16 Corresponding Velocity

$$VV = \frac{QQ}{(WW + 3 \times DD) \times DD}$$

where:

V	=	design storm flow velocity (ft/s)
Q	=	design storm peak flow rate (cfs)
W	=	channel bottom width (ft)
D	=	flow depth (ft)

The width, slope, or Manning's "n" value can be adjusted to provide an appropriate channel design for the site conditions. However, if a higher density of grass is used to increase the Manning's "n" value and decrease the resulting channel width, it is important to provide material specifications and construction oversight to ensure that the denser vegetation is actually established. Equation 4.17 can then be used to ensure adequate hydraulic residence time.

Equation 4. 17 Grass Channel Length for Hydraulic Residence Time of 9 minutes (540 seconds)

$$LL = 540 \times VV$$

where:

L	=	minimum swale length (ft)
V	=	flow velocity (ft/s)

The storage volume (Sv) provided by the grass channel is equal to the total runoff from the design storm (typically SWRv) used to size the channel (conveyed at a depth of 4 inches or less), as shown in Equation 4.18.

Equation 4. 18 Grass Channel Storage Volume

$$SSRR = DDDDDDDDDDDDSSDDDDDDDD$$

where:

Sv	=	total storage volume of grass channel (ft^3)
DesignStorm	=	SWRv or other design storm volume (ft^3) (e.g., portion of the SWRv)

Dry Swale Sizing. Dry swales are typically sized to capture the SWRv or larger design storm volumes in the surface ponding area, filter media, and gravel reservoir layers of the dry swale.

Total storage volume of the BMP is calculated using Equation 4.19.

Equation 4. 19 Dry Swale Storage Volume

$$Sv = SA_{bottom} \times (d_{media} \times \eta_{media}) + (d_{gravel} \times \eta_{gravel}) + (SA_{average} \times d_{ponding})$$

where:

Sv	=	total storage volume of dry swale (ft^3)
SA_{bottom}	=	bottom surface area of dry swale (ft^2)
d_{media}	=	depth of the filter media, including mulch layer (ft)
η_{media}	=	effective porosity of the filter media (typically 0.25)
d_{gravel}	=	depth of the underdrain and underground storage gravel layer, including choker stone (ft)
η_{gravel}	=	effective porosity of the gravel layer (typically 0.4)
$SA_{average}$	=	average surface area of the dry swale (ft^2) typically, where SA_{top} is the top surface area of dry swale, $SA_{average} = \frac{SA_{bottom} + SA_{top}}{2}$
$d_{ponding}$	=	the maximum ponding depth of the dry swale (ft)

Equation 4.19 can be modified if the storage depths of the filter media, gravel layer, or ponded water vary in the actual design or with the addition of any surface or subsurface storage components (e.g., additional area of surface ponding, subsurface storage chambers, etc.). The maximum depth of ponding in the dry swale must not exceed 18 inches. If storage practices will be provided off-line or in series with the dry swale, the storage practices should be sized using the guidance in Section 0 Storage Practices.

Dry swales can be designed to address, in whole or in part, the detention storage needed to comply with channel protection and/or flood control requirements. The Sv can be counted as part of the 2- to 25-year runoff volumes to satisfy stormwater quantity control requirements.

Note: To increase the storage volume of a dry swale, the ponding surface area may be increased beyond the filter media surface area. However, the top surface of the BMP (at the top of the ponding elevation) may not be more than twice the size of surface area of the filter media (SA_{bottom}).

Wet Swale Sizing. Wet swales can be designed to capture and treat the SWRv remaining from any upstream stormwater retention practices. The storage volume is made up of the temporary and permanent storage created within each wet swale cell. This includes the permanent pool volume and up to 12 inches of temporary storage created by check dams or other design features that has 24 hours extended detention.

The storage volume (Sv) of the practice is equal to the volume provided by the pond permanent pool plus the 24-hour extended detention (ED) volume provided by the practice (Equation 4.20). The total Sv cannot exceed the design SWRv.

Equation 4. 20 Wet Swale Storage Volume

$$Sv = \text{Permanent pool Volume} + 24\ \text{hour ED Volume}$$

RSC Sizing. RSC design is an iterative process in which the channel is sized to convey the 100-year storm event, using manning's equation for parabolic channels.

Some key RSC sizing considerations include the following:

- One control structure and pool (riffle-pool) combination is needed for each foot of elevation difference along the channel.
- The length of each grade control structure or pool is determined by Equation 4.21

Equation 4. 21 Riffle Pool Length

$$L_{pool} = \frac{L_{riffle}}{(Elevation\ Change) \times 2}$$

where:

L_{pool}	=	surface length of each pool (ft)
L_{riffle}	=	total length of riffle pool (ft)
Elevation Change	=	difference in elevation between pool and bottom pool (ft)

- In areas with steep slopes (10% or greater) the length of the pool or riffle may be small (<10'). In these locations, cascades may be needed as a part of the system design.
- The minimum width of grade control structures should be 8 ft and the width should be equal to 10 times the channel depth (Figure 4.38).
- The depth of flow in the riffle sections should be less than 4 inches.
- Cobbles in the riffle section should be sized so that the velocity of the 100-year storm is non-erosive (Table 4.36).

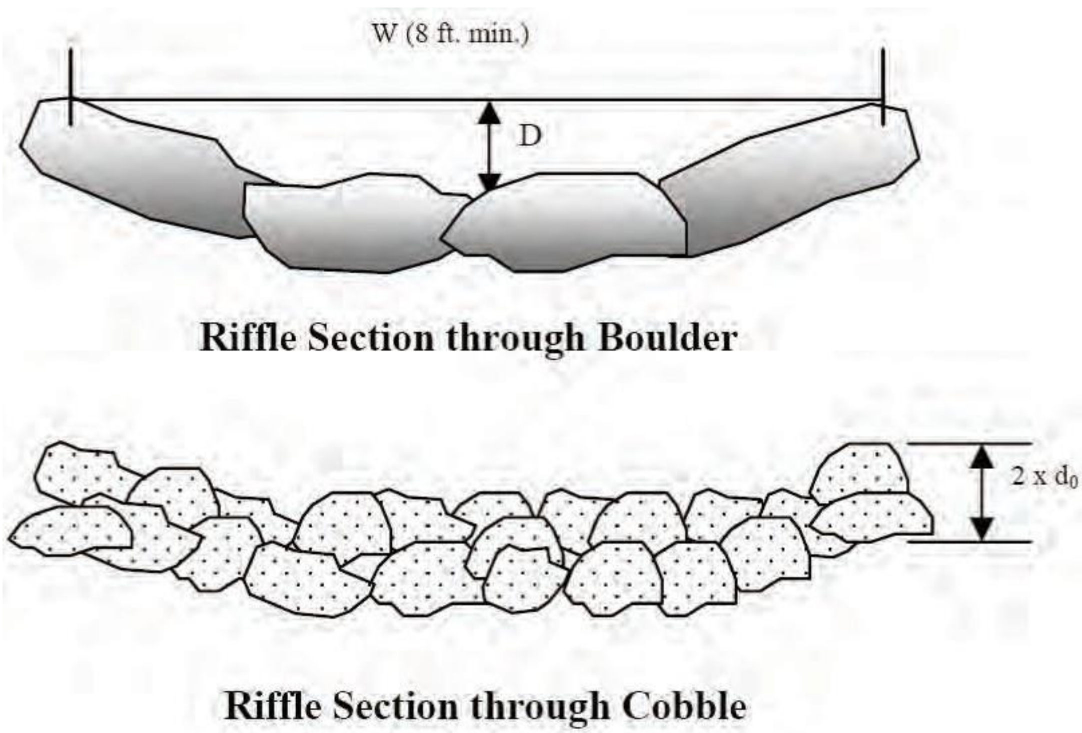


Figure 4.38. Typical Width and Depth of Riffle Sections (Anne Arundel County, 2011).

Table 4.36. Maximum Allowable Velocity

Cobble size (in)	Allowable velocity (ft/s)
4	5.8
5	6.4
6	6.9
7	7.4
8	7.9
9	8.4
10	8.8
11	9.2
12	9.6
15	10.4

- Pools should be between 1.5 and 3 feet deep, and equal to the width of the riffle sections.
- The RSC system is underlain with a sand bed with a 1–5 foot depth and a width between 4 and 14 feet.
- The downstream edge of the riffle should incorporate a series of boulders in a parabolic shape.
- Place a cobble apron below the riffle section to allow for a stable transition between the riffle section and the downstream pools when the pools are dry. The cobble apron should be approximately 5 feet wide and 3 feet long.

The total Sv in the RSC system (available for water quality treatment) is determined by Equation 4.22.

Equation 4.22 RSC Systems Storage Volume

$$SSRR = VV_{ppbbbbgg} + VV_{ssaappmmbbmmmm}$$

where:

Sv	=	total storage volume of RSC system (ft^3)
V_{pool}	=	volume in pools (ft^3)
$V_{sandbed}$	=	volume in sand bed (ft^3), use effective porosity of 0.25

4.9.5 Open Channel Landscaping Criteria

All open channels must be stabilized to prevent erosion or transport of sediment to receiving practices or drainage systems. There are several types of grasses appropriate for dry open channels (grass channels and dry swales). These are listed in Table 4.37. Designers should choose plant species that can withstand both wet and dry periods and relatively high velocity flows for planting within the channel. Designers should ensure that the maximum flow velocities do not exceed the values listed in the table for the selected grass species and the specific site slope. For more information on stabilization seeding, see the Charleston County Stabilization Specifications.

Table 4.37. Recommended Vegetation for Open Channels

Vegetation Type	Slope (%)	Maximum Velocity (ft/s)	
		Erosion Resistant Soil	Easily Eroded Soil
Bermuda Grass	0–5	8	6
	5–10	7	5
	>10	6	4
Kentucky Bluegrass	0–5	7	5
	5–10	6	4
	>10	5	3
Tall Fescue Grass Mixture	0–5	6	4
	5–10	4	3
Annual and Perennial Rye	0–5	4	3
Sod		4	3

Source: USDA, TP-61, 1954; Roanoke Virginia, Stormwater Design Manual, 2008

Wet swales should be planted with grass and wetland plant species that can withstand both wet and dry periods as well as relatively high velocity flows within the channel. For a list of wetland plant species suitable for use in wet swales, refer to the wetland panting guidance and plant lists provided in Section 0 Stormwater Wetlands.

Landscape design shall specify proper grass species based on site-specific soils and hydric conditions present along the channel.

Open channels should be seeded at such a density to achieve a 90% vegetated cover after the second growing season. Taller and denser grasses are preferable, although the species is less important than good stabilization and dense vegetative cover.

Grass channels should be seeded and not sodded. Seeding establishes deeper roots and sod may have muck soil that is not conducive to infiltration. Grass channels should be protected by a biodegradable erosion control fabric to provide immediate stabilization of the channel bed and banks.

4.9.6 Open Channel Construction Sequence

Design Notes. Channel invert and tops of banks are to be shown in plan and profile views. A cross sectional view of each configuration and completed limits of grading must be shown for proposed channels. For proposed channels, the transition at the entrance and outfall is to be clearly shown on plan and profile views.

Open Channel Installation. The following is a typical construction sequence to properly install open channels, although steps may be modified to reflect different site conditions or design variations. Grass channels should be installed at a time of year that is best to establish turf cover without irrigation. For more specific information on the installation of wet swales, designers should consult the construction criteria outlined in Section 0 Stormwater Wetlands.

1. **Protection During Site Construction.** Ideally, open channels should remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment. However, this is seldom practical, given that the channels are a key part of the drainage system at most sites. In these cases, temporary soil erosion and sediment controls such as dikes, silt fences, and other erosion control measures should be integrated into the swale design throughout the construction sequence. Specifically, barriers should be installed at key check dam locations, and erosion control fabric should be used to protect the channel. Dry swales that lack underdrains (and rely on infiltration) must be fully protected by silt fence or construction fencing to prevent compaction by heavy equipment during construction.

2. **Installation.** Installation may only begin after the entire CDA has been stabilized with vegetation. Any accumulation of sediments that does occur within the channel must be removed during the final stages of grading to achieve the design cross section. Soil erosion and sediment controls for construction of the channel must be installed as specified in the soil erosion and sediment control plan. Stormwater flows must not be permitted into the channel until the bottom and side slopes are fully stabilized.

3. **Grading.** Grade the grass channel to the final dimensions shown on the plan. Excavators or backhoes should work from the sides to grade and excavate the open channels to the appropriate design dimensions. Excavating equipment should have scoops with adequate reach so they do not have to sit inside the footprint of the open channel area. If constructing a dry swale, the bottom of the swale should be ripped, rototilled or otherwise scarified to promote greater infiltration.

4. **Placing Stone Layer (for dry swales).** If constructing a dry swale, place an acceptable geotextile fabric on the underground (excavated) sides of the dry swale with a minimum 6-inch overlap. Place the stone needed for storage layer over the filter bed. Add the perforated underdrain pipe. Add the remaining stone jacket, and then pack No. 57 stone (clean, double-washed) to 3 inches above the top of the underdrain, and then add 3 inches of pea gravel as a filter layer. Add the filter media in 12-inch lifts until the desired top elevation of the dry swale is achieved. Water thoroughly and add additional media as needed where settlement has occurred.

5. **Add Amendments (optional, for grass channels).** Add soil amendments as needed. Till the bottom of the grass channel to a depth of 1 foot and incorporate compost amendments according to Appendix C Soil Compost Amendment Requirements.

6. **Install Check Dams**. Install check dams, driveway culverts and internal pretreatment features as shown on the plan. Fill material used to construct check dams should be placed in 8- to 12-inch lifts and compacted to prevent settlement. The top of each check dam must be constructed level at the design elevation.

7. **Hydro-seed.** Hydro-seed the bottom and banks of the open channel, and peg in erosion control fabric or blanket where needed. After initial planting, a biodegradable erosion control fabric should be used, conforming the South Carolina BMP Handbook (SDHEC, 2005).

8. **Plant.** Plant landscaping materials as shown in the landscaping plan, and water them weekly during the first 2 months. The construction contract should include a care and replacement warranty to ensure that vegetation is properly established and survives during the first growing season following construction.

9. **Final Inspection.** A qualified professional should conduct the final construction inspection and develop a punch list for facility acceptance.

Open Channel Construction Supervision. Supervision during construction is recommended to ensure that the open channel is built in accordance with these specifications.

Construction phase inspection checklist is available in Appendix E Construction Inspection Checklists.

Some common pitfalls can be avoided by careful construction supervision that focuses on the following key aspects of dry swale installation:

- Make sure the desired coverage of turf or erosion control fabric has been achieved following construction, both on the channel beds and their contributing side-slopes.
- Inspect check dams and pretreatment structures to make sure they are at correct elevations, are properly installed, and are working effectively.
- For dry swale designs:
  - Check the filter media to confirm that it meets specifications and is installed to the correct depth.
  - Check elevations, such as the invert of the underdrain, inverts for the inflow and outflow points, and the ponding depth provided between the surface of the filter bed and the overflow structure.
  - Ensure that caps are placed on the upstream (but not the downstream) ends of the underdrains.
  - Check that outfall protection/energy dissipation measures at concentrated inflow and outflow points are stable.

The real test of an open channel occurs after its first big storm. The post-storm inspection should focus on whether the desired sheet flow, shallow concentrated flows or fully concentrated flows assumed in the plan actually occur in the field. Minor adjustments are normally needed as part of this post-storm inspection (e.g., spot reseeding, gully repair, added armoring at inlets, or realignment of outfalls and check dams). Also, a qualified professional should check that dry swale practices drain completely within the 72-hour drawdown period.

4.9.7 Open Channel Maintenance Criteria

Maintenance is a crucial and required element that ensures the long-term performance of open channels. Once established, grass channels have minimal maintenance needs outside of the spring cleanup, regular mowing, repair of check dams, and other measures to maintain the hydraulic efficiency of the channel and a dense, healthy grass cover. Dry swale designs may require regular pruning and management of trees and shrubs. The surface of dry swale filter beds can become clogged with fine sediment over time, but this can be alleviated through core aeration or deep tilling of the filter bed. Additional effort may be needed to repair check dams, stabilize inlet points, and remove deposited sediment from pretreatment cells. Table 4.38 provides a schedule of typical maintenance activities required for open channels.

Table 4.38.Typical Maintenance Activities and Schedule for Open Channels

Schedule	Maintenance Activity
As needed	▪ Mow grass channels and dry swales during the growing season to maintain grass heights in the 4- to 6-inch range.
Quarterly	▪ Ensure that the CDA, inlets, and facility surface are clear of debris. ▪ Ensure that the CDA is stabilized. Perform spot-reseeding if where needed. ▪ Remove accumulated sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, and overflow structures. ▪ Repair undercut and eroded areas at inflow and outflow structures.
Annual inspection	▪ Add reinforcement planting to maintain 90% turf cover. Reseed areas of dead vegetation. ▪ Remove any accumulated sand or sediment deposits behind check dams. ▪ Inspect upstream and downstream of check dams for evidence of undercutting or erosion. Remove and trash or blockages at weep holes. ▪ Examine channel bottom for evidence of erosion, braiding, excessive ponding, or dead grass. ▪ Check inflow points for clogging and remove any sediment. ▪ Inspect side slopes and grass filter strips for evidence of any rill or gully erosion and repair. ▪ Look for any bare soil or sediment sources in the CDA and stabilize immediately.

Maintenance Inspections. Annual inspections by a qualified professional are used to trigger maintenance operations, such as sediment removal, spot revegetation, and inlet stabilization. Maintenance inspection checklists for disconnection and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.9.8 Open Channel Stormwater Compliance Calculations

Grass channels are credited with 10% retention for the storage volume (Sv) provided by the practice as well as 50% TSS, 25% TN, and 30% bacteria removal (see Table 4.39).

Table 4.39. Grass Channel Retention and Pollutant Removal

Retention	= 10%
TSS Removal	= 50%
TN Removal	= 25%
Bacteria Removal	= 30%

Grass channels with amended soils are credited with 20% retention for the storage volume (Sv) provided by the practice as well as 50% TSS, 35% TN, and 30% bacteria removal (Table 4.40).

Table 4.40. Grass Channel on Amended Soils Retention and Pollutant Removal

Retention	= 20%
TSS Removal	= 50%
TN Removal	= 35%
Bacteria Removal	= 30%

Dry swales are credited with 60% retention for the storage volume (Sv) provided by the practice as well as 85% TSS, 70% TN, and 80% bacteria removal (Table 4.41).

Table 4.41. Dry Swale Retention and Pollutant Removal

Retention	= 60%
TSS Removal	= 85%
TN Removal	= 70%
Bacteria Removal	= 80%

Wet Swales are credited with 0% retention, but they do receive 80% TSS, 25% TN, and 60% bacteria removal for the storage volume (Sv) provided by the practice (Table 4.42).

Table 4.42. Wet Swale Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 25%
Bacteria Removal	= 60%

RSCs are credited with 0% retention, but they do receive 80% TSS, 40% TN, and 80% bacteria removal for the storage volume (Sv) provided by the practice (Table 4.43).

Table 4.43. RSC Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 40%
Bacteria Removal	= 80%

All practices must be sized using the guidance detailed in Section 4.9.4 Open Channel Design Criteria.

Open channels also contribute to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the storage volume from the total runoff volume for the 2-year through the 50-year storm events. The resulting reduced runoff volumes can then be used to calculate a reduced NRCS CN for the site or SDA. The reduced NRCS CN can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

4.10 Filtering Systems

<table>
<tr><th colspan="5">Filtering Systems</th></tr>
<tr><td colspan="5">Definition: Practices that capture and temporarily store the design storm volume and pass it through a filter bed of sand media. Filtered runoff may be collected and returned to the conveyance system or allowed to partially infiltrate into the soil.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban</td><td rowspan="3">Small</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80%</td><td>30%</td><td>80%</td></tr>
<tr><th colspan="3">Runoff Reductions</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>High</td><td>High</td><td colspan="3">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">0%</td></tr>
<tr><td>At least annually</td><td>Every 5 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ Applicable to small drainage areas
▪ Good for highly impervious areas
▪ Good for water quality retrofits to existing developments</td><td colspan="3">▪ High maintenance burden
▪ Not recommended for areas with high sediment content in stormwater or clay/silt runoff areas
▪ Relatively costly
▪ Possible odor problems, if not maintained
▪ Limited volume and rate control</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Pretreatment
▪ Sand bed (or Filtration) chamber
▪ Spillway/outlet system(s)
▪ Liner, as needed</td><td colspan="3">▪ Typically requires 2 to 10 feet of head
▪ Maximum CDA of 2-5 acres
▪ Must drain within 40 hours
▪ In karst areas, watertight structure required
▪ Maintenance access</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Inspect for clogging—rake first inch of sand
▪ Remove sediment from pretreatment areas</td><td colspan="3">▪ Replace filter media as needed
▪ Clean spillway/outlet system(s)</td></tr>
</table>

[1]*Credited pollutant load removal*

Stormwater filters are a useful practice to treat stormwater runoff from small, highly impervious sites. Stormwater filters capture, temporarily store, and treat stormwater runoff by passing it through an engineered filter media, collecting the filtered water in an underdrain, and then returning it back to the storm drainage system. Stormwater filters are a versatile option because they consume very little surface land and have few site restrictions. They provide moderate pollutant removal performance at small sites where space is limited.

Definition. Practices that capture and temporarily store the design storm volume and pass it through a filter bed of sand media. Filtered runoff may be collected and returned to the conveyance system or allowed to partially infiltrate into the soil. Design variants include the following:

F-1 Nonstructural sand filter

F-2 Surface sand filter

F-3 Three-chamber underground sand filter

F-4 Perimeter sand filter

Filters have no retention capability, so designers should consider using up-gradient retention practices, which have the effect of decreasing the design storm volume and size of the filtering practices. Filtering practices are also suitable to provide special treatment at designated stormwater hotspots.

Filtering systems are typically not designed to provide stormwater detention, but they may be in some circumstances. Filtering practices are generally combined with separate facilities to provide this type of control. However, the three-chamber underground sand filter can be modified by expanding the first (or settling) chamber, or by adding an extra chamber between the filter chamber and the clear well chamber to handle the detention volume, which is subsequently discharged at a predetermined rate through an orifice and weir combination.

A nonstructural or surface sand filter is depicted in Figure 4.39, while Figure 4.40 through Figure 4.45 depict three-chamber underground sand filters.

Perimeter sand filters (Figure 4.46) are enclosed stormwater management practices that are typically located just below grade in a trench along the perimeter of parking lot, driveway, or other impervious surface. Perimeter sand filters consist of a pretreatment forebay and a filter bed chamber. Stormwater runoff is conveyed into a perimeter sand filter through grate inlets located directly above the system

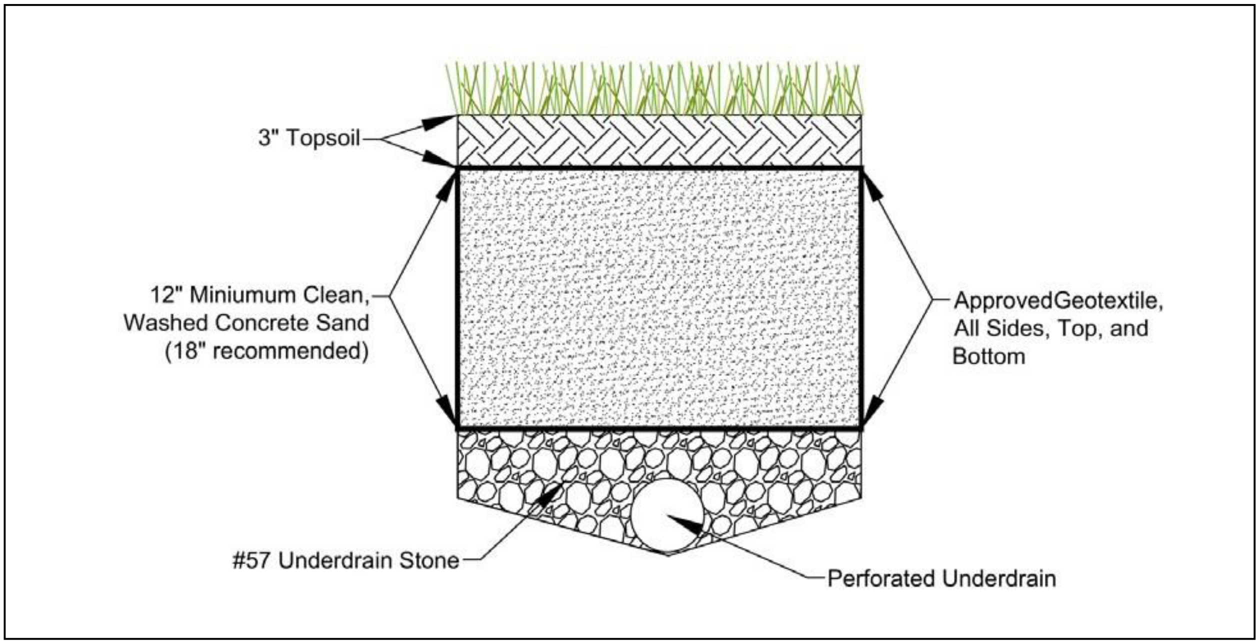


Figure 4.39. Typical schematic for a nonstructural or surface sand filter (note: material specifications are found in Table 4.44).

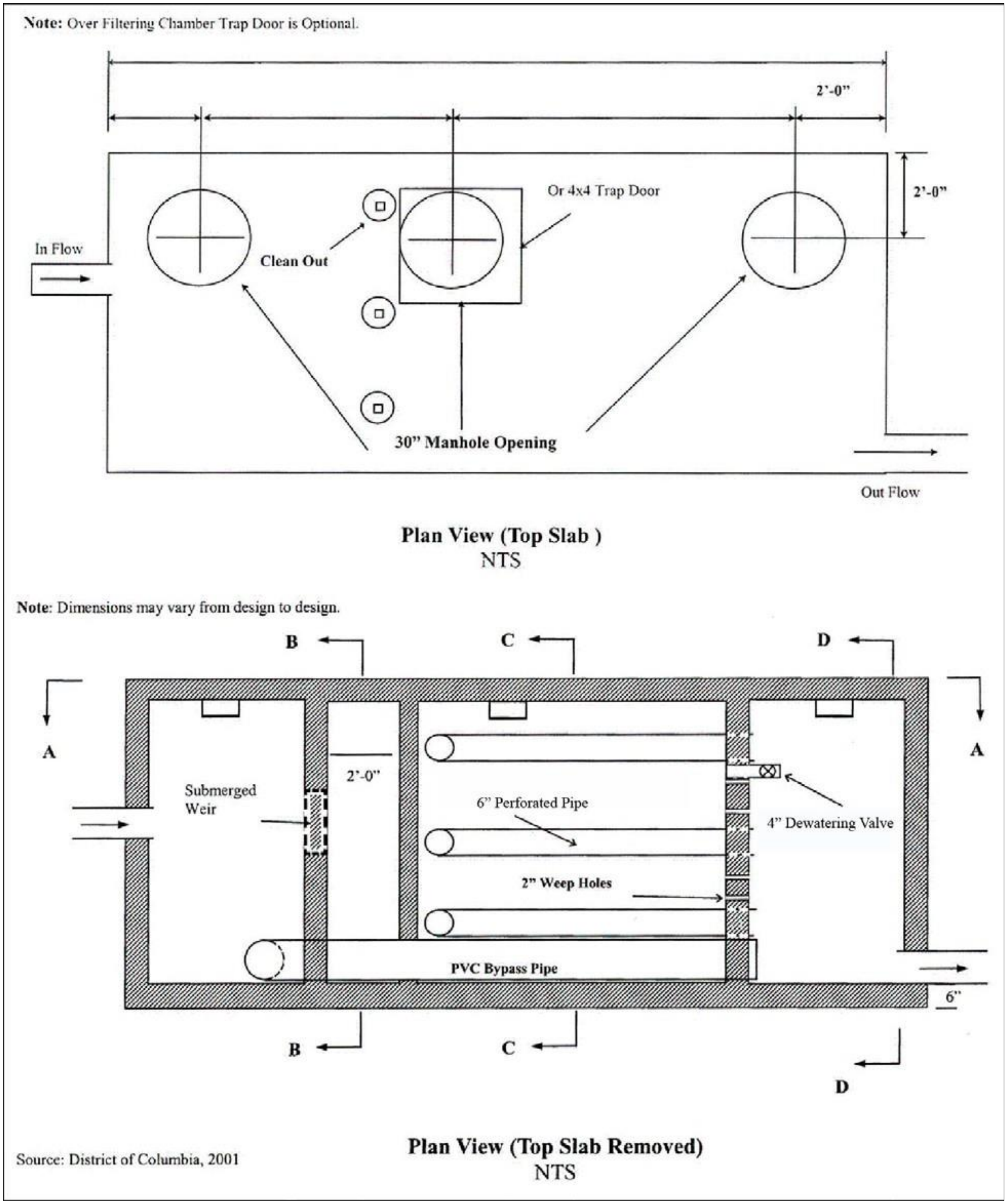


Figure 4.40. Example of a three-chamber underground sand filter (F-3) for separate sewer options. Part A. Note: material specifications are indicated in Table 4.44.

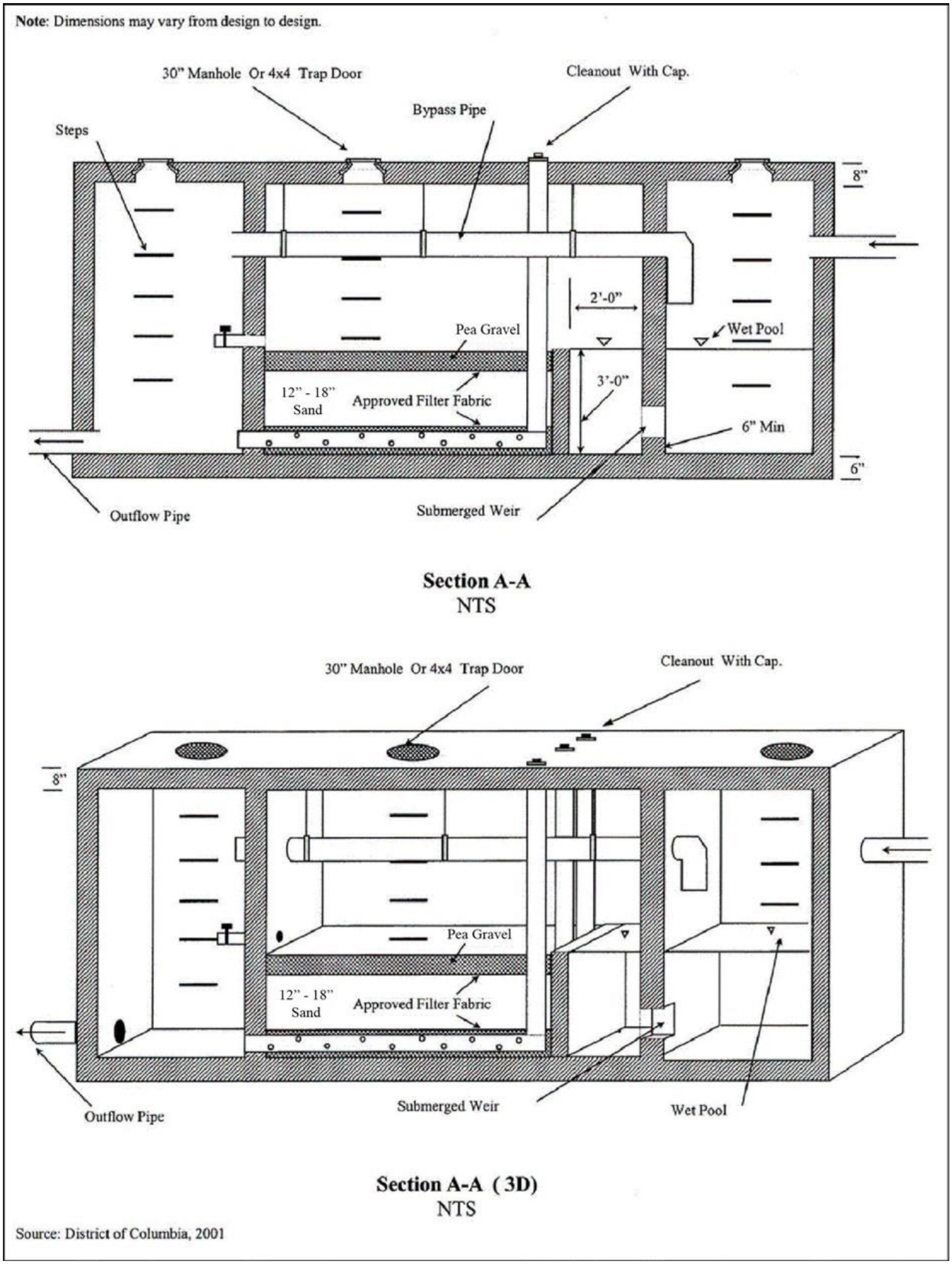


Figure 4.41. Example of a three-chamber underground sand filter (F-3) for separate sewer areas. Part B. Note: material specifications are indicated in Table 4.44.

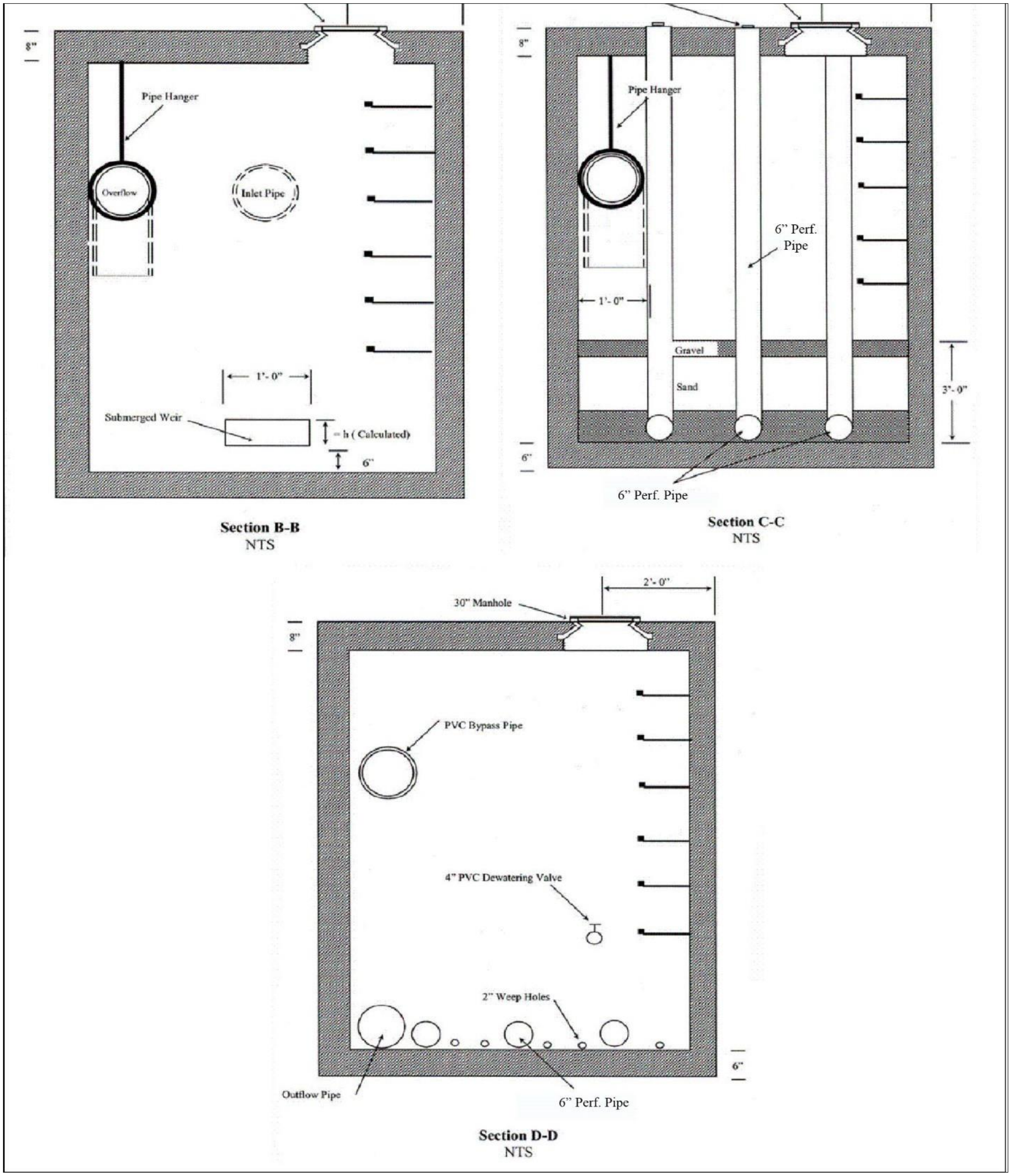
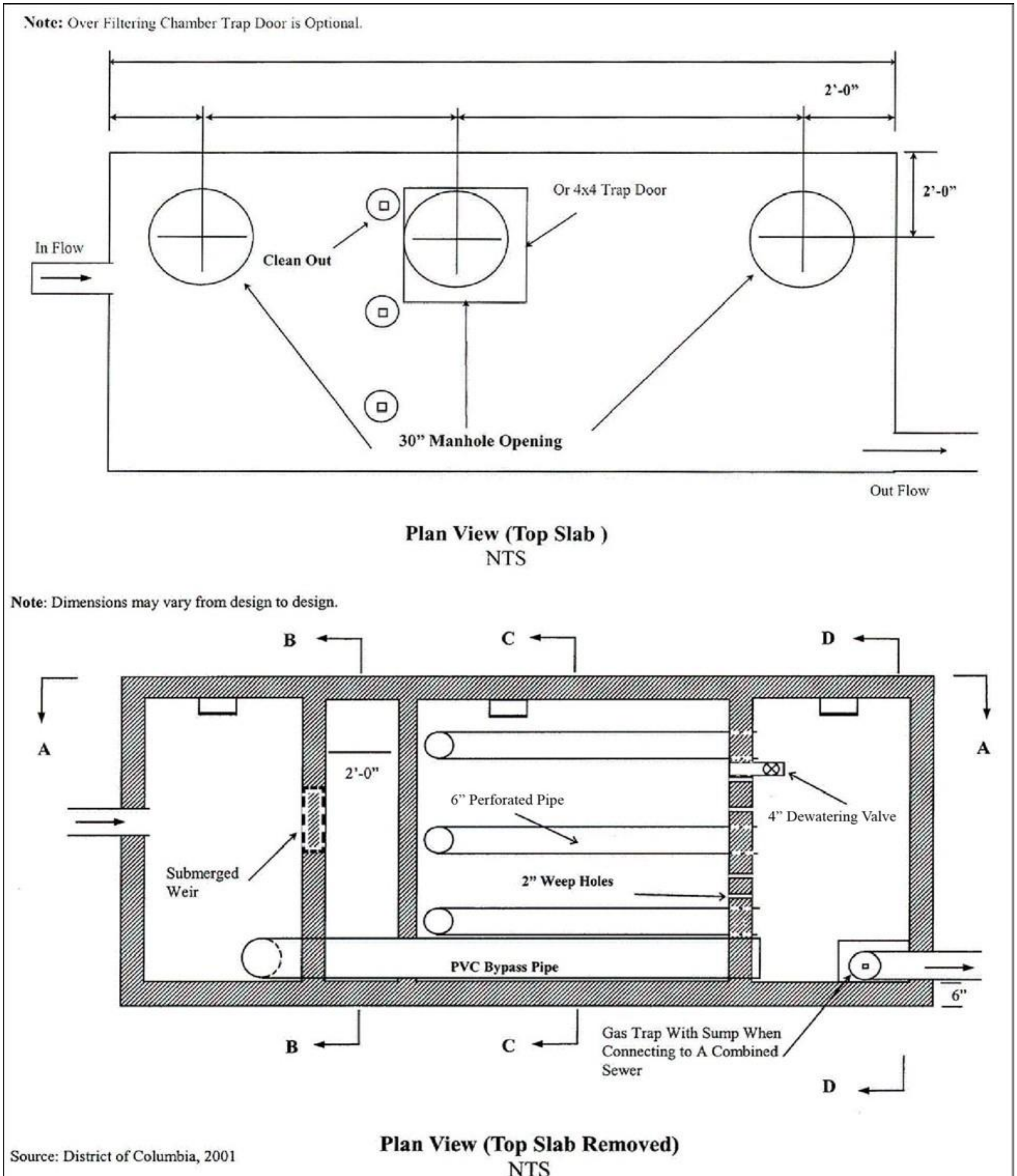


Figure 4. 42. Example of a three-chamber underground sand filter (F-3) for separate sewer areas. Part C. Note: material specifications are indicated in Table 4.44.



Source: District of Columbia, 2001

Figure 4.43. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part A. Note: Material specifications are indicated in Table 4.44.

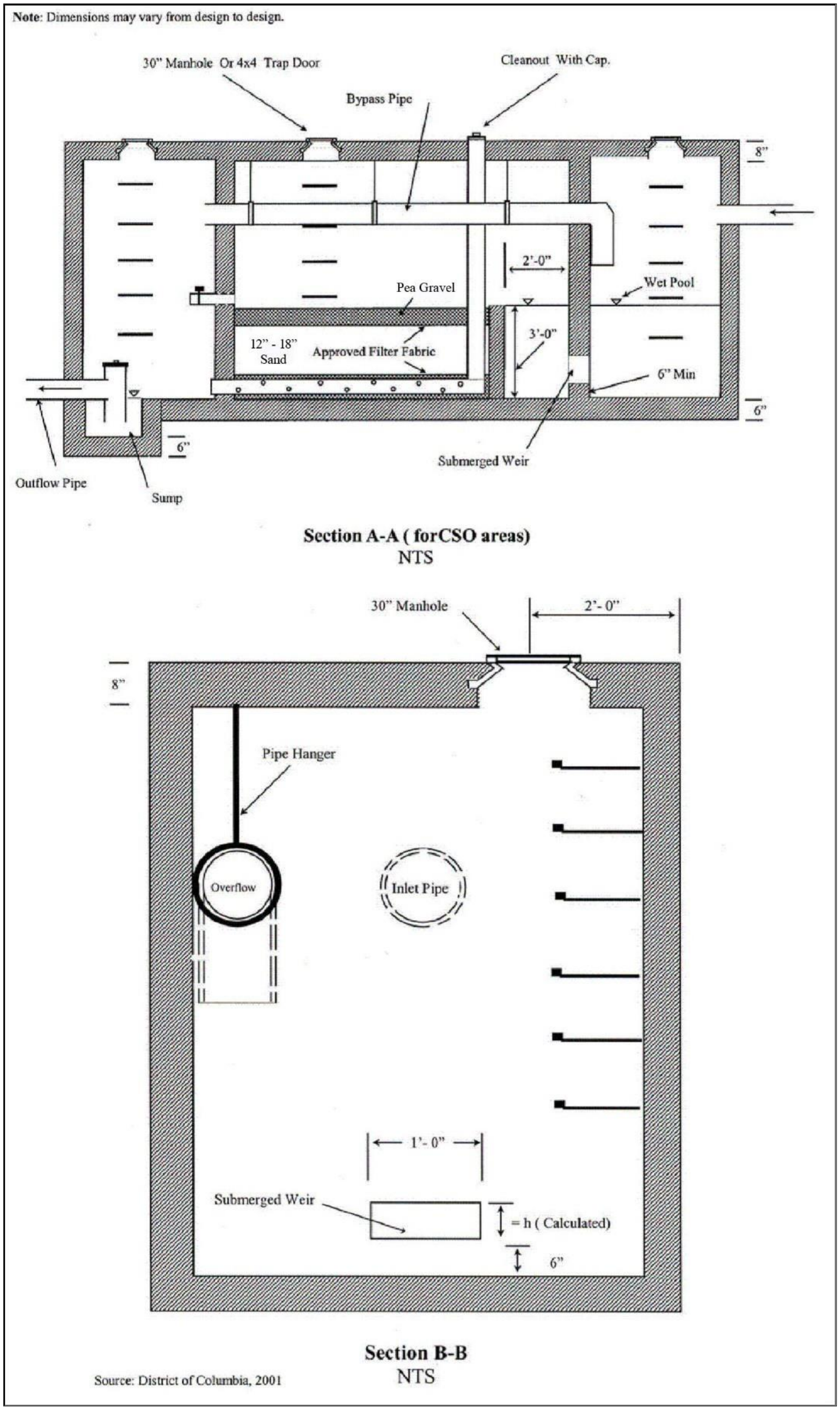


Figure 4. 44. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part B. Note: Material specifications are indicated in Table 4.44.

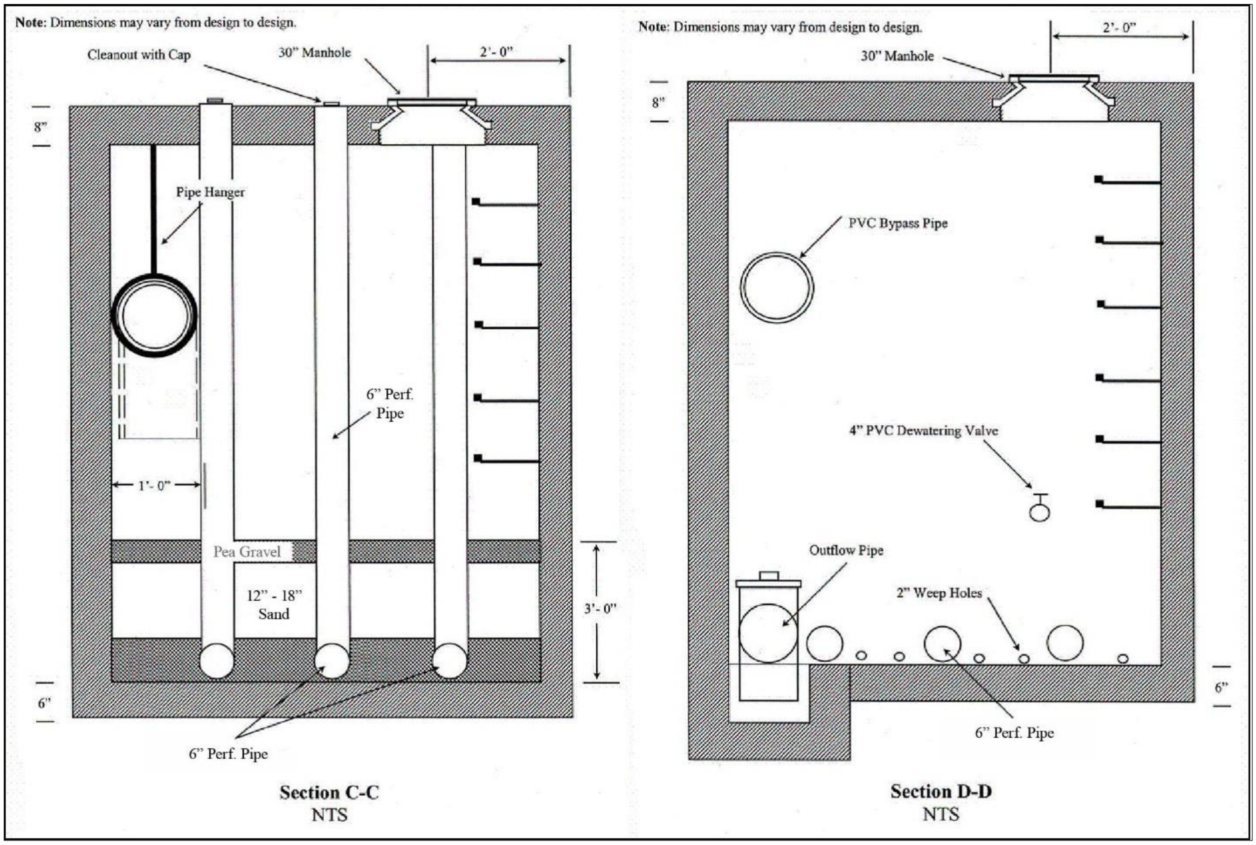


Figure 4.45. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part C. Note: Material specifications are indicated in Table 4.44.

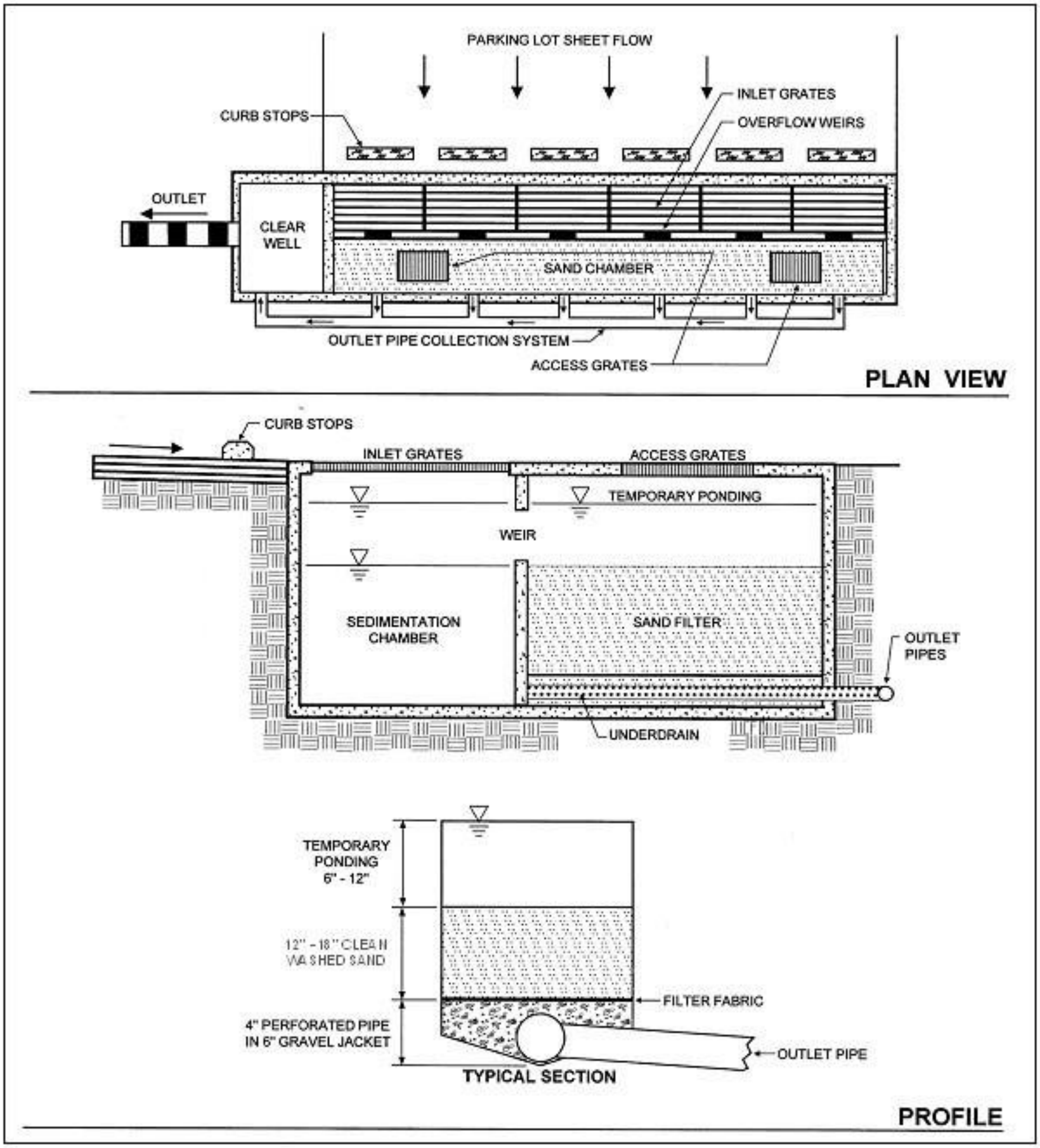


Figure 4.46. Example of a perimeter sand filter (F-4). Note: material specifications are indicated in Table 4.44.

4.10.1 Filtering System Feasibility Criteria

Stormwater filters can be applied to most types of urban land. They are not always cost-effective, given their high unit cost and small area served, but there are situations where they may clearly be the best option for stormwater treatment (e.g., hotspot runoff treatment, small parking lots, ultra-urban areas, etc.). The following criteria apply to filtering practices:

Available Hydraulic Head. The principal design constraint for stormwater filters is available hydraulic head, which is defined as the vertical distance between the top elevation of the filter and the bottom elevation of the existing storm drain system that receives its discharge. The head required for stormwater filters ranges from 2 to 10 feet, depending on the design variant. It is difficult to employ filters in extremely flat terrain, since they require gravity flow through the filter. The only exception is the perimeter sand filter, which can be applied at sites with as little as 2 feet of head.

Depth to Water Table. The designer must assure a standard separation distance of at least 0.5 feet between the groundwater table and the bottom invert of the filtering practice.

Contributing Drainage Area. Filters are best applied on small sites where the CDA is as close to 100% impervious as possible to reduce the risk that eroded sediment will clog the filter. If the CDA is pervious, then the vegetation must be dense and stable. Turf is acceptable (see Section 4.10.5 Filtering Landscaping Criteria). A maximum CDA of 5 acres is recommended for surface sand filters, and a maximum CDA of 2 acres is recommended for perimeter or underground filters. Filters have been used on larger CDAs in the past, but greater clogging problems have typically resulted.

Space Required. The amount of space required for a filter practice depends on the design variant selected. Surface sand filters typically consume about 2%–3% of the CDA, while perimeter sand filters typically consume less than 1%. Underground stormwater filters generally consume no surface area except their manholes.

Land Use. As noted above, filters are particularly well suited to treat runoff from stormwater hotspots and smaller parking lots. Other applications include redevelopment of commercial sites or when existing parking lots are renovated or expanded. Filters can work on most commercial, industrial, institutional, or municipal sites and can be located underground if surface area is not available.

Site Topography. Filters shall not be located on slopes greater than 6%.

Utilities. All utilities shall have a minimum 5-foot, horizontal clearance from the filtering practice.

Facility Access. All filtering systems shall be located in areas where they are accessible for inspection and for maintenance (by vacuum trucks).

Soils. Soil conditions do not constrain the use of filters. At least one soil boring must be taken at a low point within the footprint of the proposed filtering practice to establish the water table and evaluate soil suitability. A geotechnical investigation is required for all underground stormwater BMPs, including underground filtering systems. Geotechnical testing requirements are outlined in Appendix B Geotechnical Information Requirements for Underground BMPs.

Setbacks. Filters should be set back at least 10 feet from the property line, and the bottom of the practice should be separated from groundwater by at least 0.5 feet.

Economic Considerations. Perimeter sand filters are expensive relative to other treatment practices, but may be the only option to treat small hotspot drainage areas.

4.10.2 Filtering System Conveyance Criteria

Most filtering practices are designed as off-line systems so that all flows enter the filter storage chamber until it reaches capacity, at which point larger flows are then diverted or bypassed around the filter to an outlet chamber and are not treated. Runoff from larger storm events must be bypassed using an overflow structure or a flow splitter.

Some underground filters will be designed and constructed as on-line BMPs. In these cases, designers must indicate how the device will safely pass larger storm events (e.g., the 25-year event) to a stabilized water course without resuspending or flushing previously trapped material.

All stormwater filters must be designed to drain or dewater within 40 hours (1.67 days) after a storm event to reduce the potential for nuisance conditions.

4.10.3 Filtering System Pretreatment Criteria

Adequate pretreatment is needed to prevent premature filter clogging and ensure filter longevity. Dry or wet pretreatment shall be provided prior to filter media. Pretreatment devices are subject to the following criteria:

- Sedimentation chambers are typically used for pretreatment to capture coarse sediment particles before they reach the filter bed.
- Sedimentation chambers may be wet or dry but must be sized to accommodate at least 25% of the total design storm volume (inclusive).
- Sediment chambers should be designed as level spreaders such that inflows to the filter bed have near zero velocity and spread runoff evenly across the bed.
- Non-structural and surface sand filters may use alternative pretreatment measures, such as a grass filter strip, forebay, gravel diaphragm, check dam, level spreader, or a combination of these. The grass filter strip must be a minimum length of 15 feet and have a slope of 3% or less. The check dam may be wooden or concrete and must be installed so that it extends only 2 inches above the filter strip and has lateral slots to allow runoff to be evenly distributed across the filter surface. Alternative pretreatment measures must contain a non-erosive flow path that distributes the flow evenly over the filter surface. If a forebay is used, it must be designed to accommodate at least 25% of the total design storm volume (inclusive).

4.10.4 Filtering System Design Criteria

Detention time. All filter systems must be designed to drain the design storm volume from the filter chamber within 40 hours (1.67 days) after each rainfall event.

Structural Requirements. If a filter will be located underground or experience traffic loads, a licensed structural engineer must certify the structural integrity of the design.

Geometry. Filters are gravity flow systems that normally require 2 to 5 feet of driving head to push the water through the filter media through the entire maintenance cycle; therefore, sufficient vertical clearance between the inverts of the inflow and outflow pipes is required.

Type of Filter Media. The normal filter media consists of clean, washed AASHTO M-6/ASTM C-33 medium aggregate concrete sand with individual grains 0.02 to 0.04 inches in diameter.

Depth of Filter Media. The depth of the filter media plays a role in how quickly stormwater moves through the filter bed and how well it removes pollutants. The recommended filter bed depth is 18 inches. An absolute minimum filter bed depth of 12 inches above underdrains is required; although, designers should note that specifying the minimum depth of 12 inches will incur a more intensive maintenance schedule and possibly result in costlier maintenance.

Underdrain and Liner. Stormwater filters are normally designed with an impermeable liner and underdrain system that meet the criteria provided in Table 4. 44 below.

Underdrain Stone. The underdrain should be covered by a minimum 6-inch gravel layer consisting of clean, double washed No. 57 stone.

Type of Filter. There are several design variations of the basic filter that enable designers to use filters at challenging sites or to improve pollutant removal rates. The choice of which filter design to apply depends on available space, hydraulic head, and the level of pollutant removal desired. In ultra-urban situations where surface space is at a premium, underground sand filters are often the only design that can be used. Surface and perimeter filters are often a more economical choice when adequate surface area is available. The most common design variants include the following:

- **Non-Structural Sand Filter (F-1).** The non-structural sand filter is applied to sites less than 2 acres in size and is very similar to a bioretention practice (see Section 4.3 Bioretention), with the following exceptions:
    - The bottom is lined with an impermeable liner and always has an underdrain.
    - The surface cover is sand, turf, or pea gravel.
    - The filter media is 100% sand.
    - The filter surface is not planted with trees, shrubs, or herbaceous materials.
    - The filter has two cells, with a dry or wet sedimentation chamber preceding the sand filter bed.

  The non-structural sand filter is the least expensive filter option for treating hotspot runoff. The use of bioretention areas is generally preferred at most other sites.
- **Surface Sand Filter (F-2).** The surface sand filter is designed with both the filter bed and sediment chamber located at ground level. The most common filter media is sand; however, a peat/sand mixture may be used to increase the removal efficiency of the system. In most cases, the filter chambers are created using precast or cast-in-place concrete. Surface sand filters are normally designed to be off-line facilities, so that only the desired design volume is directed to the filter for treatment. However, in some cases they can be installed on the bottom of a dry pond (see Section 4.11 Storage Practices).
- **Underground Sand Filter.** The underground sand filter is modified to install the filtering components underground and is often designed with an internal flow splitter or overflow device that bypasses runoff from larger stormwater events around the filter. Underground sand filters are expensive to construct, but they consume very little space and are well suited to ultra-urban areas.
- **Three-Chamber Underground Sand Filter (F-3).** The three-chamber underground sand filter is a gravity flow system. The facility may be precast or cast-in-place. The first chamber acts as a pretreatment facility removing any floating organic material such as oil, grease, and tree leaves. It should have a submerged orifice leading to a second chamber, and it should be designed to minimize the energy of incoming stormwater before the flow enters the second chamber (i.e., filtering or processing chamber).

The second chamber is the filtering or processing chamber. It should contain the filter material consisting of gravel and sand and should be situated behind a weir. Along the bottom of the structure should be a subsurface drainage system consisting of a parallel perforated PVC pipe system in a stone bed. A dewatering valve should be installed at the top of the filter layer for safety release in cases of emergency. A bypass pipe crossing the second chamber to carry overflow from the first chamber to the third chamber is required.

The third chamber is the discharge chamber. It should also receive the overflow from the first chamber through the bypass pipe when the storage volume is exceeded.

Water enters the first chamber of the system by gravity or by pumping. This chamber removes most of the heavy solid particles, floatable trash, leaves, and hydrocarbons. Then the water flows to the second chamber and enters the filter layer by overtopping a weir. The filtered stormwater is then picked up by the subsurface drainage system that empties it into the third chamber.

Whenever there is insufficient hydraulic head for a three-chamber underground sand filter, a well pump may be used to discharge the effluent from the third chamber into the receiving storm or combined sewer. For three-chamber sand filters in combined-sewer areas, a water trap shall be provided in the third chamber to prevent the back flow of odorous gas.

- **Perimeter Sand Filter (F-4).** The perimeter sand filter also includes the basic design elements of a sediment chamber and a filter bed. The perimeter sand filter typically consists of two parallel trenches connected by a series of overflow weir notches at the top of the partitioning wall, which allows water to enter the second trench as sheet flow. The first trench is a pretreatment chamber removing heavy sediment particles and debris. The second trench consists of the sand filter layer. A subsurface drainage pipe must be installed at the bottom of the second chamber to facilitate the filtering process and convey filter water into a receiving system.

  In this design, flow enters the system through grates, usually at the edge of a parking lot. The perimeter sand filter is usually designed as an on-line practice (i.e., all flows enter the system), but larger events bypass treatment by entering an overflow chamber. One major advantage of the perimeter sand filter design is that it requires little hydraulic head and is therefore a good option for sites with low topographic relief.

Surface Cover. The surface cover for non-structural and surface sand filters should consist of a 3-inch layer of topsoil on top of the sand layer. The surface may also have pea gravel inlets in the topsoil layer to promote filtration. The pea gravel may be located where sheet flow enters the filter, around the margins of the filter bed, or at locations in the middle of the filter bed.

Underground sand filters should have a pea gravel or No. 57 stone layer on top of the sand layer. This gravel layer helps to prevent bio-fouling or blinding of the sand surface.

Maintenance Reduction Features. The following maintenance issues should be addressed during filter design to reduce future maintenance problems:

- **Observation Wells and Cleanouts.** Non-structural and surface sand filters must include an observation well consisting of a 6-inch diameter non-perforated PVC pipe fitted with a lockable cap. It should be installed flush with the ground surface to facilitate periodic inspection and maintenance. In most cases, a cleanout pipe will be tied into the end of all underdrain pipe runs. The portion of the cleanout pipe/observation well in the underdrain layer should be perforated. At least one cleanout pipe must be provided for every 2,000 square feet of filter surface area.

- **Access.** Good maintenance access is needed to allow crews to perform regular inspections and maintenance activities. "Sufficient access" is operationally defined as the ability to get a vacuum truck or similar equipment close enough to the sedimentation chamber and filter to enable cleanouts. Direct maintenance access shall be provided to the pretreatment area and the filter bed. For underground structures, sufficient headroom for maintenance should be provided. A minimum head space of 5 feet above the filter is recommended for maintenance of the structure. However, if 5 feet of headroom is not available, manhole access must be installed.
- **Manhole Access (for underground filters).** Access to the headbox and clearwell of Underground Filters must be provided by manholes at least 30 inches in diameter, along with steps to the areas where maintenance will occur.
- **Visibility.** Stormwater filters should be clearly visible at the site so inspectors and maintenance crews can easily find them. Adequate signs or markings must be provided at manhole access points for Underground Filters.
- **Confined Space Issues.** Underground filters are often classified as a confined space. Consequently, special OSHA rules apply, and training may be needed to protect the workers that access them. These procedures often involve training about confined space entry, venting, and the use of gas probes.

Filter Material Specifications. The basic material specifications for filtering practices that utilize sand as a filter media are outlined in Table 4.44.

Table 4.44. Filtering Practice Material Specifications

Material	Specification
Surface Cover	Non-structural and surface sand filters: 3-inch layer of topsoil on top of the sand layer. The surface may also have pea gravel inlets in the topsoil layer to promote filtration. Underground sand filters: Clean, double-washed pea gravel or No. 57 stone on top of the sand layer.
Sand	Clean AASHTO M-6/ASTM C-33 medium aggregate concrete sand with a particle size range of 0.02–0.04 inches in diameter.
Choker Stone and/or Geotextile/Filter Fabric	For choker stone, a 2- to 4-inch layer of choker stone (e.g., typically ASTM D448 No. 8 or No. 89 washed gravel) should be placed between the sand layer and the underdrain stone. Alternatively, if available head is limited, an appropriate geotextile fabric that meets AASHTO M-288 Class 2, latest edition, requirements may be used. The geotextile fabric must have a flow rate of > 125 gpm/ft^2 (ASTM D4491) and an Apparent Opening Size (AOS) equivalent to a US No. 70 or No. 80 sieve.
Underdrain/Perforated Pipe	4- or 6-inch perforated schedule 40 PVC pipe, with three or four rows of 3/8-inch perforations at 6 inches on center.
Underdrain Stone	Use No. 57 stone or the ASTM equivalent (1-inch maximum).
Impermeable Liner	Where appropriate, use a PVC Geomembrane liner or equivalent.

Filter Sizing. Filtering devices are sized to accommodate a specified design storm volume (typically SWRv). The volume to be treated by the device is a function of the storage depth above the filter and the surface area of the filter. The storage volume is the volume of ponding above the filter. For a given design volume, Equation 4.23 is used to determine the required filter surface area.

Equation 4.23 Minimum Filter Surface Area for Filtering Practices

$$SA_{filter} = \frac{DesignVolume \times d_f}{k \times (h_{avg} + d_f) \times t_d}$$

where:

SA_{filter}	=	area of the filter surface (ft^2)
DesignVolume	=	design storm volume, typically the SWRv (ft^2)
d_f	=	filter media depth (thickness) (ft), with a minimum of 1 ft
k	=	coefficient of permeability (ft/day) (3.5 ft/day for partially clogged sand)
h_f	=	height of water above the filter bed (ft), with a maximum of 5 ft
h_{avg}	=	average height of water above the filter bed (ft), one half of the filter height (h_f)
t_d	=	allowable drawdown time (1.67 days)

The coefficient of permeability (ft/day) is intended to reflect the worst-case situation (i.e., the condition of the sand media at the point in its operational life where it is in need of replacement or maintenance). Filtering practices are therefore sized to function within the desired constraints at the end of the media's operational life cycle.

The entire filter treatment system, including pretreatment, shall temporarily hold at least 50% of the design storm volume prior to filtration (see Equation 4.24). This reduced volume takes into account the varying filtration rate of the water through the media, as a function of a gradually declining hydraulic head.

Equation 4. 24 Required Ponding Volume for Filtering Practices

$$V_{ponding} = 0.50 \times DesignVolume$$

where:

$V_{ponding}$	=	storage volume required prior to filtration (ft^3)
DesignVolume	=	design storm volume, typically the SWRv (ft^2)

The total storage volume for the practice (Sv) can be determined using Equation 4. 25 below.

Equation 4.25 Storage Volume for Filtering Practices

$$SSRR = 2.0 \times W_{ppbbppmmmppgg}$$

where:

Sv	=	total storage volume for the practice (ft^3)
$V_{ponding}$	=	storage volume required prior to filtration (ft^3)

4.10.5 Filtering System Landscaping Criteria

A dense and vigorous vegetative cover shall be established over the contributing pervious drainage areas before runoff can be accepted into the facility. Filtering practices should be incorporated into site landscaping to increase their aesthetics and public appeal.

Surface filters (e.g., surface and non-structural sand filters) can have a grass cover to aid in pollutant adsorption. The grass should be capable of withstanding frequent periods of inundation and drought.

4.10.6 Filtering System Construction Sequence

Soil Erosion and Sediment Control. No runoff shall be allowed to enter the filter system prior to completion of all construction activities, including revegetation and final site stabilization. Construction runoff shall be treated in separate sedimentation basins and routed to bypass the filter system. Should construction runoff enter the filter system prior to final site stabilization, all contaminated materials must be removed and replaced with new clean filter materials before a regulatory inspector approves its completion. The approved soil erosion and sediment control plan shall include specific measures to provide for the protection of the filter system before the final stabilization of the site.

Filter Installation. The following is the typical construction sequence to properly install a structural sand filter. This sequence can be modified to reflect different filter designs, site conditions, and the size, complexity, and configuration of the proposed filtering application.

1. **Stabilize Contributing Drainage Area.** Filtering practices should only be constructed after the CDA to the facility is completely stabilized, so sediment from the CDA does not flow into and clog the filter. If the proposed filtering area is used as a sediment trap or basin during the construction phase, the construction notes should clearly specify that, after site construction is complete, the sediment control facility will be dewatered, dredged, and regraded to design dimensions for the post-construction filter.

2. **Install Soil Erosion and Sediment Control Measures for the Filtering Practice.** Stormwater should be diverted around filtering practices as they are being constructed. This is usually not difficult to accomplish for off-line filtering practices. It is extremely important to keep runoff and eroded sediment away from the filter throughout the construction process. Silt fence or other sediment controls should be installed around the perimeter of the filter, and erosion control fabric may be needed during construction on exposed side-slopes with gradients exceeding 4H:1V. Exposed soils in the vicinity of the filtering practice should be rapidly stabilized by hydro-seed, sod, mulch, or other method.

3. **Assemble Construction Materials on Site.** Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

4. **Clear and Strip.** Bring the project area to the desired subgrade.

5. **Excavate and Grade.** Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the filtering practice.

6. **Install Filter Structure. Install filter structure in design location** and check all design elevations (i.e., concrete vaults for surface, underground, and perimeter sand filters). Upon completion of the filter structure shell, inlets and outlets must be temporarily plugged and the structure filled with water to the brim to demonstrate water tightness. Maximum allowable leakage is 5% of the water volume in a 24-hour period. See Appendix E Construction Inspection Checklists for the Stormwater Facility Leak Test form. If the structure fails the test, repairs must be performed to make the structure watertight before any sand is placed into it.

7. **Install Base Material Components. Install the gravel, underdrains, and choker layers** of the filter.

8. **Install Top Sand Component. Spread sand across filter bed** in 1-foot lifts up to the design elevation. Backhoes or other equipment can deliver the sand from outside the filter structure. Sand should be manually raked. Clean water is then added until the sedimentation chamber and filter bed are completely full. The facility is then allowed to drain, hydraulically compacting the sand layers. After 48 hours of drying, refill the structure to the final top elevation of the filter bed.

9. **Install Surface Layer (Surface Sand Filters only).** Add a 3-inch topsoil layer and pea gravel inlets and immediately seed with the permanent grass species. The grass should be watered, and the facility should not be switched on-line until a vigorous grass cover has become established.

10. **Stabilize Surrounding Areas. Stabilize exposed soils** on the perimeter of the structure with temporary seed mixtures appropriate for a buffer. All areas above the normal pool should be permanently stabilized by hydroseed, sod, or seeding and mulch.

11. **Final Inspection. Conduct the final construction inspection.** Multiple construction inspections by a qualified professional are critical to ensure that stormwater filters are properly constructed. Inspections are recommended during the following stages of construction:

- Initial site preparation, including installation of soil erosion and sediment control measures;
- Excavation/grading to design dimensions and elevations;
- Installation of the filter structure, including the water tightness test;
- Installation of the underdrain and filter bed;
- Check that turf cover is vigorous enough to switch the facility on-line; and
- Final inspection after a rainfall event to ensure that it drains properly and all pipe connections are watertight. Develop a punch list for facility acceptance. Log the filtering practice’s GPS coordinates and submit them for entry into the BMP maintenance tracking database.

Construction phase inspection checklist for filters and the Stormwater Facility Leak Test form can be found in Appendix E Construction Inspection Checklists.

4.10.7 Filtering System Maintenance Criteria

Maintenance of filters is required and involves several routine maintenance tasks, which are outlined in Table 4.45. A cleanup should be scheduled at least once a year to remove trash and floatables that accumulate in the pretreatment cells and filter bed. Frequent sediment cleanouts in the dry and wet sedimentation chambers are recommended every 1 to 3 years to maintain the function and performance of the filter. If the filter treats runoff from a stormwater hotspot, crews may need to test the filter bed media before disposing of the media and trapped pollutants. Petroleum hydrocarbon contaminated sand or filter cloth must be disposed of according to State solid waste disposal regulations. Testing is not needed if the filter does not receive runoff from a designated stormwater hotspot, in which case the media can be safely disposed of in a landfill.

Table 4.45. Typical Annual Maintenance Activities for Filtering Practices

Frequency	Maintenance Tasks
At least 4 times per growing season	▪ Mow grass filter strips and perimeter turf around surface sand filters. Maximum grass heights should be less than 12 inches.
2 times per year (may be more or less frequently depending on land use)	▪ Check to see if sediment accumulation in the sedimentation chamber has exceeded 6 inches. If so, schedule a cleanout.
Annually	▪ Conduct inspection and cleanup. ▪ Dig a small test pit in the filter bed to determine whether the first 3 inches of sand are visibly discolored and need replacement. ▪ Check to see if inlets and flow splitters are clear of debris and are operating properly. ▪ Check concrete structures and outlets for any evidence of spalling, joint failure, leakage, corrosion, etc. ▪ Ensure that the filter bed is level and remove trash and debris from the filter bed. Sand or gravel covers should be raked to a depth of 3 inches.
Every 5 years	▪ Replace top sand layer. ▪ Till or aerate surface to improve infiltration/grass cover.
As needed	▪ Remove blockages and obstructions from inflows. Trash collected on the grates protecting the inlets shall be removed regularly to ensure the inflow capacity of the BMP is preserved. ▪ Stabilize CDA and side-slopes to prevent erosion. Filters with a turf cover should have 95% vegetative cover.
Upon failure	▪ Corrective maintenance is required any time the sedimentation basin and sediment trap do not draw down completely after 72 hours (i.e., no standing water is allowed).

Maintenance Inspections. Regular inspections by a qualified professional are critical to schedule sediment removal operations, replace filter media, and relieve any surface clogging. Frequent inspections are especially needed for underground and perimeter filters, since they are out of sight and can be easily forgotten. Depending on the level of traffic or the particular land use, a filter system may either become clogged within a few months of normal rainfall or could possibly last several years with only routine maintenance. Maintenance inspections should be conducted within 24 hours following a storm that exceeds 0.5 inch of rainfall, to evaluate the condition and performance of the filtering practice.

Note: Without regular maintenance, reconditioning sand filters can be very expensive.

Maintenance inspection checklists for filters and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.10.8 Filtering System Stormwater Compliance Calculations

Filtering practices are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 80% bacteria removal for the storage volume (Sv) provided by the (Table 4.46).

Table 4.46. Filter Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 30%
Bacteria Removal	= 80%

The practice must be sized using the guidance detailed in Section 4.8.4 Filtering Design Criteria.

4.11 Storage Practices

Storage Practices

Definition: Practices that are explicitly designed to provide stormwater detention (2- to 25-year, and/or flood control).

Site Applicability

Land Uses	Required Footprint
▪ Urban ▪ Suburban ▪ Rural	**Medium**

Construction Costs	Maintenance Burden
Moderate	Low

Maintenance Frequency:

Routine	Non-Routine
Quarterly	Every 10–15 years

BMP Performance Summary

WQ Improvement: Low

TSS[1]	Total N[1]	Bacteria[1]
60%	10%	60%

Runoff Reduction

Volume
Low

SWRv
0%

Advantages/Benefits

- Flood control
- Typically less costly than stormwater (wet) ponds for equivalent flood storage
- Provides recreational and other open space opportunities between storm runoff events

Disadvantages/Limitation

- Minimal water quality treatment
- Best suited to large CDAs (at least 10 acres)
- Tends to re-suspend sediment

Components

- Conveyance
- Inlets/outlets
- Forebay
- Ponding area with available storage
- Micropool
- Spillway system(s)
- Liners, as needed

Design considerations

- Depth to seasonal high water table must be at least 6 inches below bottom of practice
- Drawdown of 24 to 48 hours
- Shallow pond with large surface area performs better than deep pond of same volume
- Maintenance access

Maintenance Activities

- Remove debris (inlets/outlets/basin surface)
- Remove sediment buildup
- Repair and revegetate eroded areas.
- Perform structural repairs to inlet and outlets.
- Mow unwanted vegetation

[1]*Credited pollutant load removal*

Storage practices are a common BMP used to temporarily detain runoff to reduce peak flows (Figure 4.47**).**

Figure 4.47. Dry Extended Detention Pond (Photo: Center for Watershed Protection, Inc.)

Definition. Storage practices are explicitly designed to provide stormwater detention (2- to 25-year, and/or flood control). Design variants include the following:

S-1 Underground detention vaults and tanks

S-2 Dry detention ponds

S-3 Rooftop storage

S-4 Stone storage under permeable pavement or other BMPs

Detention vaults are box-shaped underground stormwater storage facilities typically constructed with reinforced concrete. Detention tanks are underground storage facilities typically constructed with large diameter concrete or plastic pipe (see Figure 4.44). Both serve as an alternative to surface dry detention for stormwater quantity control, particularly for space-limited areas where there is not adequate land for a dry detention basin or multi-purpose detention area. Prefabricated concrete vaults are available from commercial vendors. In addition, several pipe manufacturers have developed packaged detention systems.

Dry detention ponds are widely applicable for most land uses and are best suited for larger SDAs. An outlet structure restricts stormwater flow, so it backs up and is stored within the basin (see Figure 4.

45). The temporary ponding reduces the maximum peak discharge to the downstream channel, thereby reducing the effective shear stress on the bed and banks of the receiving stream.

Storage practices do not receive any stormwater retention or treatment volume and should be considered only for management of larger storm events. Storage practices are not considered an acceptable practice to meet the SWRv. Storage practices must be combined with a separate facility to meet these requirements. Upland practices can be used to satisfy some, or all, of the stormwater retention requirements at many sites, which can help to reduce the footprint and volume of storage practices.

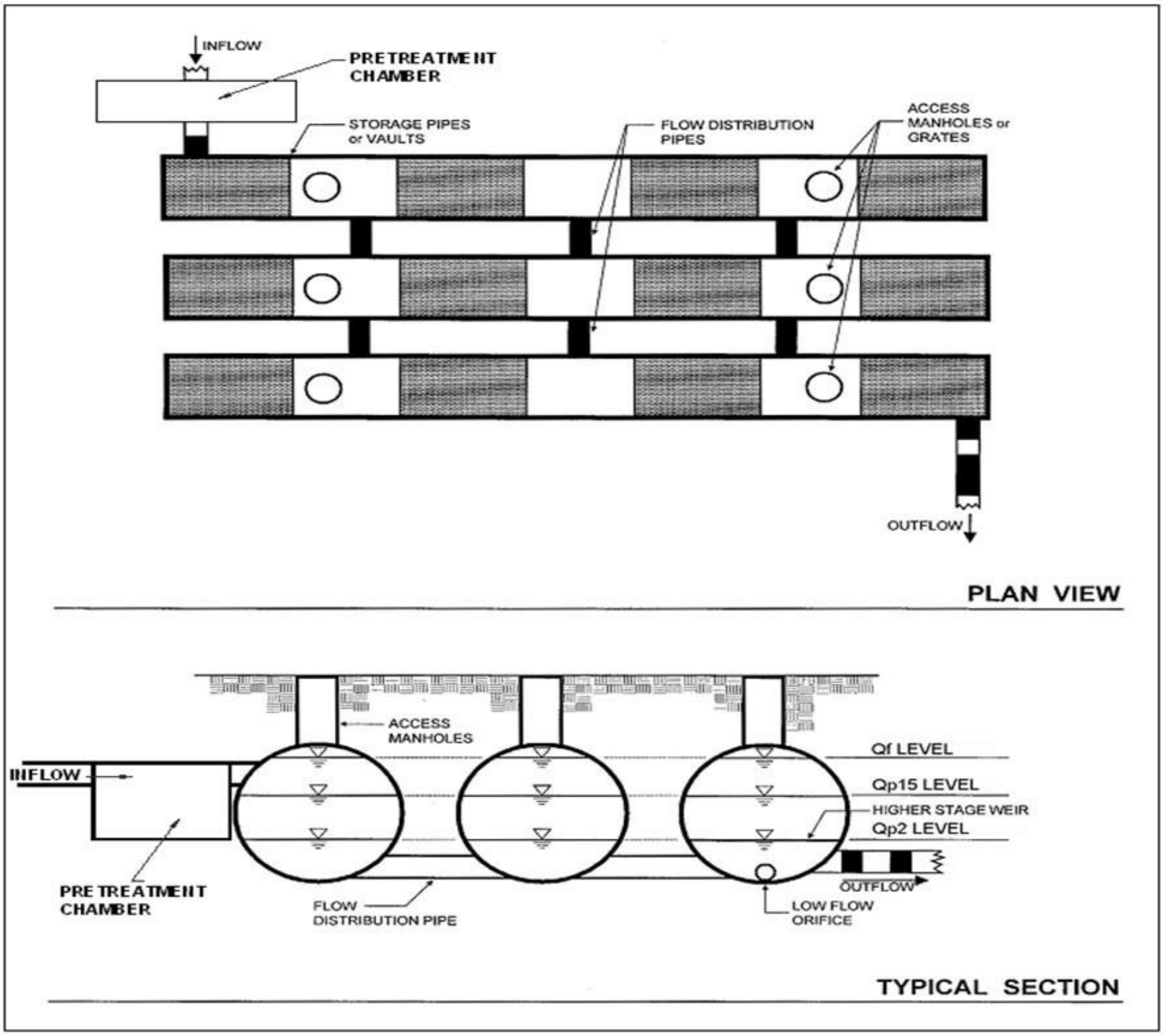


Figure 4.48 Example of an underground detention vault and/or tank (S-1).

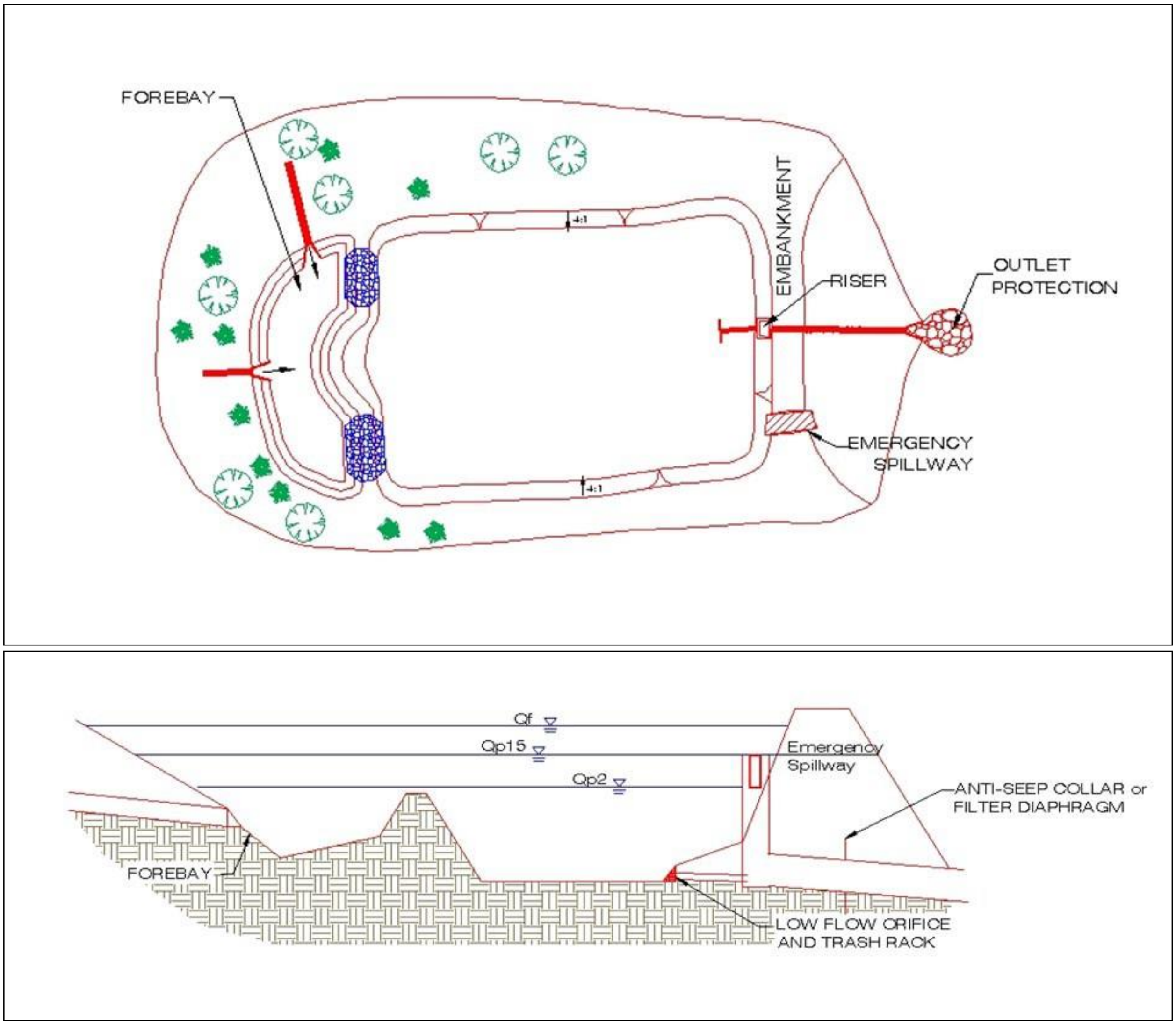


Figure 4.49 Example of a dry detention pond (S-2).

4.11.1 Storage Feasibility Criteria

The following feasibility issues need to be evaluated when storage practices are considered as the final practice in a treatment train:

Space Required. A typical storage practice requires a footprint of 1%–3% of its CDA, depending on the depth of the pond or storage vault (i.e., the deeper the practice, the smaller footprint needed).

Contributing Drainage Area. A CDA of at least 10 acres is preferred for dry ponds in order to keep the required orifice size from becoming a maintenance problem. Designers should be aware that small "pocket" ponds will typically (1) have very small orifices that will be prone to clogging, (2) experience fluctuating water levels such that proper stabilization with vegetation is very difficult, and (3) generate more significant maintenance problems.

Underground detention systems can be located downstream of other structural stormwater controls providing treatment of the design storm. For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRCS CN that reflects the volume reduction of upland practices and likely reduce the size and cost of detention (see Storage Practice Sizing in Section 4.8.4 Storage Design Criteria).

The maximum CDA to be served by a single underground detention vault or tank is 25 acres.

Available Hydraulic Head. The depth of a storage practice is usually determined by the amount of hydraulic head available at the site (dimension between the surface drainage and the bottom elevation of the site). The bottom elevation is normally the invert of the existing downstream conveyance system to which the storage practice discharges. Depending on the size of the development and the available surface area of the basin, as much as 6 to 8 feet of hydraulic head may be needed for a dry detention practice to function properly for storage. An underground storage practice will require sufficient head room to facilitate maintenance—at least 5 feet depending on the design configuration.

Setbacks. Setbacks to structures and property lines must be at least 10 feet, and adequate waterproofing protection must be provided for foundations and basements.

Depth to Water Table. Dry ponds are not allowed if the water table will be within 0.5 feet of the floor of the pond. For underground detention vaults and tanks, an anti-flotation analysis is required to check for buoyancy problems in high water table areas.

Tidal Impacts. The outlet of a dry detention practice should be located above the tidal mean high water elevation. In tidally impacted areas, detention practices may have minimal benefit, and re- questing a variance for detention requirements may be an option.

Tailwater Conditions. The flow depth in the receiving channel should be considered when determining outlet elevations and discharge rates from the dry detention practice. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis. For direct discharges to tidal waters, a king tide evaluation shall accompany the tailwater condition evaluation.

Soils. The permeability of soils is seldom a design constraint for storage practices. Soil infiltration tests should be conducted at proposed dry pond sites to estimate infiltration rates and patterns, which can be significant in HSG A soils and some group B soils. Infiltration through the bottom of the pond is typically encouraged unless it may potentially migrate laterally thorough a soil layer and impair the integrity of the embankment or other structure.

Structural Stability. Underground detention vaults and tanks must meet structural requirements for overburden support and traffic loading if appropriate as verified by shop drawings signed by an appropriately licensed professional.

Geotechnical Tests. At least one soil boring must be taken at a low point within the footprint of any proposed storage practice to establish the water table elevations and evaluate soil suitability. A geotechnical investigation is required for all underground BMPs, including underground storage systems. Geotechnical testing requirements are outlined in Appendix B Geotechnical Information Requirements for Underground BMPs.

Utilities. For a dry pond system, no utility lines shall be permitted to cross any part of the embankment where the design water depth is greater than 2 feet. Typically, utilities require a minimum 5-foot horizontal clearance from storage facilities.

Perennial Streams. Locating dry ponds on perennial streams will require both a Section 401 and Section 404 permit from the appropriate state or federal regulatory agency.

Economic Considerations. Underground detention can be expensive, but often allows for greater use of a development site. Dry detention ponds are generally inexpensive to construct and maintain. Depending upon the type of development, dry detention practices may be required to treat a larger volume of water than other BMPs. Dry detention practices must store 1 inch of runoff from the site, whereas infiltration practices and other BMPs must capture 1 inch of runoff from only the impervious cover on a site.

4.11.2 Storage Conveyance Criteria

Designers must use accepted hydrologic and hydraulic routing calculations to determine the required storage volume and an appropriate outlet design for storage practices. See Section 3.7.2 Hydrologic and Hydraulic Analysis for a summary of acceptable hydrologic methodologies and models.

For management of the 2-year storm, a control structure with a trash rack designed to release the required predevelopment Qp_2 must be provided. Ideally, the channel protection orifice should have a minimum diameter of 3 inches in order to pass minor trash and debris. However, where smaller orifices are required, the orifice must be adequately protected from clogging by an acceptable external trash rack.

As an alternative, the orifice diameter may be reduced if internal orifice protection is used (i.e., a perforated vertical stand pipe with 0.5-inch orifices or slots that are protected by wirecloth and a stone filtering jacket). Adjustable gate valves, weir manholes, and other structures designed for simple maintenance can also be used to achieve this equivalent diameter.

For overbank flood protection, an additional outlet is sized for 2- to 25-year frequency storm event control and can consist of a weir, orifice, outlet pipe, combination outlet, or other acceptable control structure.

Riprap, plunge pools or pads, or other energy dissipators are to be placed at the end of the outlet to prevent scouring and erosion and to provide a non-erosive velocity of flow from the structure to a water course. The design must specify an outfall that will be stable for the 25-year design storm event. The channel immediately below the storage practice outfall must be modified to prevent erosion. This is typically done by calculating channel velocities and flow depths, then placing appropriately sized riprap, over geotextile fabric, which can reduce flow velocities from the principal spillway to non-erosive levels (3.5 to 5.0 feet per second depending on the channel lining material). The storage practice geometry and outfall design may need to be altered in order to yield adequate channel velocities and flow.

Flared pipe sections that discharge at or near the stream invert or into a step pool arrangement should be used at the spillway outlet. An outfall analysis shall be included in the SWMP showing discharge velocities down to the nearest downstream water course. Where indicated, the developer/contractor must secure an off-site drainage easement for any improvements to the downstream channel.

When the discharge is to a manmade pipe or channel system, the system must be adequate to convey the required design storm peak discharge.

If discharge daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of riprap should be avoided.

The final release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at a downstream structure, highway, or natural point of restricted streamflow.

The following **additional** conveyance criteria apply to underground detention or ponds:

- **High Flow Bypass (underground detention).** An internal or external high flow bypass or overflow must be included in underground detention designs to safely pass the extreme flood flow.
- **Primary Spillway (dry ponds).** The primary spillway shall be designed with acceptable anti-flotation, anti-vortex, and trash rack devices. The spillway must generally be accessible from dry land. When reinforced concrete pipe is used for the principal spillway to increase its longevity, “O”-ring gaskets (ASTM C361) must be used to create watertight joints, and they should be inspected during installation.
- **Avoid Outlet Clogging (dry ponds).** The risk of clogging in outlet pipes with small orifices can be reduced by the following:
    - Providing a micropool at the outlet structure. For more information on micropool extended detention ponds see Section 4.12 Ponds.
    - Installing a trash rack to screen the low-flow orifice.
    - Using a perforated pipe under a gravel blanket with an orifice control at the end in the riser structure.
- **Emergency Spillway (dry ponds).** Dry ponds must be constructed with overflow capacity to safely pass the 100-year design storm event through either the primary spillway or a vegetated or armored emergency spillway unless waived by Beaufort County Public Works Department.
- **Inlet Protection (dry ponds).** Inflow points into dry pond systems must be stabilized to ensure that non-erosive conditions exist during storm events up to the overbank flood event (i.e., the 25-year storm event).

4.11.3 Storage Pretreatment Criteria

Dry Pond Pretreatment Forebay. A forebay must be located at each major inlet to a dry pond to trap sediment and preserve the capacity of the main treatment cell. The following criteria apply to dry pond forebay design:

- A major inlet is defined as an individual storm drain inlet pipe or open channel serving at least 10% of the storage practice’s CDA.
- The forebay consists of a separate cell, formed by an acceptable barrier (e.g., an earthen berm, concrete weir, gabion baskets, etc.).
- The forebay shall be sized to contain 0.1 inches per impervious acre of contributing drainage. The relative size of individual forebays should be proportional to the percentage of the total inflow to the dry pond.

- The forebay should be designed in such a manner that it acts as a level spreader to distribute runoff evenly across the entire bottom surface area of the main storage cell.
- Exit velocities from the forebay shall be non-erosive or an armored overflow shall be provided. Non-erosive velocities are 4 feet per second for the 2-year event and 6 feet per second for the 25-year event.
- The bottom of the forebay may be hardened (e.g., concrete, asphalt, or grouted riprap) in order to make sediment removal easier.
- Direct maintenance access for appropriate equipment shall be provided to the each forebay.

Underground Detention Pretreatment. A pretreatment structure to capture sediment, coarse trash, and debris must be placed upstream of any inflow points to underground detention. A separate sediment sump or vault chamber sized to capture 0.1 inches per impervious acre of contributing drainage, or a proprietary structure with demonstrated capability of removing sediment and trash, should be provided at the inlet for underground detention systems that are in a treatment train with off-line water quality treatment structural controls. Refer to Section 0 Proprietary Practices for information on approved proprietary practices.

4.11.4 Storage Design Criteria

Dry Pond Internal Design Features. The following apply to dry pond design:

- **No Pilot Channels.** Dry ponds shall not have a low-flow pilot channel, but instead must be constructed in a manner whereby flows are evenly distributed across the pond bottom, to avoid scour, promote attenuation and, where possible, infiltration.
- **Internal Slope.** The maximum longitudinal slope through the pond should be approximately 0.5%–1%.
- **Side Slopes.** Side slopes within the dry pond should generally have a gradient of 3H:1V to 4H:1V. The mild slopes promote better establishment and growth of vegetation and provide for easier maintenance and a more natural appearance. Ponds with side slopes steeper than 5H:1V must be fenced and include a lockable gate.
- **Long Flow Path.** Dry pond designs should have an irregular shape and a long flow path distance from inlet to outlet to increase water residence time, treatment pathways, pond performance, and to eliminate short-cutting. In terms of flow path geometry, there are two design considerations: (1) the overall flow path through the pond, and (2) the length of the shortest flow path (Hirschman et al., 2009):
  - The overall flow path can be represented as the length-to-width ratio OR the flow path ratio. These ratios must be at least 2L:1W (3L:1W preferred). Internal berms, baffles, or topography can be used to extend flow paths and/or create multiple pond cells.
  - The shortest flow path represents the distance from the closest inlet to the outlet. The ratio of the shortest flow to the overall length must be at least 0.4. In some cases—due to site geometry, storm sewer infrastructure, or other factors—some inlets may not be able to meet these ratios. However, the CDA served by these “closer” inlets must constitute no more than 20% of the total CDA.
- **Top of Bank. Dry ponds shall be provided with a 20-ft maintenance access at the top of bank with a maximum cross slope of 48:1.**

Safety Features. The following safety features must be considered for storage practices:

- The underground spillway access must be designed and constructed to prevent access by small children.
- End walls above pipe outfalls greater than 48 inches in diameter must be fenced at the top of the wall to prevent a falling hazard.
- Storage practices must incorporate an additional 1 foot of freeboard above the emergency spillway, or 2 feet of freeboard if design has no emergency spillway, for the 100-year storm.
- The emergency spillway must be located so that downstream structures will not be impacted by spillway discharges
- Underground maintenance access should be locked at all times.

Maintenance Access. All storage practices shall be designed so as to be accessible to annual maintenance. Unless waived by Beaufort County Public Works Department, a 5H:1V slope and 15-foot-wide entrance ramp is required for maintenance access to dry ponds. Adequate maintenance access must also be provided for all underground detention systems. Access must be provided over the inlet pipe and outflow structure with access steps. Access openings can consist of a standard 30-inch diameter frame, grate and solid cover, a hinged door, or removable panel. Removable panels must be designed with sufficient support so they cannot fall through the opening into the vault when removed.

Outlets. Trash racks shall be provided for low-flow pipes and for risers not having anti-vortex devices.

To reduce maintenance problems for small orifices, a standpipe design can be used that includes a smaller inner standpipe with the required orifice size, surrounded by a larger standpipe with multiple openings, and a gravel jacket surrounding the larger standpipe. This design will reduce the likelihood of the orifice being clogged by sediment.

Detention Vault and Tank Materials. Underground stormwater detention structures shall be composed of materials as approved by Beaufort County Public Works Department. All construction joints and pipe joints shall be soil-tight. Cast-in-place wall sections must be designed as retaining walls. The maximum depth from finished grade to the vault invert is 20 feet. The minimum pipe diameter for underground detention tanks is 24 inches unless otherwise approved by Beaufort County Public Works Department. Manufacturer’s specifications should be consulted for underground detention structures.

Anti-floatation Analysis for Underground Detention. Anti-flotation analysis is required to check for buoyancy problems in high water table areas. Anchors shall be designed to counter the pipe and structure buoyancy by at least a 1.2 factor of safety.

Storage Practice Sizing. Storage facilities should be sized to control peak flow rates from the 2- to 25-year frequency storm event or other design storm. Design calculations must ensure that the post-development peak discharge does not exceed the predevelopment peak discharge. See Section 3.7.2 Hydrologic and Hydraulic Analysis for a summary of acceptable hydrologic methodologies and models.

For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRCS CN that reflects the volume reduction of upland practices to compute the 2- 50-year frequency storm event that must be treated by the storage practice.

4.11.5 Storage Landscaping Criteria
No landscaping criteria apply to underground storage practices.

For dry ponds, a landscaping plan must be provided that indicates the methods used to establish and maintain vegetative coverage within the dry pond. Minimum elements of a plan include the following:

- Delineation of pondscaping zones within the pond.
- Selection of corresponding plant species.
- The planting plan.
- The sequence for preparing the wetland bed, if one is incorporated with the dry pond (including soil amendments, if needed).
- Sources of native plant material.
- The planting plan should allow the pond to mature into a native forest in the right places, but yet keep mowable turf along the embankment and all access areas. The wooded wetland concept proposed by Cappiella et al. (2005) may be a good option for many dry ponds.
- Woody vegetation may not be planted or allowed to grow within 15 feet of the toe of the embankment nor within 25 feet from the principal spillway structure.

4.11.6 Storage Construction Sequence
Construction of underground storage systems must be in accordance with manufacturer's specifications. All runoff into the system should be blocked until the site is stabilized. The system must be inspected and cleaned of sediment after the site is stabilized.

The following is a typical construction sequence to properly install a dry pond. The steps may be modified to reflect different dry pond designs, site conditions, and the size, complexity, and configuration of the proposed facility.

1. **Use of Dry Pond for Soil Erosion and Sediment Control.** A dry pond may serve as a sediment basin during project construction. Installation of the permanent riser should be initiated during the construction phase, and design elevations should be set with final cleanout of the sediment basin and conversion to the post-construction dry pond in mind. The bottom elevation of the dry pond should be lower than the bottom elevation of the temporary sediment basin. Appropriate procedures must be implemented to prevent discharge of turbid waters when the basin is being converted into a dry pond.

2. **Stabilize the Contributing Drainage Area.** Dry ponds should only be constructed after the CDA to the pond is completely stabilized. If the propose dry pond site will be used as a sediment trap or basin during the construction phase, the construction notes must clearly indicate that the facility will be dewatered, dredged, and regraded to design dimensions after the original site construction is complete.

3. **Assemble Construction Materials on Site.** Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

4. **Clear and Grade.** Bring the project area to the desired subgrade.

5. **Soil Erosion and Sediment Controls.** Install soil erosion and sediment control measures prior to construction, including temporary stormwater diversion practices. All areas surrounding the pond that are graded or denuded during construction must be planted with turf grass, native plantings, or other approved methods of soil stabilization.

6. **Install the Spillway Pipe. E**nsure the top invert of the spillway pipe is set to design elevation.

7. **Install the Riser or Outflow Structure. Once riser and outflow structures** are installed, ensure the top invert of the overflow weir is constructed level and at the design elevation.

8. **Construct the Embankment and any Internal Berms. Construct the embankment and berms** in 8- to 12-inch lifts and compact the lifts with appropriate equipment.

9. **Excavate and Grade.** Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the dry pond.

10. **Construct the Emergency Spillway. The emergency spillway must be constructed** in cut or structurally stabilized soils.

11. **Install Outlet Pipes.** The installation of outlet pipes must include a downstream riprap protection apron.

12. **Stabilize Exposed Soils.** All areas above the normal pool elevation should be permanently stabilized by hydroseeding or seeding over straw.

Dry Pond Construction Supervision. Ongoing construction supervision is recommended to ensure that stormwater ponds are properly constructed. Supervision/inspection is recommended during the following stages of construction:

- Preconstruction meeting
- Initial site preparation including the installation of soil erosion and sediment control measures
- Excavation/Grading (interim and final elevations)
- Installation of the embankment, the riser/primary spillway, and the outlet structure
- Implementation of the pondscaping plan and vegetative stabilization
- Immediately seed or install vegetated ground cover upon completion of sloping and grading of each storage practice, where applicable, within a project.
- Inspect within two weeks to ensure vegetation is in fact holding banks and slopes in place.
- Prior to completion of project, mechanically remove erosion deposition from ponds that occurred during the project. Criteria should be based on erosion of designed bank slopes and loss of storage capacity.
- Final inspection (develop a punch list for facility acceptance)

Construction phase inspection checklist for storage practices and the Stormwater Facility Leak Test form can be found in Appendix E Construction Inspection Checklists.

If the dry pond has a permanent pool, then to facilitate maintenance the contractor should measure the actual constructed dry pond depth at three areas within the permanent pool (forebay, mid-pond, and at the riser), and they should mark and geo-reference them on an as-built drawing. This simple data set will enable maintenance inspectors to determine pond sediment deposition rates in order to schedule sediment cleanouts.

4.11.7 Storage Maintenance Criteria

Typical maintenance activities for storage practices are outlined in Table 4.47. Maintenance requirements for underground storage facilities will generally require quarterly visual inspections from the manhole access points by a qualified professional to verify that there is no standing water or excessive sediment buildup. Entry into the system for a full inspection of the system components (pipe or vault joints, general structural soundness, etc.) should be conducted annually. Confined space entry credentials are typically required for this inspection.

Table 4.47. Typical Maintenance Activities for Storage Practices.

Schedule	Maintenance Activity
As needed	▪ Water dry pond side slopes to promote vegetation growth and survival.
Quarterly	▪ Remove sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, storage practices, and overflow structures. ▪ Ensure that the CDA, inlets, and facility surface are clear of debris. ▪ Ensure that the CDA is stabilized. Perform spot-reseeding where needed. ▪ Repair undercut and eroded areas at inflow and outflow structures.
Annual inspection	▪ Measure sediment accumulation levels in forebay. Remove sediment when 50% of the forebay capacity has been lost. ▪ Inspect the condition of stormwater inlets for material damage, erosion or undercutting. Repair as necessary. ▪ Inspect the banks of upstream and downstream channels for evidence of sloughing, animal burrows, boggy areas, woody growth, or gully erosion that may undermine pond embankment integrity. ▪ Inspect outfall channels for erosion, undercutting, riprap displacement, woody growth, etc. ▪ Inspect condition of principal spillway and riser for evidence of spalling, joint failure, leakage, corrosion, etc. ▪ Inspect condition of all trash racks, reverse sloped pipes, or flashboard risers for evidence of clogging, leakage, debris accumulation, etc. ▪ Inspect maintenance access to ensure it is free of debris or woody vegetation and check to see whether valves, manholes, and locks can be opened and operated. ▪ Inspect internal and external side slopes of dry ponds for evidence of sparse vegetative cover, erosion, or slumping, and make needed repairs immediately. ▪ Monitor the growth of wetlands, trees and shrubs planted in dry ponds. Remove invasive species and replant vegetation where necessary to ensure dense coverage.

Maintenance of storage practices is driven by annual inspections that evaluate the condition and performance of the storage practice. Based on inspection results, specific maintenance tasks will be triggered.

Maintenance inspection checklists for extended detention ponds and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.11.8 Storage Stormwater Compliance Calculations

Storage practices are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 80% bacteria removal for the SWRv (Table 4.48).

Table 4.48. Storage Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 60%
TN Removal	= 10%
Bacteria Removal	= 60%

4.12 Ponds

Ponds
Definition: Stormwater storage practices that consist of a combination of a permanent pool, micropool, or shallow marsh that promote a good environment for gravitational settling, biological uptake, and microbial activity.

Site Applicability	
Land Uses	**Required Footprint**
▪ Urban ▪ Suburban ▪ Rural	**Medium**
Construction Costs	**Maintenance Burden**
Moderate	Moderate
Maintenance Frequency:	
Routine	**Non-Routine**
At least annually	Every 5–7 years

BMP Performance Summary		
WQ Improvement: Moderate to High		
TSS[1]	**Total N[1]**	**Bacteria[1]**
80%	30%	60%
Runoff Reductions		
Volume		
Low		
SWRv		
0%		

Advantages/Benefits	Disadvantages/Limitation
▪ Moderate to high pollutant removal ▪ Can be designed as a multi-functional BMP ▪ Cost effective ▪ Good for sites with high water table and/or poorly drained soils ▪ Wildlife habitat potential ▪ High community acceptance when integrated into a development	▪ Requires large amount of flat land (1-3% of CDA) ▪ Must be properly designed, installed, and maintained to avoid nuisance problems ▪ Routine sediment cleanout may be needed ▪ Potential for thermal impacts downstream

Components	Design considerations
▪ Conveyance ▪ Forebay ▪ Ponding area with available storage ▪ Micropool ▪ Spillway system(s) ▪ Liners, as needed	▪ CDA of at least 10 acres and slopes <15% ▪ Use CN adjustment factor ARC III for CDA that are irrigated with harvested rainwater ▪ Minimum length to width ratio = 3:1 ▪ Maximum depth of permanent pool = 8’ ▪ 3:1 side slopes or flatter around pond perimeter

Maintenance Activities	
▪ Remove debris from inlet and outlet structures ▪ Maintain side slopes/remove invasive vegetation	▪ Monitor sediment accumulation and remove periodically

[1]*Credited pollutant load removal*

Stormwater ponds are widely applicable for most land uses and are best suited for larger drainage areas (Figure 4.47); however, they should be considered for use after all other upland retention opportunities have been exhausted and there is still a remaining treatment volume or runoff from larger storms (i.e., 2- to 25-year or flood control events) to manage.

Stormwater ponds receive no retention credit and should be considered mainly for management of larger storm events. Stormwater ponds have both community and environmental concerns (see Section 4.12.1 Pond Feasibility Criteria) that should be considered before choosing stormwater ponds as the appropriate stormwater practice on site.

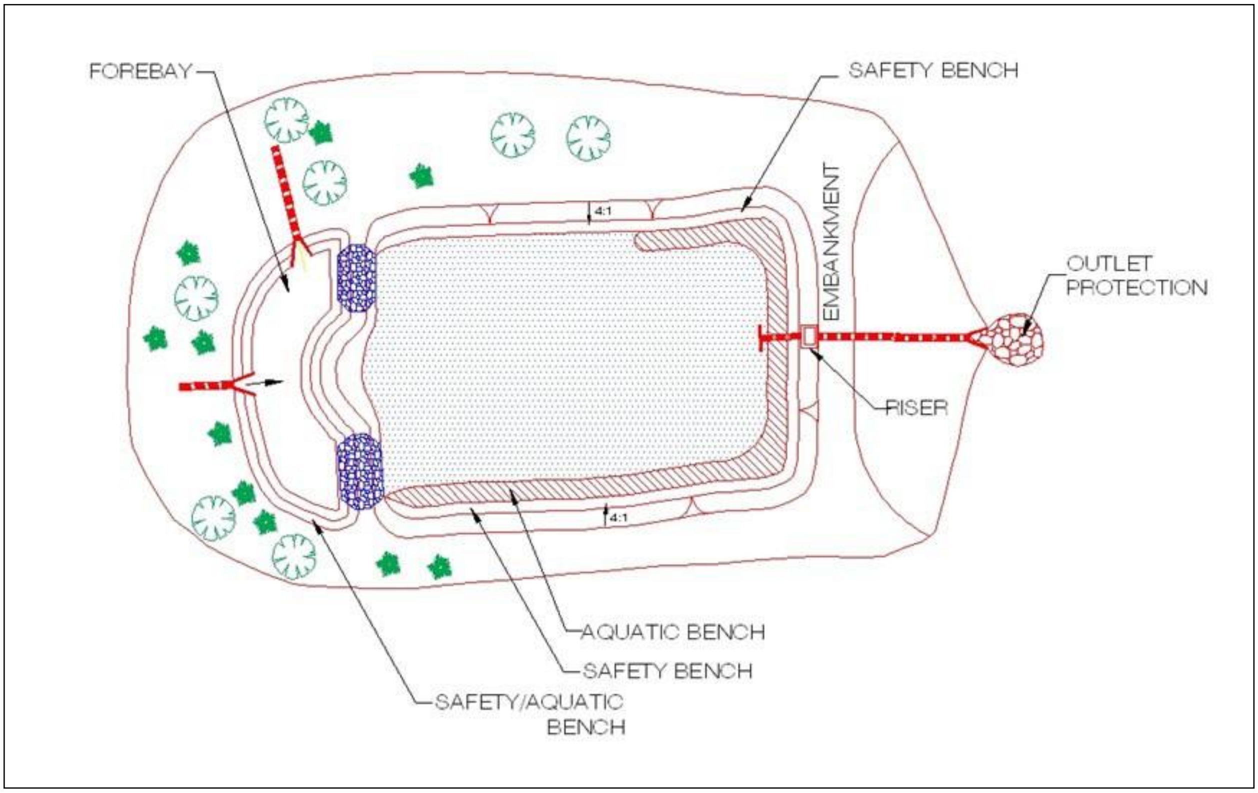
Figure 4.48 Wet Pond (photo: Denise Sanger)

Definition. Stormwater ponds are stormwater storage practices that consist of a combination of a permanent pool, micropool, or shallow marsh that promote a good environment for gravitational settling, biological uptake, and microbial activity. Ponds are best suited for larger SDAs. Runoff from each new storm enters the pond and partially displaces pool water from previous storms. The pool also acts as a barrier to resuspension of sediments and other pollutants deposited during prior storms. When sized properly, stormwater ponds have a residence time that ranges from many days to several weeks, which allows numerous pollutant removal mechanisms to operate. Stormwater ponds can also provide storage above the permanent pool to help meet stormwater management requirements for larger storms. Design variants include the following (see Figure 4. 47 and Figure 4.48):

C-1 Micropool extended detention pond

C-2 Wet pond

C-3 Wet extended detention pond



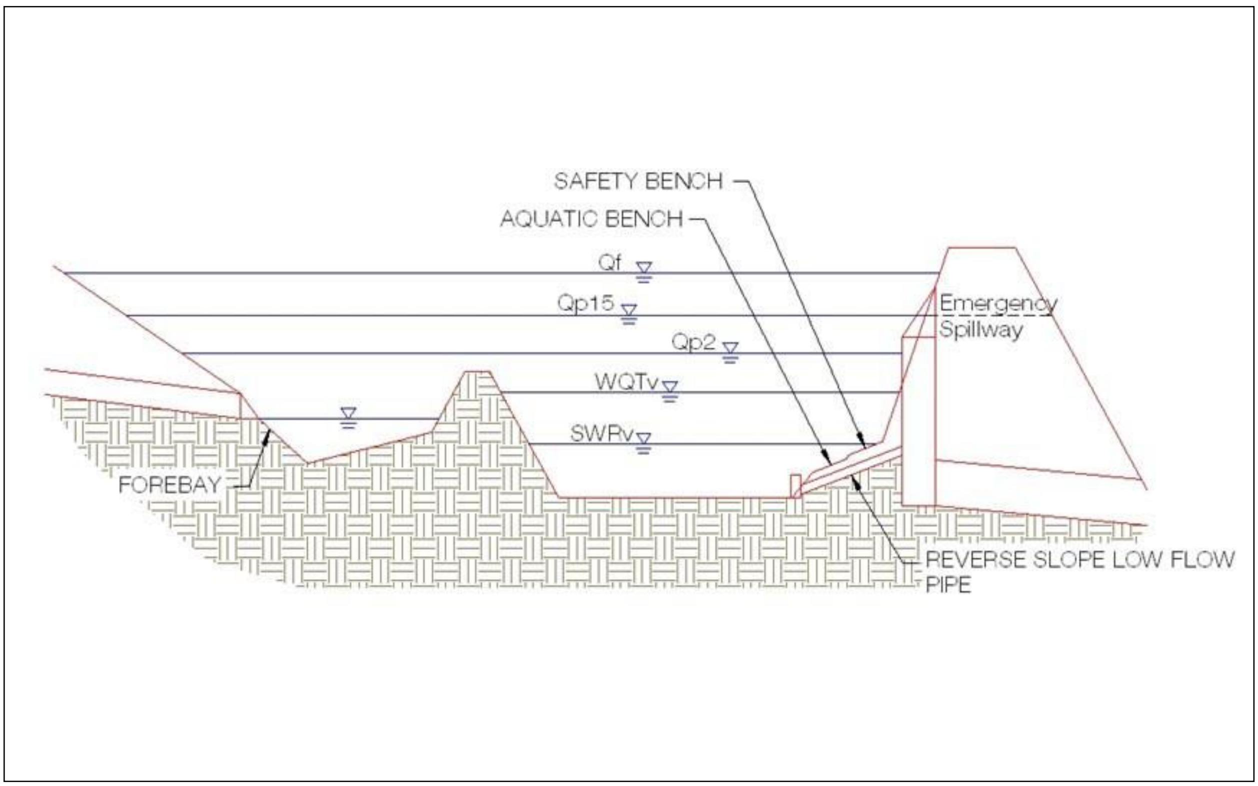
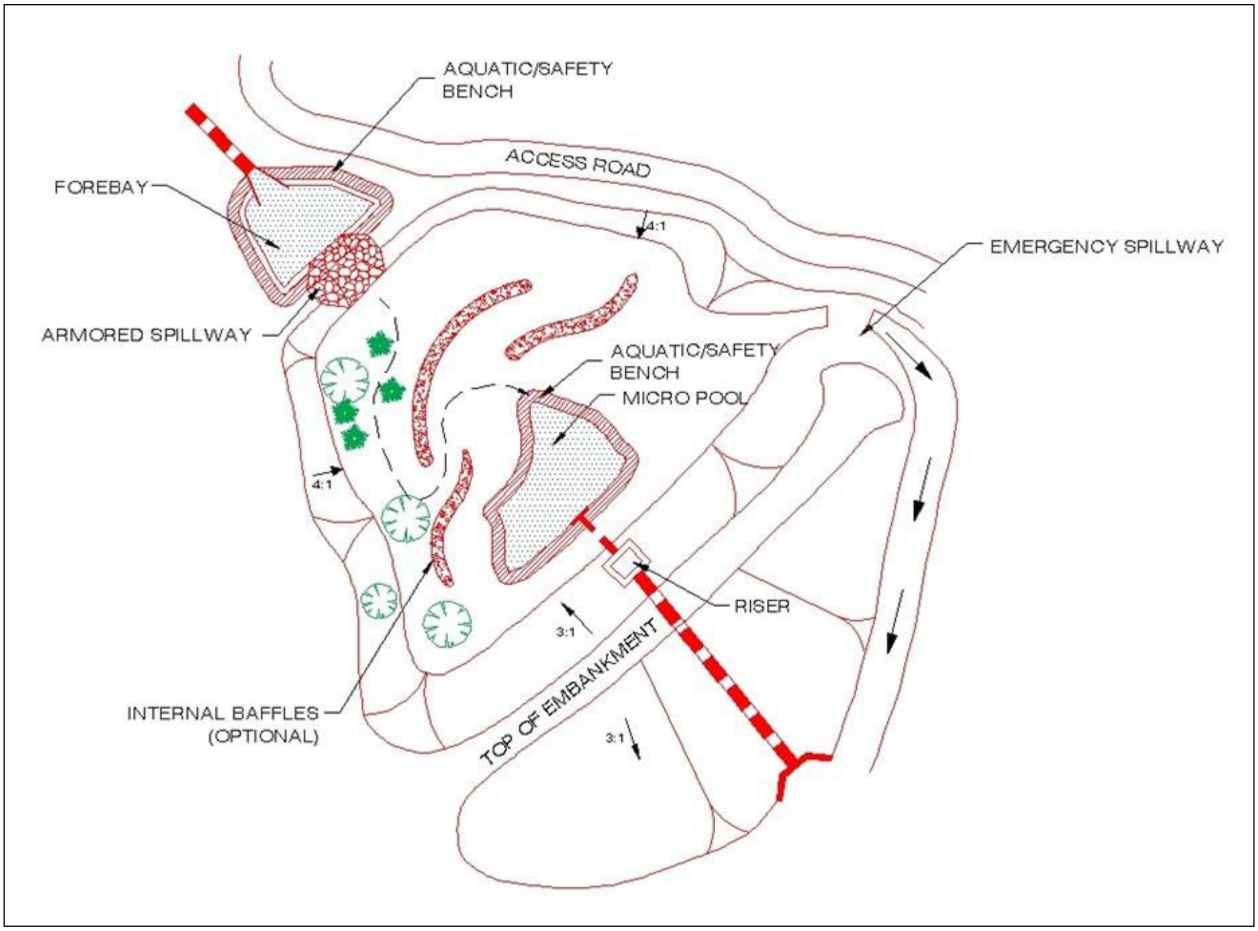


Figure 4. 50 Design schematics for a wet pond (C-2).



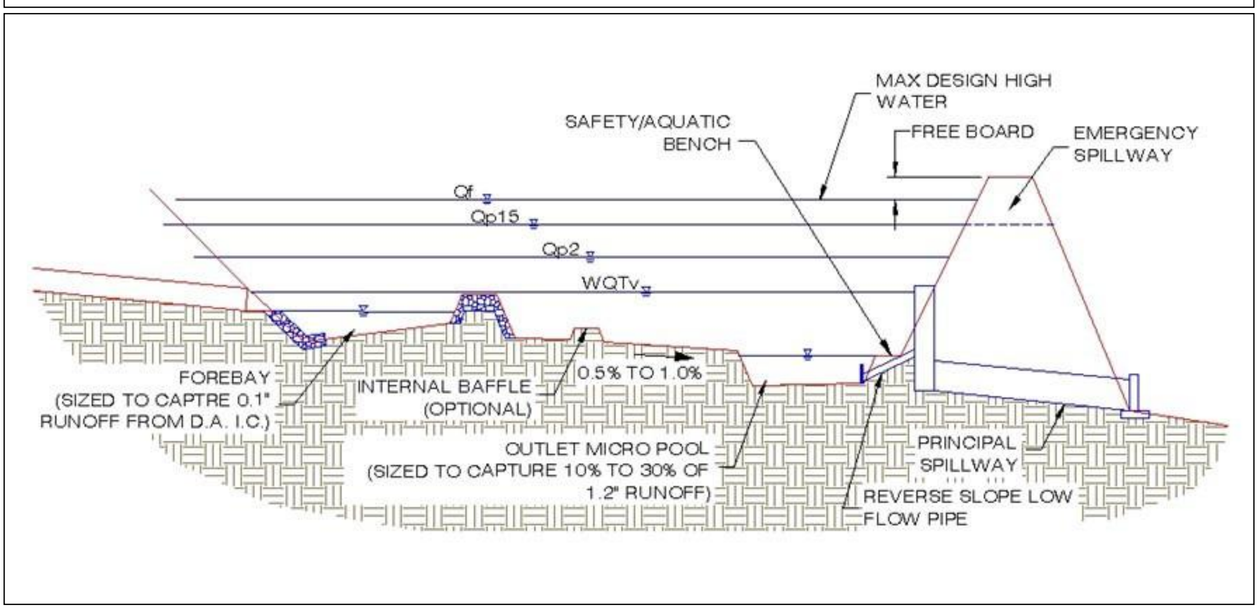


Figure 4. 51 Typical extended detention pond (C-3) details.

4.12.1 Pond Feasibility Criteria

The following feasibility issues need to be considered when ponds are considered a final stormwater management practice of the treatment train.

Adequate Water Balance. Wet ponds must have enough water supplied from groundwater, runoff, or baseflow so that the wet pools will not draw down by more than 2 feet after a 30-day summer drought. A simple water balance calculation must be performed using the Equation 4.27 in Section 4.10.4 Pond Design Criteria.

Contributing Drainage Area. A CDA of 10 to 25 acres is typically recommended for ponds to maintain constant water elevations. Ponds can still function with CDAs less than 10 acres, but designers should be aware that these “pocket” ponds will be prone to clogging, experience fluctuating water levels, and generate more nuisance conditions.

Space Requirements. The surface area of a pond will normally be at least 1%–3% of its CDA, depending on the pond’s depth.

Site Topography. Ponds are best applied when the grade of contributing slopes is less than 15%.

Available Hydraulic Head. The depth of a pond is usually determined by the hydraulic head available on the site. The bottom elevation is normally the invert of the existing downstream conveyance system to which the pond discharges. Typically, a minimum of 6 to 8 feet of head are needed to hold the wet pool and any additional large storm storage or overflow capacity for a pond to function.

Setbacks. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements.

Proximity to Utilities. For an open pond system, no utility lines shall be permitted to cross any part of the embankment of a wet pool.

Depth to Water Table. The depth to the groundwater table is not a major constraint for stormwater ponds because a high water table can help maintain wetland conditions. However, groundwater inputs can also reduce the pollutant removal rates of ponds. Further, if the water table is close to the surface, it may make excavation difficult and expensive.

Tailwater Conditions. The flow depth in the receiving channel should be considered when determining outlet elevations and discharge rates from wet pond. Design tailwater condition elevation shall be supported by a reasonable resource and/or analysis. For direct discharges to tidal waters, a king tide evaluation shall accompany the tailwater condition evaluation.

Soils. Highly permeable soils will make it difficult to maintain a healthy permanent pool. Soil infiltration tests need to be conducted at proposed pond sites to determine the need for a pond liner or other method to ensure a constant water surface elevation. Underlying soils of HSG C or D should be adequate to maintain a permanent pool. Most HSG A soils and some HSG B soils will require a liner (see Table 3.42). Geotechnical tests should be conducted to determine the saturated hydraulic conductivity and other subsurface properties of the soils beneath the proposed pond.

Use of or Discharges to Natural Wetlands. Ponds cannot be located within State waters, including wetlands, without obtaining a Section 404 permit or other permissions from the appropriate state or federal regulatory agency. In addition, the designer should investigate the wetland status of adjacent areas to determine if the discharge from the pond will change the hydroperiod of a downstream natural wetland (see Cappiella et al., 2006, for guidance on minimizing stormwater discharges to existing wetlands).

Perennial Streams. Locating ponds on perennial streams will require both US Army COE permits under Clean Water Act Section 401 and Section 404 or other permissions from the appropriate state or federal regulatory agency.

Economic Considerations. Wet detention ponds tend to have low construction costs and low space demands (in terms of the land area needed to treat a given volume of water) relative to other LID practices. In addition, the soil excavated to construct ponds can be used as fill, which is often needed for construction on low-lying coastal areas.

Community and Environmental Concerns. Ponds can generate the following community and environmental concerns that need to be addressed during design:

- Aesthetic Issues. Many residents feel that ponds are an attractive landscape feature, promote a greater sense of community and are an attractive habitat for fish and wildlife. Designers should note that these benefits are often diminished where ponds are under-sized or have small CDAs.
- Existing Forests. Construction of a pond may involve extensive clearing of existing forest cover. Designers can expect a great deal of neighborhood opposition if they do not make a concerted effort to save mature trees during pond design and construction. Consideration of Better Site Design Principles is implicit with permitting decisions related to clearing of existing forest cover.
- Safety Risk. Pond safety is an important community concern, since both young children and adults have perished by drowning in ponds through a variety of accidents, including falling through thin ice cover. Gentle side slopes and safety benches should be provided to avoid potentially dangerous drop-offs, especially where ponds are located near residential areas.
- Pollutant Concerns. Ponds collect and store water and sediment to increase residence time that will increase the likelihood for contaminated water and sediments to be neutralized. However, poorly sized, maintained, and/or functioning ponds can export contaminated sediments and/or water to receiving waterbodies (Mallin, 2000; Mallin et al., 2001; Messersmith, 2007). Further, designers are cautioned that recent research on ponds has shown that some ponds can be hotspots or incubators for algae that generate harmful algal blooms (HABs).
- Mosquito Risk. Mosquitoes are not a major problem for larger ponds (Santana et al., 1994; Ladd and Frankenburg, 2003; Hunt et al., 2005). However, fluctuating water levels in smaller or under-sized ponds could pose some risk for mosquito breeding. Mosquito problems can be minimized through simple design features and maintenance operations described in MSSC (2005).
- Geese and Waterfowl. Ponds with extensive turf and shallow shorelines can attract nuisance populations of resident geese and other waterfowl, whose droppings add to the nutrient and bacteria loads, thus reducing the removal efficiency for those pollutants. Several design and landscaping features can make ponds much less attractive to geese (see Schueler, 1992).

4.12.2 Pond Conveyance Criteria

Internal Slope. The longitudinal slope of the pond bottom should be at least 0.5% to facilitate maintenance.

Primary Spillway. The spillway shall be designed with acceptable anti-flotation, anti-vortex and trash rack devices. The spillway must generally be accessible from dry land. When reinforced concrete pipe is used for the principal spillway to increase its longevity, “O-ring” gaskets (ASTM C361) shall be used to create watertight joints.

Non-Clogging Low-Flow Orifice. A low-flow orifice must be provided that is adequately protected from clogging by either an acceptable external trash rack or by internal orifice protection that may allow for smaller diameters. Orifices less than 3 inches in diameter may require extra attention during design to minimize the potential for clogging.

- One option is a submerged reverse-slope pipe that extends downward from the riser to an inflow point 1 foot below the normal pool elevation.
- Alternative methods must employ a broad crested rectangular V-notch (or proportional) weir, protected by a half-round CMP that extends at least 12 inches below the normal pool elevation.

Emergency Spillway. Ponds must be constructed with overflow capacity to pass the 100-year design storm event through either the primary spillway or a vegetated or armored emergency spillway unless waived by Beaufort County Public Works Department.

Adequate Outfall Protection. The design must specify an outfall that will be stable for the 25-year design storm event. The channel immediately below the pond outfall must be modified to prevent erosion and conform to natural dimensions in the shortest possible distance. This is typically done by placing appropriately sized riprap over geotextile fabric, which can reduce flow velocities from the principal spillway to non-erosive levels (3.5 to 5.0 feet per second) depending on the channel lining material. Flared pipe sections, which discharge at or near the stream invert or into a step pool arrangement, should be used at the spillway outlet.

When the discharge is to a manmade pipe or channel system, the system must be adequate to convey the required design storm peak discharge.

If a pond daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of riprap should be avoided.

The final release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at a downstream structure, highway, or natural point of restricted streamflow.

Inlet Protection. Inflow points into the pond must be stabilized to ensure that non-erosive conditions exist during storm events up to the overbank flood event (i.e., the 25-year storm event). Inlet pipe inverts should generally be located at or slightly below the permanent pool elevation. A forebay shall be provided at each inflow location, unless the inlet is submerged or inflow provides less than 10% of the total design storm inflow to the pond.

Dam Safety Permits. The designer must verify whether or not Dam Safety permits or approvals are required for the embankment.

4.12.3 Pond Pretreatment Criteria

Sediment forebays are considered to be an integral design feature to maintain the longevity of all ponds. A forebay must be located at each major inlet to trap sediment and preserve the capacity of the main treatment cell. The following criteria apply to forebay design:

- A major inlet is defined as an individual storm drain inlet pipe or open channel serving at least 10% of the pond's CDA.
- The forebay consists of a separate cell, formed by an acceptable barrier (e.g., an earthen berm, concrete weir, gabion baskets, etc.).
- The forebay should be between 4 and 6 feet deep and must be equipped with a variable width aquatic bench for safety purposes. The aquatic bench should be 4 to 6 feet wide at a depth of 1 to 2 feet below the water surface. Small forebays may require alternate geometry to achieve the goals of pretreatment and safety within a small area.
- The forebay shall be sized to contain 0.1 inches of runoff from the contributing drainage impervious area. The relative size of individual forebays should be proportional to the percentage of the total inflow to the pond.
- The bottom of the forebay may be hardened (e.g., with concrete, asphalt, or grouted riprap) to make sediment removal easier.
- The forebay must be equipped with a metered rod in the center of the pool (as measured lengthwise along the low-flow water travel path) for long-term monitoring of sediment accumulation.
- Exit velocities from the forebay shall be non-erosive or an armored overflow shall be provided. Non-erosive velocities are 4 feet per second for the 2-year event, and 6 feet per second for the 25-year event.
- Direct maintenance access for appropriate equipment shall be provided to each forebay.
- Designers of ponds that are used for irrigation should be mindful of pretreatment provisions that help prevent irrigation system pluggages and operational issues.

4.12.4 Pond Design Criteria

Pond Storage Design. The pond permanent pool must be sized to store a volume equivalent to the SWRv. Volume storage may be provided in multiple cells. Performance is enhanced when multiple treatment pathways are provided by using multiple cells, longer flowpaths, high surface area to volume ratios, complex microtopography, and/or redundant treatment methods (combinations of pool, ED, and marsh). Volume storage below the permanent pool is not considered in the detention calculations.

Pond Geometry. Pond designs should have an irregular shape and a long flow path from inlet to outlet to increase water residence time and pond performance. The minimum length to width ratio (i.e., length relative to width) for ponds is 1.5:1. Greater flowpaths and irregular shapes are recommended. Internal berms, baffles, or vegetated peninsulas can be used to extend flow paths and/or create multiple pond cells.

Permanent Pool Depth. The maximum depth of the permanent pool should not generally exceed 8 feet unless the pond is designed for multiple uses.

Micropool. A micropool is a 3- to 6-foot-deep pool used to protect the low-flow pipe from clogging and to prevent sediment resuspension. For micropool extended detention ponds, the micropool shall be designed to hold at least 10%–25% of the 85th or 95th percentile storm event.

Side Slopes. Side slopes for ponds should generally have a gradient no steeper than 3H:1V. Mild slopes promote better establishment and growth of vegetation and provide for easier maintenance and a more natural appearance.

Maximum Extended Detention Levels. The total storage, including any ponding for larger flooding events (100-year storm) should not extend more than 5 feet above the pond permanent pool unless specific design enhancements to ensure side slope stability, safety, and maintenance are identified and approved.

Top of Bank. Storm ponds shall be provided with a 20-ft maintenance access at the top of bank with a maximum cross slope of 48:1.

Stormwater Pond Benches. The perimeter of all pool areas greater than 4 feet in depth must be surrounded by two benches, as follows:

- **Safety Bench.** This is a flat bench located just outside of the perimeter of the permanent pool to allow for maintenance access and reduce safety risks. Except when the stormwater pond side slopes are 5H:1V or flatter, provide a safety bench that generally extends 8 to 15 feet outward from the normal water edge to the toe of the stormwater pond side slope. The maximum slope of the safety bench is 5%.
- **Aquatic Bench.** This is a shallow area just inside the perimeter of the normal pool that promotes growth of aquatic and wetland plants. The bench also serves as a safety feature, reduces shoreline erosion, and conceals floatable trash. Incorporate an aquatic bench that generally extends up to 10 feet inward from the normal shoreline, has an irregular configuration, and extends a maximum depth of 18 inches below the normal pool water surface elevation.

Liners. When a stormwater pond is located over highly permeable soils, a liner may be needed to sustain a permanent pool of water. If geotechnical tests confirm the need for a liner, acceptable options include the following:

1. a clay liner following the specifications outlined in Table 4.49;
2. a 30-mil- poly-liner;
3. bentonite;
4. use of chemical additives; or
5. an engineering design, as approved on a case-by-case basis by Beaufort County Public Works Department.

A clay liner must have a minimum thickness of 12 inches with an additional 12-inch layer of compacted soil above it, and it must meet the specifications outlined in Table 4.49. Other synthetic liners can be used if the designer can supply supporting documentation that the material will achieve the required performance.

Table 4.49. Clay Liner Specifications

Property	Test Method	Unit	Specification
Permeability	ASTM D2434	cm/s	1×10^{-6}
Plasticity Index of Clay	ASTM D4318	%	Not less than 15
Liquid Limit of Clay	ASTM D2216	%	Not less than 30
Clay Particles Passing	ASTM D422	%	Not less than 30
Clay Compaction	ASTM D2216	%	95% of standard proctor density

Source: DCR (1999). VA

Required Geotechnical Testing. Soil borings must be taken below the proposed embankment, in the vicinity of the proposed outlet area, and in at least two locations within the proposed pond treatment area. Soil boring data is needed to (1) determine the physical characteristics of the excavated material, (2) determine its adequacy for use as structural fill or spoil, (3) provide data for structural designs of the outlet works (e.g., bearing capacity and buoyancy), (4) determine compaction/composition needs for the embankment, (5) determine the depth to groundwater and (6) evaluate potential infiltration losses (and the potential need for a liner).

Non-clogging Low-Flow (Extended Detention) Orifice. The low-flow ED orifice shall be adequately protected from clogging by an acceptable external trash rack. The preferred method is a submerged reverse-slope pipe that extends downward from the riser to an inflow point 1 foot below the normal pool elevation. Alternative methods are to employ a broad crested rectangular, V-notch, or proportional weir, protected by a half-round CMP that extends at least 12 inches below the normal pool.

Riser in Embankment. The riser should be located within the embankment for maintenance access, safety, and aesthetics. Access to the riser is to be provided by lockable manhole covers and manhole steps within easy reach of valves and other controls. The principal spillway opening can be "fenced" with pipe or rebar at 8-inch intervals for safety purposes.

Trash Racks. Trash racks shall be provided for low-flow pipes and for riser openings not having anti-vortex devices.

Pond Drain. Ponds should have a drainpipe that can completely or partially drain the permanent pool. In cases where a low-level drain is not feasible (such as in an excavated pond), a pump well must be provided to accommodate a temporary pump intake when needed to drain the pond.

- The drain pipe must have an upturned elbow or protected intake within the pond to help keep it clear of sediment deposition, and a diameter capable of draining the pond within 24 hours.
- The pond drain must be equipped with an adjustable valve located within the riser, where it will not be normally inundated and can be operated in a safe manner.

Care must be exercised during pond drawdowns to prevent downstream discharge of sediments or anoxic water and rapid drawdown. The approving authority shall be notified before draining a pond.

Safety Features.

- The principal spillway opening must be designed and constructed to prevent access by small children.
- End walls above pipe outfalls greater than 48 inches in diameter must be fenced to prevent a falling hazard.
- Storage practices must incorporate an additional 1 foot of freeboard above the emergency spillway, or 2 feet of freeboard if design has no emergency spillway, for the 100-year storm.
- The emergency spillway must be located so that downstream structures will not be impacted by spillway discharges.
- Both the safety bench and the aquatic bench should be landscaped with vegetation that hinders or prevents access to the pool.
- Warning signs prohibiting swimming must be posted.
- Where permitted, fencing of the perimeter of ponds is discouraged. The preferred method to reduce risk is to manage the contours of the stormwater pond to eliminate drop-offs or other safety hazards. Fencing is required at or above the maximum water surface elevation in the rare situations when the pond slope is a vertical wall.
- Side slopes to the pond shall not be steeper than 3H:1V, and shall terminate on a 15-foot-wide safety bench. Both the safety bench and the aquatic bench may be landscaped to prevent access to the pool. The bench requirement may be waived if slopes are 4H:1V or flatter.

Maintenance Reduction Features. Many maintenance issues can be addressed through well designed access. All ponds must be designed for annual maintenance. Good access is needed so crews can remove sediments, make repairs, and preserve pond-treatment capacity. Design for the following:

- Adequate maintenance access must extend to the forebay, safety bench, riser, and outlet structure and must have sufficient area to allow vehicles to turn around.
- The riser should be located within the embankment for maintenance access, safety, and aesthetics. Access to the riser should be provided by lockable manhole covers and manhole steps within easy reach of valves and other controls.
- Access roads must (1) be constructed of load-bearing materials or be built to withstand the expected frequency of use, (2) have a minimum width of 20 feet, and (3) have a profile grade that does not exceed 5H:1V.
- A maintenance right-of-way or easement must extend to the stormwater pond from a public or private road.
- No permanent structures (mechanical, electrical, phone, fences) or landscaping are allowed within the 20’ pond maintenance access easement.

- **Material Specifications.** ED ponds are generally constructed with materials obtained on site, except for the plant materials, inflow and outflow devices (e.g., piping and riser materials), possibly stone for inlet and outlet stabilization, and geotextile fabric for lining banks or berms.

- **Pond Sizing.** Stormwater ponds can be designed to capture and treat the remaining stormwater discharged from upstream practices from the design storm (SWRv). Additionally, stormwater ponds may be sized to control peak flow rates from the 2- to 25-year frequency storm event or other design storms as required. Design calculations must ensure that the post-development peak discharge does not exceed the predevelopment peak discharge. See Section 3.7.2 Hydrologic and Hydraulic Analysis and Appendix I for a summary of acceptable hydrologic methodologies and models.

  For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRSC CN that reflects the volume reduction of upland practices to compute the 2- 50-year frequency storm event that must be treated by the stormwater pond.

  The pond permanent pool must be sized to store a volume equivalent to the SWRv or design volume.

  The storage volume (Sv) of the practice is equal to the volume provided by the pond permanent pool (Equation 4. 26). The total Sv cannot exceed the design SWRv.

Equation 4. 26 Pond Storage Volume

$$SSRR = PPDDDDdd\ ppDDDDDDppDDDDDDDD\ ppDDDDpp\ RRDDppvvDDDD$$

- **Water Balance Testing.** A water balance calculation is recommended to document that sufficient inflows to wet ponds and wet ED ponds exist to compensate for combined infiltration and evapotranspiration losses during a 30-day summer drought without creating unacceptable drawdowns (see Equation 4.27, adapted from Hunt et al., 2007). The recommended minimum pool depth to avoid nuisance conditions may vary; however, it is generally recommended that the water balance maintain a minimum 24-inch reservoir.

Equation 4. 27 Water Balance Equation for Acceptable Water Depth in a Wet Pond

$$DDPP > EEEE + IIIIII + RREESS - MMMM$$

Where:

DP	=	average design depth of the permanent pool (in.)
ET	=	summer evapotranspiration rate (in.) (assume 8 in.)
INF	=	monthly infiltration loss (assume 7.2 inches at 0.01 in./hour)
RES	=	reservoir of water for a factor of safety (assume 24 in.)
MB	=	measured baseflow rate to the pond, if any convert to pond-inches (in.)

Design factors that will alter this equation are the measurements of seasonal base flow and infiltration rate. The use of a liner could eliminate or greatly reduce the influence of infiltration. Similarly, land use changes in the upstream watershed could alter the base flow conditions over time (e.g., urbanization and increased impervious cover).

Translating the baseflow to inches refers to the depth within the pond. Therefore, Equation 4. 28 can be used to convert the baseflow, measured in cubic feet per second (cfs), to pond-inches:

Equation 4. 28 Baseflow Conversion

$$Pond - inches = \frac{MB \times 2.592 \times 10^{6} \times 12}{SA}$$

where:

Pond – inches	=	depth within the pond (in,)
MB	=	measured baseflow rate to the pond (cfs)
2.592 × 106	=	conversion factor, converting cfs to ft^3/month
12	=	conversion factor, converting feet to inches
SA	=	surface area of pond (ft^2)

4.12.5 Pond Landscaping Criteria

Pond Benches. The perimeter of all deep pool areas (4 feet or greater in depth) must be surrounded by two benches:

- A safety bench that extends 8 to 15 feet outward from the normal water edge to the toe of the pond side slope. The maximum slope of the safety bench shall be 6%.
- An aquatic bench that extends up to 10 feet inward from the normal shoreline and has a maximum depth of 18 inches below the normal pool water surface elevation.

Landscaping and Planting Plan. A landscaping plan must be provided that indicates the methods used to establish and maintain vegetative coverage in the pond and its buffer (see Section 4.3.5 Bioretention Landscaping Criteria for extended landscaping and planting details). Minimum elements of a landscaping plan include the following:

- Delineation of pondscaping zones within both the pond and buffer.
- Selection of corresponding plant species.
- The planting plan.
- The sequence for preparing the wetland benches (including soil amendments, if needed).
- Sources of native plant material.
- The landscaping plan should provide elements that promote diverse wildlife and waterfowl use within the stormwater wetland and buffers.
- Woody vegetation may not be planted or allowed to grow within 15 feet of the toe of the embankment nor within 25 feet from the principal spillway structure.
- A vegetated buffer should be provided that extends at least 25 feet outward from the maximum water surface elevation of the pond. Permanent structures (e.g., buildings) should not be constructed within the buffer area. Existing trees should be preserved in the buffer area during construction.

- The soils in the stormwater buffer area are often severely compacted during the construction process, to ensure stability. The density of these compacted soils can be so great that it effectively prevents root penetration and, therefore, may lead to premature mortality or loss of vigor. As a rule of thumb, planting holes should be three times deeper and wider than the diameter of the root ball for bare root and ball-and-burlap stock, and five times deeper and wider for container-grown stock.
- Avoid species that require full shade or are prone to wind damage. Extra mulching around the base of trees and shrubs is strongly recommended as a means of conserving moisture and suppressing weeds.

For more guidance on planting trees and shrubs in pond buffers, consult Cappiella et al. (2006).

4.12.6 Pond Construction Sequence

The following is a typical construction sequence to properly install a stormwater pond. The steps may be modified to reflect different pond designs; site conditions; and the size, complexity and configuration of the proposed facility.

1. Use of Ponds for Soil Erosion and Sediment Control. A pond may serve as a sediment basin during project construction. If this is done, the volume should be based on the more stringent sizing rule (soil erosion and sediment control requirement versus storage volume requirement). Installation of the permanent riser should be initiated during the construction phase, and design elevations should be set with final cleanout of the sediment basin and conversion to the post-construction pond in mind. The bottom elevation of the pond should be lower than the bottom elevation of the temporary sediment basin. Appropriate procedures must be implemented to prevent discharge of turbid waters when the basin is being converted into a pond.

Approval from Beaufort County Public Works Department must be obtained before any sediment pond can be used for stormwater management.

2. Stabilize the Contributing Drainage Area. Ponds should only be constructed after the CDA to the pond is completely stabilized. If the proposed pond site will be used as a sediment trap or basin during the construction phase, the construction notes should clearly indicate that the facility will be de-watered, dredged, and regraded to design dimensions after the original site construction is complete.

3. Assemble Construction Materials on Site. Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

4. Clear and Strip. Bring the project area to the desired subgrade.

5. Soil Erosion and Sediment Controls. Install soil erosion and sediment control measures prior to construction, including temporary de-watering devices and stormwater diversion practices. All areas surrounding the pond that are graded or denuded during construction must be planted with turf grass, native plantings, or other approved methods of soil stabilization.

6. Excavate the Core Trench and Install the Spillway Pipe.

7. Install the Riser or Outflow Structure. Once riser and outflow structures are installed ensure the top invert of the overflow weir is constructed level at the design elevation.

8. Construct the Embankment and any Internal Berms. These features must be installed in 8- to 12-inch lifts; compact the lifts with appropriate equipment.

9. Excavate and Grade. Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the pond.

10. Construct the Emergency Spillway. The emergency spillway must be constructed in cut or structurally stabilized soils.

11. Install Outlet Pipes. The installation of outlet pipes must include a downstream riprap protection apron.

12. Stabilize Exposed Soils. Use temporary seed mixtures appropriate for the pond buffer to stabilize the exposed soils. All areas above the normal pool elevation must be permanently stabilized by hydroseeding or seeding over straw.

13. Plant the Pond Buffer Area. Establish the planting areas according to the pondscaping plan (see Section 4.12.5 Pond Landscaping Criteria).

Construction Supervision. Supervision during construction is recommended to ensure that stormwater ponds are properly constructed, especially during the following stages of construction:

- Preconstruction meeting
- Initial site preparation including the installation of soil erosion and sediment control measures
- Excavation/Grading (interim and final elevations)
- Installation of the embankment, the riser/primary spillway, and the outlet structure
- Implementation of the pondscaping plan and vegetative stabilization
- Immediately seed or install vegetated ground cover upon completion of sloping and grading of each stormwater pond within a project.
- Inspect within two weeks to insure vegetation is in fact holding banks and slopes in place.
- Prior to completion of project, mechanically remove erosion deposition from ponds that occurred during the project. Criteria should be based on erosion of designed bank slopes and loss of storage capacity.
- Final inspection (develop a punch list for facility acceptance)

Construction phase inspection checklist for ponds can be found in Appendix E Construction Inspection Checklists.

To facilitate maintenance, contractors should measure the actual constructed pond depth at three areas within the permanent pool (forebay, mid-pond and at the riser), and they should mark and geo-reference them on an as-built drawing. This simple data set will enable maintenance inspectors to determine pond sediment deposition rates in order to schedule sediment cleanouts.

4.12.7 Pond Maintenance Criteria

Maintenance is needed so stormwater ponds continue to operate as designed on a long-term basis. Ponds normally have fewer routine maintenance requirements than other stormwater control measures. Stormwater pond maintenance activities vary regarding the level of effort and expertise required to perform them. Routine stormwater pond maintenance, such as mowing and removing debris and trash, is needed several times each year (see Table 4.50). More significant maintenance (e.g., removing accumulated sediment) is needed less frequently but requires more skilled labor and special equipment. Inspection and repair of critical structural features (e.g., embankments and risers) needs to be performed by a qualified professional (e.g., a structural engineer) who has experience in the construction, inspection, and repair of these features.

Table 4.50. Pond Maintenance Tasks and Frequency.

Frequency	Maintenance Items
During establishment, as needed (first year)	▪ Inspect the site at least twice after storm events that exceed a 1/2 inch of rainfall. ▪ Plant the aquatic benches with emergent wetland species, following the planting recommendations contained in Section 4.11.6 Stormwater Wetland Landscaping Criteria. ▪ Stabilize any bare or eroding areas in the CDA or around the pond buffer. ▪ Water trees and shrubs planted in the pond buffer during the first growing season. In general, consider watering every 3 days for first month, and then weekly during the remainder of the first growing season (April through October), depending on rainfall.
Quarterly or after major storms (>1 inch of rainfall)	▪ Mowing (twice a year) ▪ Remove debris and blockages ▪ Repair undercut, eroded, and bare soil areas
Twice a year	▪ Mowing of the buffer and pond embankment
Annually	▪ Shoreline cleanup to remove trash, debris, and floatables ▪ A full maintenance inspection ▪ Open up the riser to access and test the valves ▪ Repair broken mechanical components, if needed
Once—during the second year following construction	▪ Pond buffer and aquatic bench reinforcement plantings
Every 5 to 7 years	▪ Forebay sediment removal
From 5 to 25 years	▪ Repair pipes, the riser, and spillway, as needed

Sediment removal in the pond pretreatment forebay should occur every 5 to 7 years or after 50% of total forebay capacity has been lost. The designer should also check to see whether removed sediments can be spoiled on site or must be hauled away. Sediments excavated from ponds are not usually considered toxic or hazardous. They can be safely disposed of by either land application or land filling. Sediment testing may be needed prior to sediment disposal if the pond serves a pollutant hotspot land use, as the sediment could be potentially toxic or hazardous (Weinstein et al., 2008). In lieu of local regulations for sediment testing, the parameters in Table 4.51 may be used.

Table 4.51. Ceiling Levels Governing Management of Accumulated Sediment[1]

Parameter	Ceiling Level (ppm or mg/kg)
Total Arsenic	8
Total Cadmium	10
Total Chromium	100

Total Lead	250
pH	Less than 5 or greater than 10 standard units
Electrical Conductivity	8 deciSiemens/meter (dS/m) at 25°C
[1] *Excerpt from Wisconsin Administrative Code NR 528.03, Table 2*	

Maintenance Plans. Maintenance plans must clearly outline how vegetation in the pond and its buffer will be managed or harvested in the future. Periodic mowing of the stormwater buffer is only required along maintenance rights-of-way and the embankment. The remaining buffer can be managed as a meadow (mowing every other year) or forest. The maintenance plan should schedule a shoreline cleanup at least once a year to remove trash and floatables. For information on chemical control methods for aquatic plants, consult Clemson's fact sheet entitled "Aquatic Weed Control Overview" available online at http://www.clemson.edu/extension/hgic/plants/other/landscaping/hgic1714.html.

Maintenance Inspections. Maintenance of a pond is driven by annual inspections by a qualified professional who evaluates the condition and performance of the pond. Based on inspection results, specific maintenance tasks will be triggered.

Maintenance inspection checklist for stormwater ponds and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law. However, sediment testing may be needed prior to sediment disposal because sediments excavated from ponds could be contaminated.

4.12.8 Pond Stormwater Compliance Calculations

Stormwater ponds are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 60% bacteria removal for the storage volume (Sv) provided by in the permanent pool (Table 4.52).

Table 4.52. Pond Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 30%
Bacteria Removal	= 60%

4.13 Stormwater Wetlands

<table>
<tr><th colspan="5">Stormwater Wetlands</th></tr>
<tr><td colspan="5">Definition: Practices that create shallow marsh areas to treat urban stormwater, which often incorporate small permanent pools and/or extended detention storage. Stormwater wetlands are explicitly designed to provide stormwater detention for larger storms (2- to 25-year, or flood control events) above the design storm (SWRv) storage.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Medium</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>80%</td><td>25%</td><td>60%</td></tr>
<tr><th colspan="3">Runoff Reduction</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="3">Low</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">0%</td></tr>
<tr><td>At least annually</td><td>Every 2 years</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ High removal of typical stormwater pollutants
▪ Provides habitat for wildlife
▪ Attractive when integrated into site development
▪ Good for sites with high water table and/or poorly drained soils</td><td colspan="3">▪ Requires large amount of flat land (3% of CDA)
▪ Must be properly designed, installed, and maintained to avoid nuisance problems
▪ Needs constant source of water
▪ Routine sediment cleanout may be needed
▪ Potential for thermal impacts downstream</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Conveyance
▪ Forebay
▪ Deep ponding area
▪ High marsh and transition zones
▪ Micropool
▪ Spillway system(s)</td><td colspan="3">▪ CDA must be large enough to sustain permanent water level
▪ Flow path through the wetland system should be at least 2L:1W
▪ 25% of pool depth should be 18-48 inches
▪ Water balance must be maintained</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Reinforce plantings as needed
▪ Remove accumulated sediments
▪ Remove invasive vegetation</td><td colspan="3">▪ Thin/harvest vegetation every 2 years on embankments and access areas; elsewhere every 5–10 years</td></tr>
</table>

[1]*Credited pollutant load removal*

Stormwater wetlands, sometimes called constructed wetlands, are shallow depressions that receive stormwater inputs for water quality treatment. Runoff from each new storm displaces runoff from previous storms, and the long residence time allows multiple pollutant removal processes to operate. The wetland environment provides an ideal environment for gravitational settling, biological uptake, and microbial activity. Wetlands include various design adaptations to allow them to be applied in specific settings. For example, some designs incorporate trees within the wetland area.

Stormwater wetlands should be considered for use after all other upland retention opportunities have been exhausted and there is still a remaining treatment volume or runoff from larger storms (i.e., 2- to 25-year or flood control events) to manage. Stormwater wetlands receive no stormwater retention credit and should be considered mainly for management of larger storm events. Stormwater wetlands have both community and environmental concerns (see Section 4.13.1 Stormwater Wetland Feasibility Criteria) that should be considered before choosing stormwater ponds for the appropriate stormwater practice on site.

Figure 4.52 Stormwater Wetland at Carolina Forest Recreation Center, Myrtle Beach (photo: Kathryn Ellis).

Definition. Practices that create shallow marsh areas to treat urban stormwater, which often incorporate small permanent pools and/or extended detention storage. Stormwater wetlands are explicitly designed to provide stormwater detention for larger storms (2 – 25-year, or flood control events) above the design storm (SWRv) storage. Wetlands are typically less than 1 foot deep (although they have greater depths at the forebay and in micropools) and possess variable microtopography to promote dense and diverse wetland cover. Design variants include the following:

W-1 Shallow wetland

W-2 Extended detention shallow wetland

Several stormwater wetland design features are illustrated in Figure 4. 48 through Figure 4. 52.

Note: All of the pond performance criteria presented in Section 4.1~~0~~ Ponds also apply to the design of stormwater wetlands. Additional criteria that govern the geometry and establishment of created wetlands are presented in this section.

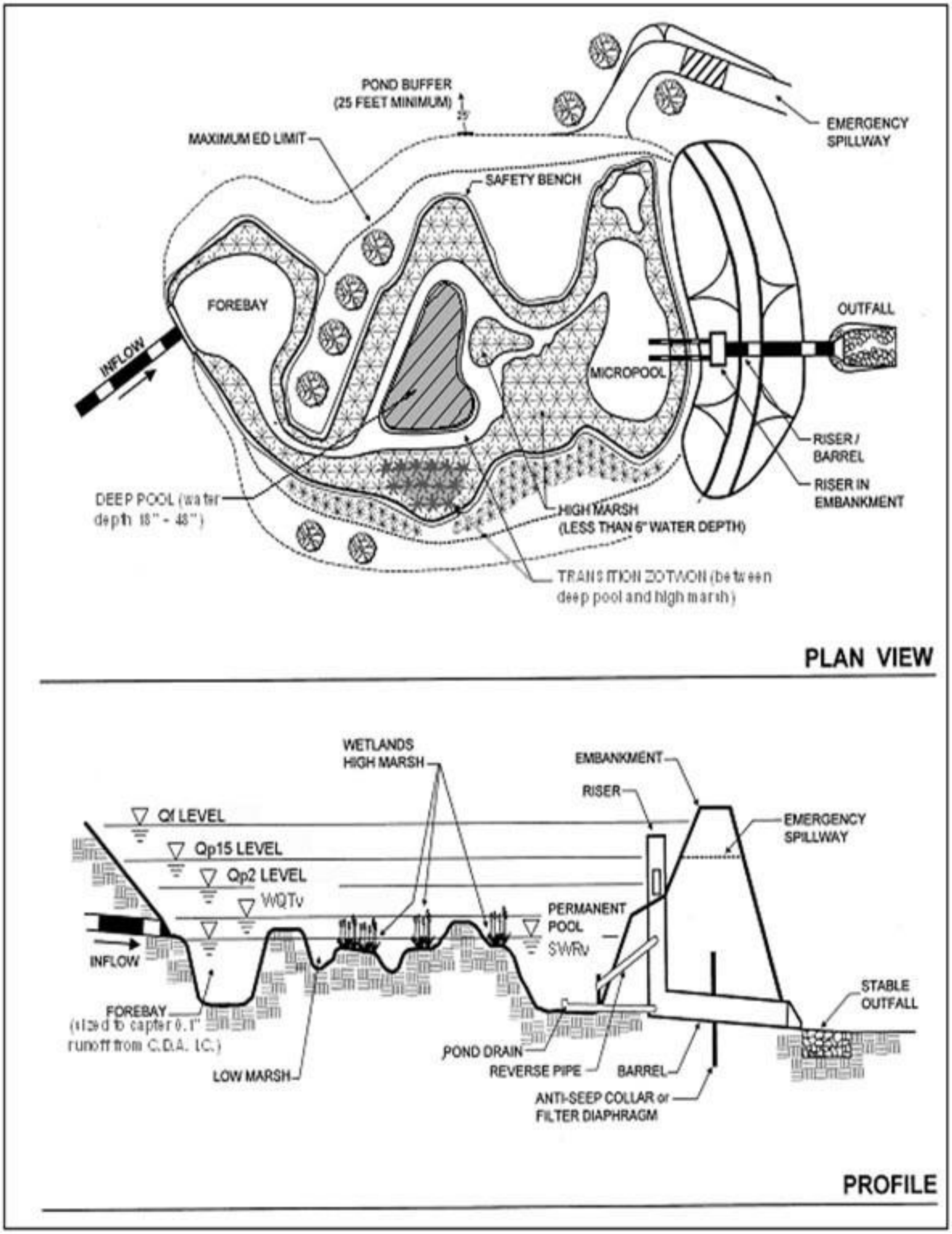


Figure 4. 53 Example of extended detention shallow wetland.

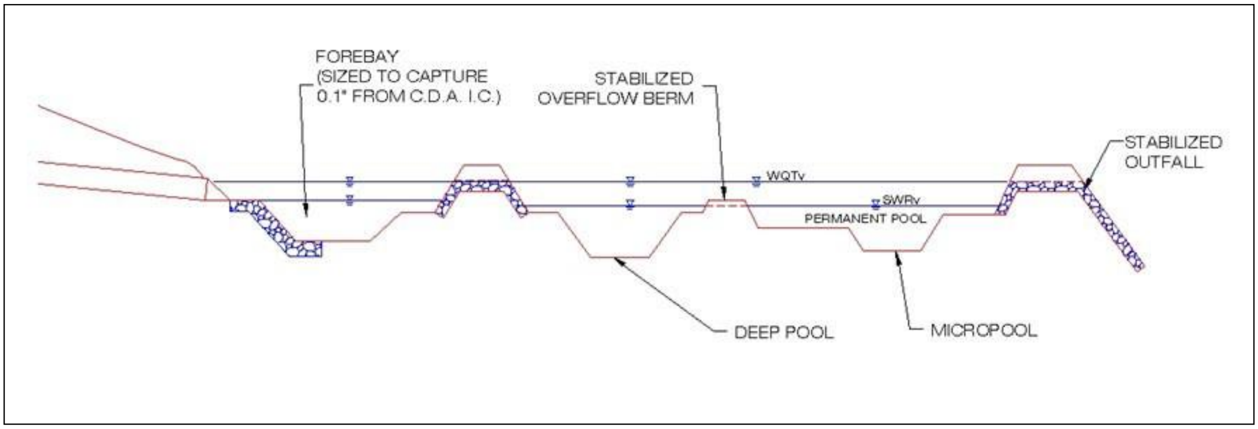


Figure 4. 54 Cross section of a typical stormwater wetland.

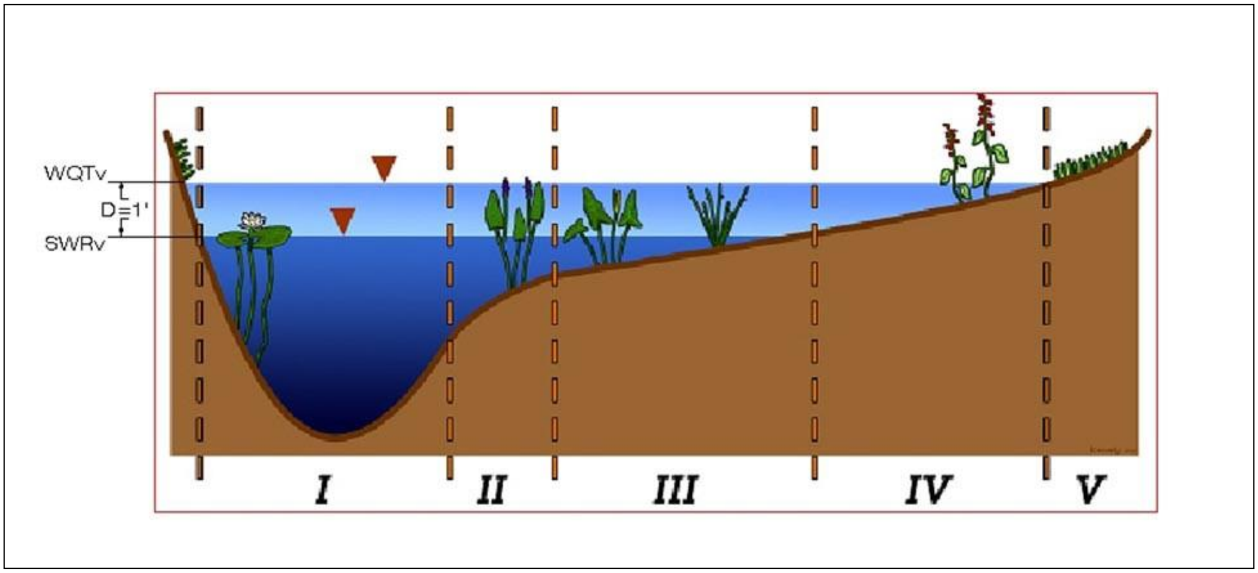


Figure 4. 55 Interior wetland zones
(I) Deep Pool (depth -48 to -18 inches),
(II) Transition Zone (depth -18 to -6 inches),
(III and IV) High Marsh Zone (depth -6 to +6 inches),
(IV) Temporary Inundation Area, and
(V) Upper Bank
Adapted from Hunt et al., 2007

4.13.1 Stormwater Wetland Feasibility Criteria

Constructed wetland designs are subject to the following site constraints:

Adequate Water Balance. Stormwater wetlands must have enough water supplied from groundwater, runoff, or baseflow so that the permanent pools will not draw down by more than 2 feet after a 30-day summer drought. A simple water balance calculation must be performed using the equation provided in Section 4.11.4 Stormwater Wetland Design Criteria.

Contributing Drainage Area. The CDA must be large enough to sustain a permanent water level within the stormwater wetland. If the only source of wetland hydrology is stormwater runoff, then several dozen acres of CDA are typically needed to maintain constant water elevations. Smaller CDAs are acceptable if the bottom of the stormwater wetland intercepts the groundwater table or if the designer or approving agency is willing to accept periodic wetland drawdown.

Space Requirements. Constructed wetlands normally require a footprint that takes up about 3% of the CDA, depending on the average depth of the wetland and the extent of its deep pool features.

Site Topography. Stormwater wetlands are best applied when the grade of contributing slopes is less than 8%.

Steep Slopes. A modification of the constructed wetland (and linear wetland or wet swale system) is the regenerative stormwater conveyance (RSC) or step pool storm conveyance channel. The RSC can be used to bring stormwater down steeper grades through a series of step pools. This can serve to bring stormwater down outfalls where steep drops on the edge of the tidal receiving system can create design challenges. A description of this practice is provided in Section 4.9 Open Channel Systems.

Available Hydraulic Head. The depth of a constructed wetland is usually constrained by the hydraulic head available on the site. The bottom elevation is fixed by the elevation of the existing downstream conveyance system to which the wetland will ultimately discharge. Because constructed wetlands are typically shallow, the amount of head needed (usually a minimum of 2 to 4 feet) is typically less than for wet ponds.

Setbacks. Setbacks to structures and property lines must be at least 10 feet and adequate waterproofing protection must be provided for foundations and basements.

Depth to Water Table. The depth to the groundwater table is not a major constraint for constructed wetlands, since a high water table can help maintain wetland conditions. However, designers should keep in mind that high groundwater inputs may increase excavation costs (refer to Section 4.12 Ponds).

Soils. Soil tests should be conducted to determine the saturated hydraulic conductivity and other subsurface properties of the soils underlying the proposed stormwater wetland. Highly permeable soils will make it difficult to maintain a healthy permanent pool. Underlying soils of HSG C or D should be adequate to maintain a permanent pool. Most HSG A soils and some HSG B soils will require a liner (see Table 4.49 in Section 4.12 Ponds).

Use of or Discharges to Natural Wetlands. Constructed wetlands may not be located within jurisdictional waters, including wetlands, without obtaining a Section 404 permit from the appropriate federal regulatory agency. In addition, designer should investigate the status of adjacent wetlands to determine if the discharge from the constructed wetland will change the hydroperiod of a downstream natural wetland. See Cappiella et al. (2006) for guidance on minimizing stormwater discharges to existing wetlands.

Regulatory Status. Constructed wetlands built for the express purpose of stormwater treatment are generally not considered jurisdictional wetlands, but designers should check with their wetland regulatory authorities to ensure the status.

Perennial Streams. Locating a constructed wetland along or within a perennial stream will require both Section 401 and Section 404 permits from the state or federal regulatory authority.

Economic Considerations. If space is available, wetlands can be a very cost-effective stormwater practice.

Community and Environmental Concerns. In addition to the community and environmental concerns that exist for stormwater ponds, the following must be addressed during design of stormwater wetlands:

- **Aesthetics and Habitat.** Constructed wetlands can create wildlife habitat and can also become an attractive community feature. Designers should think carefully about how the wetland plant community will evolve over time, since the future plant community seldom resembles the one initially planted.
- **Existing Forests.** Given the large footprint of a constructed wetland, there is a strong chance that the construction process may result in extensive tree clearing. The designer should preserve mature trees during the facility layout and may consider creating a wooded wetland (see Cappiella et al., 2006).
- **Safety Risk.** Constructed wetlands are safer than other types of ponds, although forebays and micropools must be designed with aquatic benches to reduce safety risks.
- **Mosquito Risk.** Mosquito control can be a concern for stormwater wetlands if they are under-sized or have a small CDA. Deepwater zones serve to keep mosquito populations in check by providing habitat for fish and other pond life that prey on mosquito larvae. Few mosquito problems are reported for well-designed, properly sized, and frequently maintained constructed wetlands; however, no design can eliminate them completely. Simple precautions can be taken to minimize mosquito breeding habitat within constructed wetlands (e.g., constant inflows, benches that create habitat for natural predators, and constant pool elevations—MSSC, 2005).

4.13.2 Stormwater Wetland Conveyance Criteria

- The slope profile within individual stormwater wetland cells should generally be flat from inlet to outlet (adjusting for microtopography). The recommended maximum elevation drop between wetland cells is 1 foot or less.
- Since most constructed wetlands are on-line facilities, they need to be designed to safely pass the maximum design storm (e.g., the 25-year and 100-year design storms). While the ponding depths for the more frequent 2-year storm are limited in order to avoid adverse impacts to the planting pallet, the overflow for the less frequent 25-100-year storms must likewise be carefully designed to minimize the depth of ponding. A maximum depth of 4 feet over the wetland pool is recommended.
- While many options are available for setting the normal pool elevation, it is strongly recommended that removable flashboard risers be used, given their greater operational flexibility to adjust water levels following construction (see Hunt et al., 2007). Also, a weir can be designed to accommodate passage of the larger storm flows at relatively low ponding depths.

4.13.3 Stormwater Wetland Pretreatment Criteria

Sediment regulation is critical to sustain stormwater wetlands. Consequently, a forebay shall be located at the inlet and a micropool shall be located at the outlet. A micropool is a 3- to 6-foot-deep pool used to protect the low-flow pipe from clogging and to prevent sediment resuspension. Forebays are designed in the same manner as stormwater ponds (see Section 4.12.3 Pond Pretreatment Criteria). The design of forebays should consider the possibility of heavy trash loads from public areas.

4.13.4 Stormwater Wetland Design Criteria

Internal Design Geometry. Research and experience have shown that the internal design geometry and depth zones are critical in maintaining the pollutant removal capability and plant diversity of stormwater wetlands. Stormwater wetland performance is enhanced when the wetland has multiple cells, longer flowpaths, and a high ratio of surface area to volume. Whenever possible, constructed wetlands should be irregularly shaped with long, sinuous flow paths. The following design elements are required for stormwater wetlands:

Multiple-Cell Wetlands. Stormwater wetlands can be divided into at least four internal sub-cells of different elevations: the forebay, a micro-pool outlet, and two additional cells. Cells can be formed by sand berms (anchored by rock at each end), back-filled coir fiber logs, or forested peninsulas (extending as wedges across 95% of the wetland width). The vegetative target is to ultimately achieve a 50-50 mix of emergent and forested wetland vegetation within all four cells.

The first cell (the forebay) is deeper and is used to receive runoff from the pond cell or the inflow from a pipe or open channel and distribute it as sheetflow into successive wetland cells. The surface elevation of the second cell is the normal pool elevation. It may contain a forested island or a sand wedge channel to promote flows into the third cell, which is 3 to 6 inches lower than the normal pool elevation. The purpose of the wetland cells is to create an alternating sequence of aerobic and anaerobic conditions to maximize pollutant removal. The fourth wetland cell is located at the discharge point and serves as a micro-pool with an outlet structure or weir.

Extended Detention Ponding Depth. When extended detention is provided for management of larger storm events, the total ED volume shall not comprise more than 50% of the total volume stored by the stormwater wetland, and its maximum water surface elevation shall not extend more than 3 feet above the normal pool.

Deep Pools. Approximately 25% of the stormwater surface area must be provided in at least three deeper pools—located at the inlet (forebay), center, and outlet (micropool) of the wetland—with each pool having a depth of from 18 to 48 inches. Refer to the sizing based on water balance below for additional guidance on the minimum depth of the deep pools.

High Marsh Zone. Approximately 70% of the stormwater wetland surface area must exist in the high marsh zone (-6 inches to +6 inches, relative to the normal pool elevation).

Transition Zone. The low marsh zone is no longer an acceptable wetland zone, and is only allowed as a short transition zone from the deeper pools to the high marsh zone (-6 to -18 inches below the normal pool elevation). In general, this transition zone should have a maximum slope of 5H:1V (or preferably flatter) from the deep pool to the high marsh zone. It is advisable to install biodegradable erosion control fabrics or similar materials during construction to prevent erosion or slumping of this transition zone.

Flow Path. In terms of the flow path, there are two design objectives:

- The overall flow path through the stormwater wetland can be represented as the length-to-width ratio OR the flow path ratio. A minimum overall flow path of 2:1 must be provided across the stormwater wetland.
- The shortest flow path represents the distance from the closest inlet to the outlet. The ratio of the shortest flow path to the overall length must be at least 0.5. In some cases—due to site geometry, storm sewer infrastructure, or other factors—some inlets may not be able to meet these ratios. However, the CDA served by these “closer” inlets must constitute no more than 20% of the total CDA.

Side Slopes. Side slopes for the stormwater wetland should generally have gradients of 4H:1V or flatter. These mild slopes promote better establishment and growth of the wetland vegetation. They also contribute to easier maintenance and a more natural appearance.

Micro-Topographic Features. Stormwater wetlands must have internal structures that create variable micro-topography, which is defined as a mix of above-pool vegetation, shallow pools, and deep pools that promote dense and diverse vegetative cover.

Stormwater Wetland Material Specifications. Stormwater wetlands are generally constructed with materials obtained on site, except for the plant materials, inflow and outflow devices (e.g., piping and riser materials), possibly stone for inlet and outlet stabilization, and geotextile fabric for lining banks or berms. Plant stock should be nursery grown, unless otherwise approved (e.g. by the local regulatory authority), and must be healthy and vigorous native species free from defects, decay, disfiguring roots, sun-scald, injuries, abrasions, diseases, insects, pests, and all forms of infestations or objectionable disfigurements, as determined during the local plan review.

Stormwater Wetland Sizing. Stormwater wetlands can be designed to capture and treat the remaining stormwater discharged from upstream practices from the design storm (SWRv). Additionally, stormwater wetlands can be sized to control peak flow rates from the 2- 50-year frequency storm event or other design storm. Design calculations must ensure that the post-development peak discharge does not exceed the predevelopment peak discharge. See Section 3.7.2 Hydrologic and Hydraulic Analysis for a summary of acceptable hydrologic methodologies and models.

For treatment train designs where upland practices are utilized for treatment of the SWRv, designers can use a site-adjusted Rv or NRCS CN that reflects the volume reduction of upland practices to compute the 2- 100-year frequency storm event that must be treated by the stormwater wetland.

The wetland permanent pools (volume stored in deep pools and pool depths) must be sized to store a volume equivalent to the SWRv or design volume.

The storage volume (Sv) of the practice is equal to the volume provided by the wetland permanent pool (Equation 4.29). The total Sv cannot exceed the SWRv.

Equation 4. 29 Stormwater Wetland Storage Volume

$$SSRR = SSDDDDDDDDSSppDDDDDD\ SSDDDDppppDDdd\ ppDDDDDDppDDDDDDDD\ ppDDDDpp\ RRDDppvvDDDD$$

Sizing for Minimum Pool Depth. Initially, it is recommended that there be no minimum CDA requirement for the system, although it may be necessary to calculate a water balance for the wet pond cell when its CDA is less than 10 acres (Refer to Section 4.12 Ponds).

Similarly, if the hydrology for the constructed wetland is not supplied by groundwater or dry weather flow inputs, a simple water balance calculation must be performed, using Equation 4.30 (Hunt et al., 2007), to assure the deep pools will not go completely dry during a 30-day summer drought.

Equation 4.30 Water Balance for Acceptable Water Depth in a Stormwater Wetland

$$DP = \left(RF_m \times EF \times \frac{WS}{WL}\right) - (ET - INF - RES)$$

Where:

DP	=	depth of pool (in.)
RF_m	=	monthly rainfall during drought (in.)
EF	=	fraction of rainfall that enters the stormwater wetland (in.) (CDA × Rv)
WS/WL	=	ratio of contributing drainage area to stormwater wetland surface area
ET	=	summer evapotranspiration rate (in.) (assume 8 in.)
INF	=	monthly infiltration loss (assume 7.2 inches at 0.01 in./hr)
RES	=	reservoir of water for a factor of safety (assume 6 in.)

Using Equation 4.30, setting the groundwater and (dry weather) base flow to zero and assuming a worst-case summer rainfall of 0 inches, the minimum depth of the pool calculates as follows (Equation 4.31):

Equation 4.31 Minimum Depth of the Permanent Pool

$$DP = RF_m - ET - INF - RES = 21.2$$

Where:

DP	=	depth of pool (in.)
RF_m	=	monthly rainfall during drought (in.)
ET	=	summer evapotranspiration rate (in.) (assume 8 in.)
INF	=	monthly infiltration loss (assume 7.2 inches at 0.01 in./hr)
RES	=	reservoir of water for a factor of safety (assume 6 in.)

Therefore, unless there is other input, such as base flow or groundwater, the minimum depth of the pool should be at least 22 inches (rather than the 18-inch minimum depth noted in Section 4.11.4 Stormwater Wetland Design Criteria).

4.13.5 Stormwater Wetland Construction Sequence

The construction sequence for stormwater wetlands depends on site conditions, design complexity, and the size and configuration of the proposed facility. The following two-stage construction sequence is recommended for installing an on-line stormwater wetland facility and establishing vigorous plant cover.

Stage 1 Construction Sequence: Wetland Facility Construction.

1. **Stabilize Contributing Drainage Area.** Stormwater wetlands should only be constructed after the CDA to the wetland is completely stabilized. If the proposed stormwater wetland site will be used as a sediment trap or basin during the construction phase, the construction notes must clearly indicate that the facility will be de-watered, dredged, and re-graded to design dimensions after the original site construction is complete.

2. **Assemble Construction Materials on Site.** Inspect construction materials to ensure they conform to design specifications and prepare any staging areas.

3. **Clear and Strip. Bring the project area** to the desired subgrade.

4. **Install Soil Erosion and Sediment Control Measures** prior to construction, including sediment basins and stormwater diversion practices. All areas surrounding the stormwater wetland that are graded or denuded during construction of the wetland are to be planted with turf grass, native plant materials, or other approved methods of soil stabilization. Grass sod is preferred over seed to reduce seed colonization of the stormwater wetland. During construction, the stormwater wetland must be separated from the CDA so that no sediment flows into the wetland areas. In some cases, a phased or staged soil erosion and sediment control plan may be necessary to divert flow around the stormwater wetland area until installation and stabilization are complete.

5. **Excavate the Core Trench for the Embankment and Install the Spillway Pipe.**

6. **Install the Riser or Outflow Structure** and ensure that the top invert of the overflow weir is constructed level and at the proper design elevation (flashboard risers are strongly recommended by Hunt et al., 2007).

7. **Construct the Embankment and any Internal Berms** in 8- to 12-inch lifts and compact them with appropriate equipment.

8. **Excavate and Grade.** Survey to achieve the appropriate elevation and designed contours for the bottom and side slopes of the stormwater wetland. This is normally done by “roughing up” the interim elevations with a skid loader or other similar equipment to achieve the desired topography across the wetland. Spot surveys should be made to ensure that the interim elevations are 3 to 6 inches below the final elevations for the wetland.

9. **Install Micro-Topographic Features and Soil Amendments** within the stormwater wetland area. Since most stormwater wetlands are excavated to deep sub-soils, they often lack the nutrients and organic matter needed to support vigorous growth of wetland plants. It is therefore essential to add sand, compost, topsoil, or wetland mulch to all depth zones in the stormwater wetland. The importance of soil amendments in excavated stormwater wetlands cannot be over-emphasized; poor survival and future wetland coverage are likely if soil amendments are not added. The planting soil should be a high organic content loam or sandy loam, placed by mechanical methods, and spread by hand. Planting soil depth should be at least 4 inches for shallow wetlands. No machinery should be allowed to traverse over the planting soil during or after construction. Planting soil should be tamped as directed in the design

specifications, but it should not be overly compacted. After the planting soil is placed, it should be saturated and allowed to settle for at least one week prior to installation of plant materials.

10. Construct the Emergency Spillway in cut or structurally stabilized soils.

11. Install Outlet Pipes. The installation of outlet pipes must include a downstream riprap protection apron.

12. Stabilize Exposed Soils with temporary seed mixtures appropriate for a wetland environment. All wetland features above the normal pool elevation should be temporarily stabilized by hydro-seeding or seeding over straw.

Stage 2 Construction Sequence: Establishing the Wetland Vegetation.

13. Finalize the Stormwater Wetland Landscaping Plan. At this stage the engineer, landscape architect, and wetland expert work jointly to refine the initial wetland landscaping plan after the stormwater wetland has been constructed. Several weeks of standing time is needed so that the designer can more precisely predict the following:

- Where the inundation zones are located in and around the stormwater wetland; and
- Whether the final grade and wetland microtopography will persist over time.

This allows the designer to select appropriate species and additional soil amendments, based on field confirmation of soils properties and the actual depths and inundation frequencies occurring within the stormwater wetland.

14. Open Up the Stormwater Wetland Connection. Once the final grades are attained, the pond and/or CDA connection should be opened to allow the wetland cell to fill up to the normal pool elevation. Gradually inundate the stormwater wetland to avoid erosion of unplanted features. Inundation must occur in stages so that deep pool and high marsh plant materials can be placed effectively and safely. Wetland planting areas should be at least partially inundated during planting to promote plant survivability.

15. Measure and Stake Planting Depths at the onset of the planting season. Depths in the stormwater wetland should be measured to the nearest inch to confirm the original planting depths of the planting zone. At this time, it may be necessary to modify the plan to reflect altered depths or a change in the availability of wetland plant stock. Surveyed planting zones should be marked on the as-built or design plan, and their locations should also be identified in the field, using stakes or flags.

16. Propagate the Stormwater Wetland. Two techniques are used in combination to propagate the emergent community over the wetland bed:

17. Initial Planting of Container-Grown Wetland Plant Stock. The transplanting window extends from early March through May. Planting after these dates can decrease the chance of survival, since emergent wetland plants need a full growing season to build the root reserves needed to get through the winter. It is recommended that plants be ordered at least 6 months in advance to ensure the availability and on-time delivery of desired species.

18. Broadcasting Wetland Seed Mixes. The higher wetland elevations should be established by broadcasting wetland seed mixes to establish diverse emergent wetlands. Seeding of switchgrass or wetland seed mixes as a ground cover is recommended for all zones above 3 inches below the normal pool elevation. Hand broadcasting or hydroseeding can be used to spread seed, depending on the size of the wetland cell.

19. Install Goose Protection to Protect Newly Planted or Newly Growing Vegetation. This is particularly critical for newly established emergent and herbaceous plants, as predation by Canada geese can quickly decimate wetland vegetation. Goose protection can consist of netting, webbing, or string installed in a crisscross pattern over the surface area of the stormwater wetland, above the level of the emergent plants.

20. Plant the Stormwater Wetland Fringe and Buffer Area. This zone generally extends from 1 to 3 feet above the normal pool elevation (from the shoreline fringe to about half of the maximum water surface elevation for the 2-year storm). Consequently, plants in this zone are infrequently inundated (5 to 10 times per year) and must be able to tolerate both wet and dry periods.

Construction Supervision. Supervision during construction is recommended to ensure that stormwater wetlands are properly constructed and established. Multiple site visits and inspections by a qualified professional are recommended during the following stages of the stormwater wetland construction process:

- Preconstruction meeting
- Initial site preparation including the installation of soil erosion and sediment control measures
- Excavation/Grading (interim and final elevations)
- Installation of the embankment, the riser/primary spillway, and the outlet structure
- Implementation of the pondscaping plan and vegetative stabilization
- Immediately seed or install vegetated ground cover upon completion of sloping and grading, where applicable, of each stormwater wetland within a project.
- Inspect within two weeks to ensure vegetation is in fact holding banks and slopes in place.
- Prior to completion of project, mechanically remove erosion deposition from ponds that occurred during the project. Criteria should be based on erosion of designed bank slopes and loss of storage capacity.
- Final inspection (develop a punch list for facility acceptance)

Construction inspection checklist for Stormwater Wetlands can be found in Appendix E Construction Inspection Checklists.

4.13.6 Stormwater Wetland Landscaping Criteria

An initial stormwater wetland landscaping plan is required for any stormwater wetland and should be jointly developed by the engineer and a wetlands expert or experienced landscape architect. The plan should outline a detailed schedule for the care, maintenance, and possible reinforcement of vegetation in the wetland and its buffer for up to 10 years after the original planting.

The plan should outline a realistic, long-term planting strategy to establish and maintain desired wetland vegetation. The plan should indicate how wetland plants will be established within each inundation zone (e.g., wetland plants, seed-mixes, volunteer colonization, and tree and shrub stock) and whether soil amendments are needed to get plants started. At a minimum, the plan should contain the following:

- Plan view(s) with topography at a contour interval of no more than 1 foot and spot elevations throughout the cell showing the stormwater wetland configuration, different planting zones (e.g., high marsh, deep water, upland), microtopography, grades, site preparation, and construction sequence.

- A plant schedule and planting plan specifying emergent, perennial, shrub and tree species, quantity of each species, stock size, type of root stock to be installed, and spacing. To the degree possible, the species list for the constructed wetland should contain plants found in similar local wetlands.

The following general guidance is provided:

- **Use Native Species Where Possible.** Table 4.53 provides a list of common native shrub and tree species and Table 4.54 provides a list of common native emergent, submergent, and perimeter plant species, all of which have proven to do well in stormwater wetlands in the mid-Atlantic region and are generally available from most commercial nurseries. Other native species can be used that appear in state-wide plant lists. The use of native species is strongly encouraged, but in some cases, non-native ornamental species may be added as long as they are not invasive. Invasive species such as cattails (*Typha latifolia*), common reed (*Phragmites australis*), and purple loosestrife (*Lythrum salicaria*) must not be planted.
- **Match Plants to Inundation Zones.** The various plant species shown in Table 4.53 and Table 4.54 should be matched to the appropriate inundation zone. The first four inundation zones are particularly applicable to stormwater wetlands, as follows:

  Zone 1 -6 inches to -12 inches below the normal pool elevation

  Zone 2 -6 inches to the normal pool elevation

  Zone 3 From the normal pool elevation to +12 inches above

  Zone 4 +12 inches to +36 inches above the normal pool elevation (i.e., above ED Zone)

  Note: The Low Marsh Zone (-6 to -18 inches below the normal pool elevation) has been dropped since experience has shown that few emergent wetland plants flourish in this deeper zone.
- **Aggressive Colonizers.** To add diversity to the stormwater wetland, five to seven species of emergent wetland plants should be planted, using at least four emergent species designated as aggressive colonizers (shown in bold in Table 4.54). No more than 25% of the high marsh wetland surface area needs to be planted. If the appropriate planting depths are achieved, the entire stormwater wetland should be colonized within 3 years. Individual plants should be planted 18 inches on center within each single species "cluster."
- **Suitable Tree Species.** The major shift in stormwater wetland design is to integrate trees and shrubs into the design, in tree islands, peninsulas, and fringe buffer areas. Deeper-rooted trees and shrubs that can extend to the stormwater wetland's local water table are important for creating a mixed wetland community. Table 4. 53 above presents some recommended tree and shrub species for different inundation zones. A good planting strategy includes varying the size and age of the plant stock to promote a diverse structure. Using locally grown container or bare root stock is usually the most successful approach if planting in the spring. It is recommended that buffer planting areas be over-planted with a small stock of fast-growing successional species to achieve quick canopy closure and shade out invasive plant species. Trees may be planted in clusters to share rooting space on compacted wetland side-slopes. Planting holes should be amended with compost (a 2:1 ratio of loose soil to compost) prior to planting.
- **Pre- and Post-Nursery Care.** Plants should be kept in containers of water or moist coverings to protect their root systems and keep them moist when in transporting them to the planting location.

As much as 6 to 9 months of lead time may be needed to fill orders for wetland plant stock from aquatic plant nurseries. Consult local regulatory authorities for information on area suppliers.

Table 4.53. Popular, Versatile, and Available Native Trees and Shrubs for Stormwater Wetlands

Shrubs		Trees	
Common and *Scientific* Names	**Zone[1]**	**Common and *Scientific* Names**	**Zone[1]**
Button Bush *(Cephalanthus occidentalis)*	2, 3	Atlantic White Cedar *(Charnaecyparis thyoides)*	2, 3
Common Winterberry *(Ilex verticillatta)*	3, 4	Bald Cypress *(Taxodium distichum)*	2, 3
Elderberry *(Sambucus canadensis)*	3	Black Willow *(Salix nigra)*	3, 4
Indigo Bush *(Amorpha fruticosa)*	3	Box Elder *(Acer Negundo)*	2, 3
Inkberry *(Ilex glabra)*	2, 3	Green Ash *(Fraxinus pennsylvanica)*	3, 4
Smooth Alder *(Alnus serrulata)*	2, 3	Grey Birch *(Betula populifolia)*	3, 4
Spicebush *(Lindera benzoin)*	3, 4	Red Maple *(Acer rubrum)*	3, 4
Swamp Azalea *(Azalea viscosum)*	2, 3	River Birch *(Betula nigra)*	3, 4
Swamp Rose *(Rosa palustris)*	2, 3	Swamp Tupelo *(Nyssa biflora)*	2, 3
Sweet Pepperbush *(Clethra ainifolia)*	2, 3	Sweetbay Magnolia *(Magnolia virginiana)*	3, 4
		Sweetgum *(Liquidambar styraciflua)*	3, 4
		Sycamore *(Platanus occidentalis)*	3, 4
		Water Oak *(Quercus nigra)*	3, 4
		Willow Oak *(Quercus phellos)*	3,4

[1] Zone 1: -6 to -12 inches below the normal pool elevation
Zone 2: -6 inches to the normal pool elevation
Zone 3: From the normal pool elevation to +12 inches
Zone 4: +12 to +36 inches; above ED zone

Source: Virginia DCR Stormwater Design Specification No. 13: Constructed Wetlands Version 1.8. 2010.

Table 4.54. Popular, Versatile, and Available Native Emergent and Submergent Vegetation for Stormwater Wetlands

Plant	Zone[1]	Form	Inundation Tolerance	Wildlife Value	Notes
Arrow Arum *(Peltandra virginica)*	2	Emergent	Up to 1 ft	High; berries are eaten by wood ducks	Full sun to partial shade
Broad-Leaf Arrowhead (Duck Potato) *(Saggitaria latifolia)*	2	Emergent	Up to 1 ft	Moderate; tubers and seeds eaten by ducks	Aggressive colonizer
Blueflag Iris* *(Iris versicolor)*	2, 3	Emergent	Up to 6 in.	Limited	Full sun (to flower) to partial shade
Broomsedge *(Andropogon virginianus)*	2, 3	Perimeter	Up to 3 in.	High; songbirds and browsers; winter food and cover	Tolerant of fluctuating water levels and partial shade
Bulltongue Arrowhead *(Sagittaria lancifolia)*	2, 3	Emergent	0 to 24 in.	Waterfowl, small mammals	Full sun to partial shade
Burreed *(Sparganium americanum)*	2, 3	Emergent	0 to 6 in.	Waterfowl, small mammals	Full sun to partial shade
Cardinal Flower* *(Lobelia cardinalis)*	3	Perimeter	Periodic inundation	Attracts hummingbirds	Full sun to partial shade
Common Rush *(Juncus spp.)*	2, 3	Emergent	Up to 12 in.	Moderate; small mammals, waterfowl, songbirds	Full sun to partial shade
Common Three Square *(Scipus pungens)*	2	Emergent	Up to 6 in.	High; seeds, cover, waterfowl, songbirds	Fast colonizer; can tolerate periods of dryness; full sun; high metal removal
Duckweed (*Lemna sp.)*	1, 2	Submergent / Emergent	Yes	High; food for waterfowl and fish	May biomagnify metals beyond concentrations found in the water
Joe Pye Weed *(Eupatorium purpureum)*	2, 3	Emergent	Drier than other Joe-Pye Weeds; dry to moist areas; periodic inundation	Butterflies, songbirds, insects	Tolerates all light conditions
Lizard's Tail *(Saururus cernus)*	2	Emergent	Up to 1 ft	Low; except for wood ducks	Rapid growth; shade-tolerant

Plant	Zone[1]	Form	Inundation Tolerance	Wildlife Value	Notes
Marsh Hibiscus *(Hibiscus moscheutos)*	2, 3	Emergent	Up to 3 in.	Low; nectar	Full sun; can tolerate periodic dryness
Pickerelweed *(Pontederia cordata)*	2, 3	Emergent	Up to 1 ft	Moderate; ducks, nectar for butterflies	Full sun to partial shade
Pond Weed *(Potamogeton pectinatus)*	1	Submergent	Yes	Extremely high; waterfowl, marsh and shore birds	Removes heavy metals from the water
Rice Cutgrass *(Leersia oryzoides)*	2, 3	Emergent	Up to 3 in.	High; food and cover	Prefers full sun, although tolerant of shade; shoreline stabilization
Sedges *(Carex spp.)*	2, 3	Emergent	Up to 3 in.	High; waterfowl, songbirds	Wetland and upland species
Softstem Bulrush *(Scipus validus)*	2, 3	Emergent	Up to 2 ft	Moderate; good cover and food	Full sun; aggressive colonizer; high pollutant removal
Smartweed *(Polygonum spp.)*	2	Emergent	Up to 1 ft	High; waterfowl, songbirds; seeds and cover	Fast colonizer; avoid weedy aliens, such as *P. Perfoliatum*
Spatterdock *(Nuphar luteum)*	2	Emergent	Up to 1.5 ft	Moderate for food, but High for cover	Fast colonizer; tolerant of varying water levels
Switchgrass *(Panicum virgatum)*	2, 3, 4	Perimeter	Up to 3 in.	High; seeds, cover; waterfowl, songbirds	Tolerates wet/dry conditions
Sweet Flag* *(Acorus calamus)*	2, 3	Perimeter	Up to 3 in.	Low; tolerant of dry periods	Tolerates acidic conditions; not a rapid colonizer
Waterweed *(Elodea canadensis)*	1	Submergent	Yes	Low	Good water oxygenator; high nutrient, copper, manganese, and chromium removal
Wild celery *(Valisneria americana)*	1	Submergent	Yes	High; food for waterfowl; habitat for fish and invertebrates	Tolerant of murkey water and high nutrient loads
Wild Rice *(Zizania aquatica)*	2	Emergent	Up to 1 ft	High; food, birds	Prefers full sun
Woolgrass Bulrush *(Scirpus cyperinus)*	3, 4	Emergent	Yes	High: waterfowl, small mammals	Fresh tidal and non-tidal, swamps, forested wetlands, meadows, ditches

Aggressive colonizers are shown in bold type

[1] Zone 1: -6 to -12 inches below the normal pool elevation

Plant	Zone[1]	Form	Inundation Tolerance	Wildlife Value	Notes

Zone 2: -6 inches to the normal pool elevation
Zone 3: From the normal pool elevation to +12 inches
Zone 4: +12 to +36 inches; above ED zone
***Not a major colonizer, but adds color
Source: Virginia DCR Stormwater Design Specification No. 13: Constructed Wetlands Version 1.8. 2010.

4.13.7 Stormwater Wetland Maintenance Criteria

Successful establishment of constructed wetland areas requires that the following tasks be undertaken in the first 2 years:

- **Initial Inspections.** During the first 6 months following construction, the site should be inspected by a qualified professional at least twice after storm events that exceed 0.5 inch of rainfall.
- **Spot Reseeding.** Inspections should include looking for bare or eroding areas in the CDA or around the wetland buffer and make sure they are immediately stabilized with grass cover.
- **Watering.** Trees planted in the buffer and on wetland islands and peninsulas need watering during the first growing season. In general, consider watering every 3 days for first month, and then weekly during the first growing season (April through October), depending on rainfall.
- **Reinforcement Plantings.** Regardless of the care taken during the initial planting of the stormwater wetland and buffer, it is probable that some areas will remain unvegetated and some species will not survive. Poor survival can result from many unforeseen factors, such as predation, poor quality plant stock, water level changes, and drought. Thus, it is advisable to budget for an additional round of reinforcement planting after one or two growing seasons. Construction contracts should include a care and replacement warranty extending at least two growing seasons after initial planting, to selectively replant portions of the stormwater wetland that fail to fill in or survive. If a minimum coverage of 50% is not achieved in the planted wetland zones after the second growing season, a reinforcement planting will be required.

Managing vegetation is an important ongoing maintenance task at every constructed wetland and for each inundation zone. Following the design criteria above should result in a reduced need for regular mowing of the embankment and access roads. Vegetation within the stormwater wetland, however, will require some annual maintenance.

Designers should expect significant changes in wetland species composition to occur over time. Inspections should carefully track changes in wetland plant species distribution over time. Invasive plants should be dealt with as soon as they begin to colonize the stormwater wetland. As a general rule, control of undesirable invasive species (e.g., cattails and Phragmites) should commence when their coverage exceeds more than 15% of a wetland cell area. Although the application of herbicides is not recommended, some types (e.g., Glyphosate) have been used to control cattails with some success. Extended periods of dewatering may also work, since early manual removal provides only short-term relief from invasive species. While it is difficult to exclude invasive species completely from stormwater wetlands, their ability to take over the entire wetland can be reduced if the designer creates a wide range of depth zones and a complex internal structure within the wetland.

- For more information on invasive plants, consult the South Carolina Exotic Pest Plant Council. Resources are available online at http://www.se-eppc.org/southcarolina/invasivePlants.cfm.

- For more information related to chemical control methods for aquatic plants, please review the fact sheet "Aquatic Weed Control Overview" provided by Clemson's Cooperative Extension Service and available online at http://www.clemson.edu/extension/hgic/plants/other/landscaping/hgic1714.html.

Thinning or harvesting of excess forest growth may be periodically needed to guide the forested stormwater wetland into a more mature state. Vegetation may need to be harvested periodically if the constructed wetland becomes overgrown. Thinning or harvesting operations should be scheduled to occur approximately 5 and 10 years after the initial stormwater wetland construction. Removal of woody species on or near the embankment and maintenance access areas should be conducted every 2 years.

Designers should refer to Section 4.12.7 Pond Maintenance Criteria for additional maintenance responsibilities associated with stormwater wetlands. Ideally, maintenance of constructed wetlands should be driven by annual inspections by a qualified professional that evaluates the condition and performance of the stormwater wetland. Based on inspection results, specific maintenance tasks will be triggered.

Maintenance inspection checklist for stormwater wetlands and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.13.8 Stormwater Wetland Stormwater Compliance Calculations

Stormwater wetlands are credited with 0% retention, but they do receive 80% TSS, 30% TN, and 60% bacteria removal for the storage volume (Sv) provided by in the permanent pool (Table 4.55).

Table 4.55. Stormwater Wetland Retention and Pollutant Removal

Retention	= 0%
TSS Removal	= 80%
TN Removal	= 25%
Bacteria Removal	= 60%

4.14 Tree Planting & Preservation

<table>
<tr><th colspan="4">Tree Planting and Preservation</th></tr>
<tr><td colspan="4">Definition: Existing trees can be preserved or new trees can be planted to reduce stormwater runoff.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="2">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="2">WQ Improvement: Moderate to High</th></tr>
</table>

Land Uses	Required Footprint
▪ Urban ▪ Suburban ▪ Rural	**Small**

TSS[1]	Total N[1]	Bacteria[1]
N/A	N/A	N/A

Runoff Reductions

Construction Costs	Maintenance Burden	Volume
Low	Low	Low

Maintenance Frequency:

Routine	Non-Routine
At least annually	Every 10–15 years

SWRv*

T-1 Small	T-1 Large	T-2 Small	T-2 Large	T-2 Special
5 ft^3	10 ft^3	10 ft^3	20 ft^3	30 ft^3

Advantages/Benefits	Disadvantages/Limitation
▪ High community acceptance ▪ Relatively low maintenance requirements ▪ Increases property value ▪ Easily incorporated with other practices ▪ Excellent for soils	▪ Preserved trees must be protected during construction ▪ Must be within LOD ▪ Must maintain tree health

Components	Design considerations
▪ Inventory of existing trees ▪ Identification of trees to preserve or plant ▪ Preference for Special trees ▪ Average tree spread	▪ Inventory of existing trees ▪ Identification of trees to preserve or plant ▪ Preference for Special trees ▪ Slope-steep slopes must be terraced/benched ▪ Maintenance access

Maintenance Activities

▪ If staked during establishment, remove stakes within 1 year of planting	▪ Maintain appropriate mulch cover ▪ Ensure tree health

[1] *Credited pollutant load removal*

Per planted/preserved tree

Easily combined with other practices, tree planting and preservation provide stormwater interception, beauty, and shade, thereby increasing aesthetics and property values. See Figure 4. 57

Figure 4. 56 Tree Planting and Preservation in Bioretention
Photo: Center for Watershed Protection

Definition. Existing trees can be preserved or new trees can be planted to reduce stormwater runoff. The design includes the following:

T-1 Tree planting

T-2 Tree preservation

Tree canopy can intercept a significant amount of rainfall before it becomes runoff, particularly if the tree canopy covers impervious surfaces, as in the case of street trees. Through the processes of evapotranspiration and nutrient uptake, trees—even when located on a development site—have the capacity to reduce stormwater runoff volumes and improve water quality. Further, through root growth, trees can improve the infiltration capacity of the soils in which they grow.

Both tree planting and tree preservation can contribute to stormwater management on a site. Note that retention credit is available for preserved trees only when they are within the limits of disturbance of a project. Preserved trees outside of the limits of disturbance may offer an opportunity for additional retention when they constitute an area of natural cover and stormwater is conveyed to that area.

4.14.1 Preserving Existing Trees during Construction

The preferred method for increasing tree cover at a development site is to preserve existing trees during construction, particularly where mature trees are present. Existing trees are preserved during construction through a four-step process:

1. Inventory existing trees.
2. Identify trees to preserve.
3. Protect trees and soil during construction.
4. Protect trees after construction.

Inventory Existing Trees. An inventory of existing trees and forested areas at the development site must be conducted before any site design, clearing, or construction takes place, as specified by the DDOT UFD. The inventory must be conducted by one of the following qualified professionals, which includes, but is not limited to:

- South Carolina Licensed Forester
- South Carolina Licensed Tree Expert
- South Carolina Experienced Forester
- South Carolina Licensed Landscape Architect
- International Society of Arboriculture (ISA) Certified Arborist

The inventory must include a survey of existing trees and determine their size, species, condition, and ecological value. Locations of trees and forest stands must be recorded.

Identify Trees to Preserve. From the tree inventory, individual trees can be identified for preservation and protection during site development. Preserved trees fall into three categories of retention credit: tree species with an average mature spread less than or equal to 40 feet ("small" trees) receive 10 cubic feet of retention credit; trees species with an average mature spread greater than or equal to 40 feet ("large" trees) receive 20 cubic feet of retention credit; and trees with an existing diameter greater than 14" ("Special" trees receive 30 cubic feet of retention credit, regardless of mature spread size. Additional selection criteria may include tree species, size, condition, and location (see Table 4.56).

Table 4.56. Selecting Priority Trees and Forests for Preservation

Selection Criteria	Examples of Priority Tree and Forests to Conserve
Species	▪ Rare, threatened, or endangered species ▪ Specimen trees ▪ High quality tree species (e.g., white oaks and sycamores because they are structurally strong and live longer than trees such as silver maple and cottonwood) ▪ Species that are tolerant of specific site conditions and soils
Size	▪ Trees over a specified diameter at breast height (DBH) or other size measurement ▪ Trees designated as national, state, or local champions ▪ Contiguous forest stands

Selection Criteria	Examples of Priority Tree and Forests to Conserve
Condition	▪ Healthy trees that are structurally sound in "fair" or better condition ▪ High quality forest stands with high forest structural diversity
Location	▪ Trees located where they will provide direct benefits at the site (e.g., shading, privacy, windbreak, buffer from adjacent land use) ▪ Forest stands that are connected to off-site forests that create wildlife habitat and corridors ▪ Trees located in protected natural areas such as floodplains, stream buffers, wetlands, erodible soils, critical habitat areas, and steep slopes. ▪ Forest stands that are connected to off-site non-forested natural areas or protected land (e.g., has potential to provide wildlife habitat)

Trees selected for preservation and protection must be clearly marked both on construction drawings and at the actual site. Flagging or fencing is typically used to protect trees at the construction site. Areas of trees to preserve should be marked on the site map and walked during preconstruction meetings.

Protect Trees and Soil During Construction. Physical barriers must be properly installed around the Critical Root Zone (CRZ) of trees to be preserved. The CRZ shall be determined by a landscape professional from the above list, and in general is equal to 1.5 feet of tree protection (radius of circle) for every 1 inch in tree diameter. For example, a 10-inch diameter tree would have a CRZ radius extending 15 feet from the tree. The barriers must be maintained and enforced throughout the construction process. Tree protection barriers include highly visible, well-anchored temporary protection devices, such as 6-foot-tall chain link fencing.

All protection devices must remain in place throughout construction.

When excavation is proposed immediately adjacent to the CRZ, roots must first be pruned at the edge of the excavation with a trenching machine, vibratory knife or rock saw to a depth of 18 inches. Any requirements here may be superseded by the requirements of the CDC.

Protect Trees After Construction. Maintenance covenants, as described below, are required to ensure that preserved trees are protected.

4.14.2 Planting Trees

Considerations at Development Sites. New development sites provide many opportunities to plant new trees. Planting trees at development sites is done in three steps:

1. Select tree species.

2. Evaluate and improve planting sites.

3. Plant and maintain trees.

Tree Species. Planted trees fall into two categories of retention: tree species with an average mature spread less than or equal to 40 feet ("small" trees) receive 5 cubic feet of retention and trees species with an average mature spread greater than or equal to 40 feet ("large" trees) receive 10 cubic feet of retention. Trees to be planted must have a minimum caliper size of 1.5 inches.

Planting Sites. Ideal planting sites within a development are those that create interception opportunities around impervious surfaces. These include areas along pathways, roads, islands and median strips, and parking lot interiors and perimeters. Other areas of a development site may benefit from planting trees (including stream valleys and floodplains, areas adjacent to existing forest, steep slopes, and portions of the site where trees would provide buffers, screening, noise reduction, or shading).

It is important to evaluate and record the conditions, such as soil type, soil pH, soil compaction, and the hydrology of proposed planting sites to ensure they are suitable for planting. These evaluations provide a basis for species selection and determination of the need for any special site preparation techniques.

A minimum of 1,500 cubic feet of rootable soil volume must be provided per large tree. In planting arrangements that allow for shared rooting space amongst multiple trees, a minimum of 1,000 cubic feet of rootable soil volume must be provided for each large tree. Rootable soil volume must be within 3 feet of the surface.

Smaller trees with an average mature spread of less than or equal to 40 feet must have a minimum of 600 cubic feet of rootable soil volume. In planting arrangements that permit shared rooting space amongst multiple trees, a minimum of 400 cubic feet of rootable soil volume must be provided for each tree. Rootable soil volume must be within 3 feet of the surface.

Site characteristics determine what tree species will flourish there and whether any of the conditions, such as soils, can be improved through the addition of compost or other amendments. Table 4.57 presents methods for addressing common constraints to urban tree planting.

Table 4.57. Methods for Addressing Urban Planting Constraints

Potential Impact	Potential Resolution
Limited Soil Volume	▪ Provide 1,500 cubic feet of rootable soil volume per large tree (greater than or equal to 40-foot spread) and 600 cubic feet of rootable soil volume per small tree (less than or equal to 40-foot spread). This soil must be within 3 feet of the surface. ▪ Use planting arrangements that allow shared rooting space. A minimum of 1,000 cubic feet of rootable soil volume must be provided for each tree in shared rooting space arrangements. A minimum of 400 cubic feet of rootable soil volume must be provided for each small tree in shared rooting arrangements.
Poor Soil Quality	▪ Test soil and perform appropriate restoration. ▪ Select species tolerant of soil pH, compaction, drainage, etc. ▪ Replace very poor soils if necessary.
Air Pollution	▪ Select species tolerant of air pollutants.
Damage from Lawnmowers	▪ Use mulch to protect trees.
Damage from Vandalism	▪ Use tree cages or benches to protect trees. ▪ Select species with inconspicuous bark or thorns. ▪ Install lighting nearby to discourage vandalism.
Damage from Vehicles	▪ Provide adequate setbacks between vehicle parking stalls and trees.

Potential Impact	Potential Resolution
Damage from animals such as deer, rodents, rabbits, and other herbivores	▪ Use protective fencing or chemical retardants.
Exposure to pollutants in stormwater runoff	▪ Select species that are tolerant of specific pollutants, such as oils and metals.
Soil moisture extremes	▪ Select species that are tolerant of inundation or drought. ▪ Install underdrains if necessary. ▪ Select appropriate backfill soil and mix thoroughly with site soil. ▪ Improve soil drainage with amendments and tillage if needed.
Increased temperature	▪ Select drought tolerant species.
Increased wind	▪ Select drought tolerant species.
Abundant populations of invasive species	▪ Control invasive species prior to planting. ▪ Continually monitor for and remove invasive species.
Conflict with infrastructure	▪ Design the site to keep trees and infrastructure separate. ▪ Provide appropriate setbacks from infrastructure. ▪ Select appropriate species for planting near infrastructure. ▪ Use alternative materials to reduce conflict.
Disease or insect infestation	▪ Select resistant species

Planting trees at development sites requires prudent species selection, a maintenance plan, and careful planning to avoid impacts from nearby infrastructure, runoff, vehicles or other urban elements.

Trees Along Streets and in Parking Lots. When considering a location for planting, clear lines of sight must be provided, as well as safe travel surfaces, and overhead clearance for pedestrians and vehicles. Also, ensure enough soil volume for healthy tree growth. Usable soil must be uncompacted and may not be covered by impervious material. Having at least a 6-foot-wide planting strip or locating sidewalks between the trees and street allows more rooting space for trees in adjacent property.

Select tree species that are drought tolerant, can grow in poor or compacted soils, and are tolerant to typical urban pollutants (oil and grease, metals, and chlorides). Additionally, select species that do not produce excessive fruits, nuts, or leaf litter, that have fall color, spring flowers or some other aesthetic benefit, and can be limbed up to 6 feet to provide pedestrian and vehicle traffic underneath.

Planting Techniques. Prepare a hole no deeper than the root ball or mass but two to three times wider than the spread of the root ball or mass. The majority of the roots on a newly planted tree will develop in the top 12 inches of soil and spread out laterally. There are some additional considerations depending on the type of plant material being used (Table 4.58).

Table 4.58. Tree Planting Techniques

Plant Material	Planting Technique	Planting Season
Bare root	Hand plant	Spring or fall when tree is dormant
Container grown	Hand plant or use mechanical planting tools (e.g., auger)	Spring or fall, summer if irrigated
Balled and burlapped	Use backhoe (or other specialized equipment) or hand plant	Spring or fall

Sources: Palone and Todd (1998), WSAHGP (2002)

One of the most important planting guidelines is too make sure the tree is not planted too deeply. The root collar, the lowest few inches of trunk just above its junction with the roots (often indicated by a flare), should be exposed. Trees planted too deeply have buried root collars, and are weakened, stressed, and predisposed to pests and disease. Trees planted too deeply can also form adventitious roots (roots that form from non-root tissue) near the soil surface in an attempt to compensate for the lack of available oxygen to buried roots. Adventitious roots are not usually large enough to provide support for a large tree and may eventually lead to collapse. ISA (2005) provides additional guidance on how to avoid planting too deeply. It is generally better to plant the tree a little high, that is, with the base of the trunk flare 2 to 3 inches above the soil, rather than at or below the original growing level.

Proper handling during planting is essential to avoid prolonged transplant shock and ensure a healthy future for new trees and shrubs. Trees should always be handled by the root ball or container, never by the trunk. Specifications for planting a tree are illustrated in Figure 4.58. Trees must be watered well after planting.

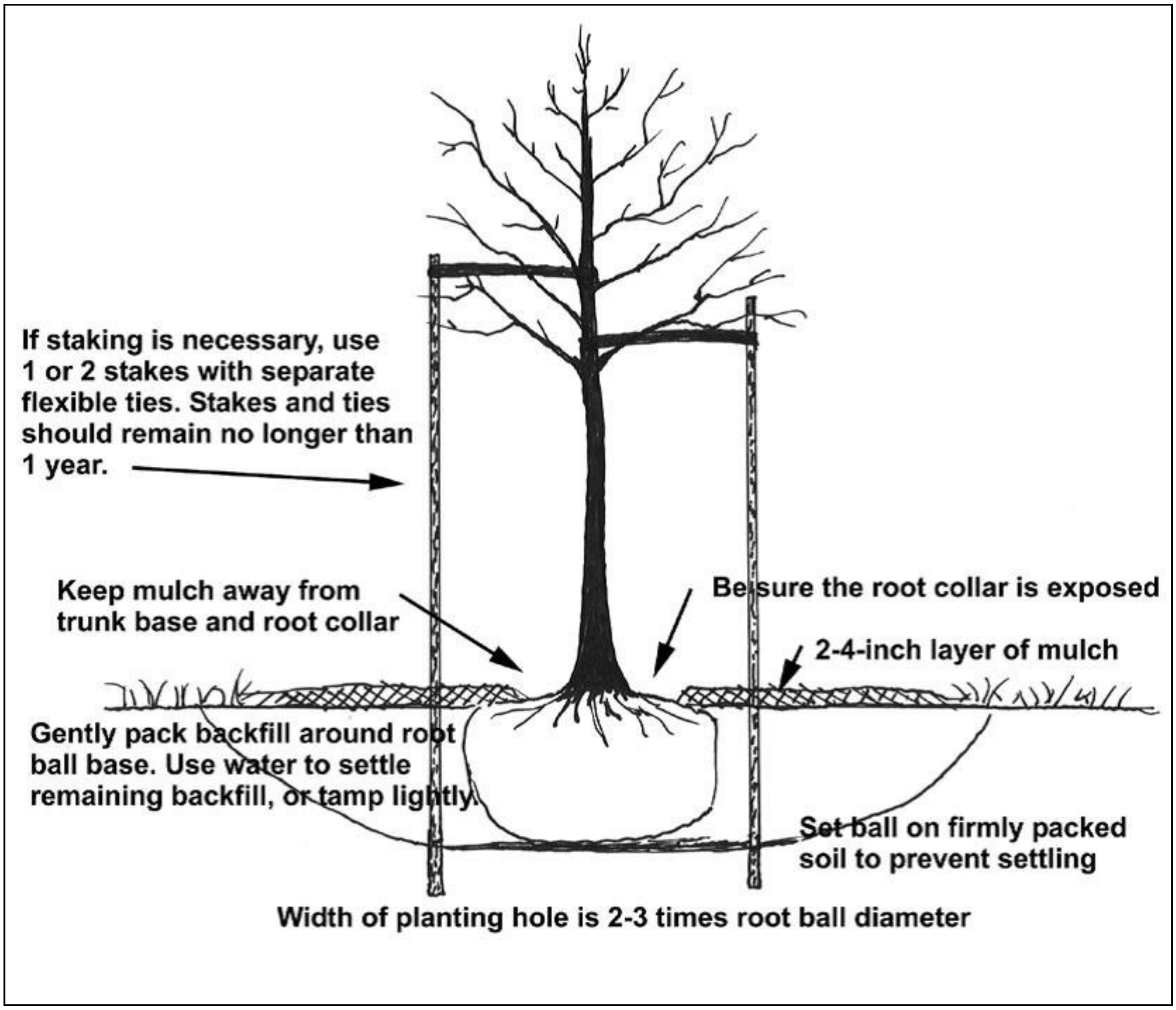


Figure 4.57. Tree planting guidelines. Adapted from Flott, 2004 and ISA, 2003b.

Steep slopes require additional measures to ensure planting success and reduce erosion, especially if the slope receives stormwater runoff from upland land uses. Depending on the steepness of the slope and the runoff volume, rill or gully erosion may occur on these slopes, requiring a twofold approach: controlling the stormwater and stabilizing the slope.

Erosion control blankets are recommended to temporarily stabilize soil on slopes until vegetation is established. Erosion control fabrics come in a variety of weights and types and should be combined with vegetation establishment such as seeding. Other options for stabilizing slopes include applying compost or bark mulch, plastic sheeting, or sodding.

Trees will add stability to slopes because of their deep roots, provided they are not planted by digging rows of pits across a slope. Required maintenance will include mowing (if slopes are not too steep) and establishing cover on bare or eroded areas.

Planting methods for slopes steeper than 3H:1V involve creating a level planting space on the slope (see Figure 4.59). A terrace can be dug into the slope in the shape of a step by cutting into the existing slope and using the excavated soil as fill to create the step area. A low soil berm (or rock berm) can be formed at the front edge of each step or terrace to slow the flow of water. Trees can also be planted in clusters on slopes (using the above method) to limit potential for desiccation. Staggering tree placement and mulching will prevent water from running straight downhill.

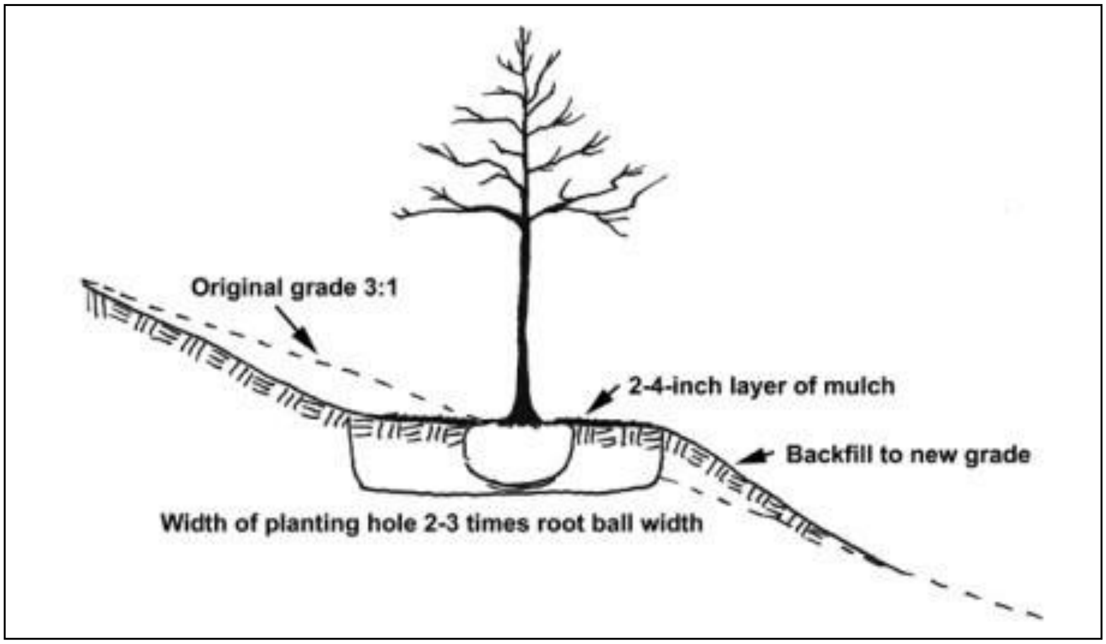


Figure 4.58 Trees planted on steep slopes require a constructed level planting surface.

Post-Planting Tree Protection

Mulching: Once the tree has been properly planted, 2 to 4 inches (maximum) of organic mulch must be spread over the soil surface out to the drip line (the outermost circumference of the tree canopy) of the tree. A mulch-free area, 2 to 3 inches wide at the base of the tree, must be provided to avoid moist bark conditions and prevent decay

If planting a cluster of trees, mulch the entire planting area, ensuring a 2- to 3-inch wide mulch free area at the base of each tree.

Slow-decomposing organic mulches, such as shredded bark, compost, leaf mulch, or wood chips provide many added benefits for trees. Mulch that contains a combination of chips, leaves, bark, and twigs is ideal for reforestation sites. Grass clippings and sawdust are not recommended as mulches because they decompose rapidly and require frequent application, resulting in reduced benefits.

For well-drained sites, up to 4 inches of mulch may be applied. For poorly drained sites, a thinner layer of mulch should be applied. Mulch should never be more than 4 inches deep or applied right next to the tree trunk; however, a common sight in many landscaped areas is the “mulch volcano.” This over-mulching technique can cause oxygen and moisture-level problems, and decay of the living bark at the base of the tree.

Staking: Studies have shown that trees will establish more quickly and develop stronger trunk and root systems if they are not staked at the time of planting. Staking for support may be necessary only for top-heavy trees or at sites where vandalism or windy exposure are a concern.

If staking is necessary for support, two stakes used in conjunction with a wide flexible tie material will hold the tree upright, provide flexibility, and minimize injury to the trunk. To prevent damage to the root ball, stakes should be placed in undisturbed soil beyond the outer edges of the root ball.

Perhaps the most important part of staking is its removal. Over time, guy wires (or other tie material) can cut into the growing trunk bark and interfere with the movement of water and nutrients within the tree. Staking material should be removed within 1 year of planting.

4.14.3 Tree Inspection Criteria

An initial inspection by a qualified professional should be done to ensure the tree has been planted, watered, and protected correctly with locations flagged if appropriate. For newly planted trees, transplant shock is common and causes stress on the tree. For this reason, newly planted trees should be inspected more frequently than established trees. The time it takes for a tree to become established varies with the size at planting, species, stock, and site conditions, but generally, trees should be inspected every few months during the first 3 years after planting, to identify problems and implement repairs or modify maintenance strategies.

After the first 3 years, annual inspections are sufficient to check for problems. Trees should also be inspected after major storm events for any damage that may have occurred. The inspection should take only a few minutes per tree, but prompt action on any problems encountered results in healthier, stronger trees. Inspections should include an assessment of overall tree health, an assessment of survival rate of the species planted, cause of mortality, if maintenance is required, insect or disease problems, tree protection adjustment, and weed control condition.

Construction inspection checklist for tree planting and preservation can be found in Appendix E Construction Inspection Checklists.

4.14.4 Tree Maintenance Criteria

Water newly planted trees regularly (at least once a week) during the first growing season. Water trees less frequently (about once a month) during the next two growing seasons. After 3 growing seasons, water trees only during drought. The exact watering frequency will vary for each tree and site.

A general horticultural rule of thumb is that trees need 1 inch of rainfall per week during the growing season. This means new trees need a minimum of 25 gallons of water a week to stay alive (http://caseytrees.org/get-involved/water/). Water trees deeply and slowly near the roots. Light, frequent watering of the entire plant can encourage roots to grow at the surface. Soaker hoses and drip irrigation work best for deep watering of trees. It is recommended that slow leak watering bags or tree buckets are installed to make watering easier and more effective. Continue watering until mid-fall, tapering off during lower temperatures.

Pruning is usually not needed for newly planted trees but may be beneficial for tree structure. If necessary, prune only dead, diseased, broken or crossing branches at planting. As the tree grows, lower branches may be pruned to provide clearance above the ground, or to remove dead or damaged limbs.

Maintenance inspection checklist for tree planting and preservation and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.15 Proprietary Practices

<table>
<tr><th colspan="6">Proprietary Practices</th></tr>
<tr><td colspan="6">Definition: Manufactured stormwater treatment practices that utilize settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to manage the impacts stormwater runoff. Performance varies based on manufacturer's design.</td></tr>
<tr><th colspan="2">Site Applicability</th><th colspan="3">BMP Performance Summary</th></tr>
<tr><th>Land Uses</th><th>Required Footprint</th><th colspan="3">WQ Improvement: Moderate to High</th></tr>
<tr><td rowspan="3">▪ Urban
▪ Suburban
▪ Rural</td><td rowspan="3">Small</td><th>TSS[1]</th><th>Total N[1]</th><th>Bacteria[1]</th></tr>
<tr><td>Varies*</td><td>Varies*</td><td>Varies*</td></tr>
<tr><th colspan="3">Runoff Reductions</th></tr>
<tr><th>Construction Costs</th><th>Maintenance Burden</th><th colspan="3">Volume</th></tr>
<tr><td>Moderate</td><td>Moderate</td><td colspan="3">Varies*</td></tr>
<tr><th colspan="2">Maintenance Frequency:</th><th colspan="3">SWRv</th></tr>
<tr><th>Routine</th><th>Non-Routine</th><td colspan="3" rowspan="2">Refer to Device Manufacturers Specifications</td></tr>
<tr><td>At least annually</td><td>Variable</td></tr>
<tr><th colspan="2">Advantages/Benefits</th><th colspan="3">Disadvantages/Limitation</th></tr>
<tr><td colspan="2">▪ On- or off-line treatment
▪ Useful in challenging stormwater site designs
▪ Water quality treatment</td><td colspan="3">▪ Devices can be costly
▪ Most devices do not provide retention</td></tr>
<tr><th colspan="2">Components</th><th colspan="3">Design considerations</th></tr>
<tr><td colspan="2">▪ Pretreatment
▪ Conveyance
▪ Bypass mechanism</td><td colspan="3">▪ Must safely overflow or bypass flow from 2- to 25-year design storms.
▪ Manufacturer's specifications
▪ Adequate maintenance access required</td></tr>
<tr><th colspan="5">Maintenance Activities</th></tr>
<tr><td colspan="2">▪ Based on manufacturer's specifications</td><td colspan="3">▪ Routine inspection for proper function</td></tr>
</table>

[1]*Credited pollutant load removal*

**Varies according to proprietary practice*

Definition. Proprietary practices are manufactured stormwater treatment practices that utilize settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to manage the impacts stormwater runoff. The design includes the following:

M-1 Proprietary practices

Proprietary practices may be used to achieve treatment compliance, provided they have been approved by the State and meet the performance criteria outlined in this specification. Historically, proprietary practices do not provide retention volume. A proprietary practice will not be valued for retention volume unless the practice can demonstrate the occurrence of retention processes.

4.15.1 Proprietary Practice Feasibility Criteria

Individual proprietary practices will have different site constraints and limitations. Manufacturer's specifications should be consulted to ensure that proprietary practices are feasible for application on a site-by-site basis.

4.15.2 Proprietary Practice Conveyance Criteria

All proprietary practices must be designed to safely overflow or bypass flows from larger storm events to downstream drainage systems. The overflow associated with the 2- to 25-year design storms must be controlled so that velocities are non-erosive at the outlet point (i.e., to prevent downstream erosion).

Manufactured treatment devices may be constructed on-line or off-line. On-line systems receive upstream runoff from all storms, providing runoff treatment for the stormwater quality design storm and conveying the runoff from larger storms through an overflow. In off-line devices, most, or all, of the runoff from storms larger than the stormwater quality design storm bypass the device through an upstream diversion or other mechanism.

4.15.3 Proprietary Practice Pretreatment Criteria

Individual proprietary practices may require pretreatment or may be appropriate for use as pretreatment devices. Manufacturer's specifications should be consulted to determine the device-specific pretreatment requirements.

4.15.4 Proprietary Practice Design Criteria

The basic design parameters for a proprietary practice will depend on the techniques it employs to control stormwater runoff and remove particulate and dissolved pollutants from runoff. In general, the design of devices that treat runoff with no significant storage and flow rate attenuation must be based upon the peak design flow rate. However, devices that do provide storage and flow rate attenuation must be based, at a minimum, on the design storm runoff volume and, in some instances, on a routing of the design runoff hydrograph. Hydrologic design is discussed further in Appendix I Hydrology and Hydraulics Design Requirements.

Proprietary practices approval is contingent on adherence to the New Jersey Department of Environmental Protection Certification (NJDEP) protocols and testing. The NJDEP Certification Process includes details of the verification process and the required data submittals for determination of proprietary practice performance. The current NJDEP version should be followed and is included in the References below.

Adequate maintenance access must be provided for all proprietary practice systems. Access, with access steps, as applicable, must be provided for the inlet pipe, outflow structure, and over any other functional components.

4.15.5 Proprietary Practice Landscaping Criteria

Proprietary devices may or may not require landscaping considerations. Manufacturer's specifications should be consulted to determine any landscaping requirements for the device.

4.15.6 Proprietary Practice Construction Sequence

The construction and installation of individual proprietary practices will vary based on the specific proprietary practice. Manufacturer's specifications should be consulted to determine the device specific construction sequencing requirements.

Construction inspection checklist for generic structural BMPs can be found in Appendix E Construction Inspection Checklists.

4.15.7 Proprietary Practice Maintenance Criteria

In order to ensure effective and long-term performance of a proprietary practice, regular maintenance tasks and inspections are required.

All proprietary practices should be inspected by a qualified professional and maintained in accordance with the manufacturer's instructions and/or recommendations and any maintenance requirements associated with the device's verification by Beaufort County Public Works Department.

Maintenance inspection checklist for generic structural BMPs and the Maintenance Service Completion Inspection form can be found in Appendix F Maintenance Inspection Checklists.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable local, state, and federal law.

4.15.8 Proprietary Practice Stormwater Compliance Calculations

Proprietary practices receive retention credit when explicitly approved by the Beaufort County Public Works Department. Pollutant removal (TSS EMC reduction) may be awarded for specific practices provided they meet the performance criteria outlined in Section 4.15.4 Proprietary Practice Design Criteria.

4.16 Conservation Area

If a site includes a Conservation Area which is protected under a conservation easement or equivalent form of protection, a portion of the conservation area may be "removed" from the site for the purposes of calculating the stormwater retention volume (SWRv). There are four scenarios that could qualify for a conservation area credit.

4.16.1 Scenario 1: Natural Conservation Area

Scenario 1 is applicable if a portion of the post-developed area is left in its natural condition and protected, in perpetuity, by a conservation easement or equivalent form of protection. If this scenario is applicable, subtract 100% of the protected natural area from the total site area when calculating the SWRv.

4.16.2 Scenario 2: Reforestation/Revegetation

Scenario 2 is applicable if a portion of the post-developed area employs site reforestation/revegetation and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the reforested/revegetated area from the total site area when calculating the SWRv.

4.16.3 Scenario 3: Soil Restoration

Scenario 3 is applicable if a portion of the post-developed area employs soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection. If this application is used alone, subtract 50% of the soil restoration area from the total site area when calculating the SWRv.

4.16.4 Scenario 4: Reforestation/Revegetation & Soil Restoration

Scenario 4 is applicable if the same portion of the post-developed area employs site reforestation/revegetation as well as soil restoration and is protected, in perpetuity, by a conservation easement or equivalent form of protection, subtract 100% of the acres of development with restored soils in a reforested and revegetated area from the total site area when calculating the SW

Chapter 5. Erosion & Sediment Control

Sedimentation involves three basic geologic processes: erosion, transportation, and deposition. These are natural geologic phenomena; however, land development activities may initiate severe, highly undesirable and damaging alterations in the natural sedimentation cycle by drastically accelerating the erosion and transportation process. Receiving waters are the final destination for sediment transport and deposition. However, natural streams and lakes are not capable of handling the excessive sediments created by this accelerated cycle. Therefore, excessive sediment loads result in turbid waters and heavy deposition over the substrate. The impact of these events directly affects the propagation of aquatic life, which relies on clear substrates and water to feed and reproduce. Sediment-laden waters affect human activities through the degradation of waters used for aquatic recreation and sport fishing and complicate water treatment processes. Consequently, minimizing the occurrence of erosion and effective control of sediment transport is imperative to all.

5.1 Sedimentation Cycle

Soil erosion is usually caused by the impact force of raindrops and by the sheer stress of runoff flowing in rills and streams. Raindrops falling on bare or sparsely vegetated soil detach soil particles; runoff, in the form of sheet flow along the ground, picks up and carries these particles to surface waters. As the runoff gains velocity and concentration, it detaches more soil particles, cuts deeper rills and gullies into the surface of the soil, and adds to its own sediment load. Coalescing rivulets produce streams which have a larger volume and usually an increased velocity. These increasing streams have a greater capacity to remove sediment and transport it downstream. The further the runoff runs uncontrolled, the greater its erosive force and the greater the resulting damage. As the distance and volume of uncontrolled flow increase, the control becomes increasingly difficult. At some point, the energy in the stream dissipates to level that can no longer support the transport of the sediment. At this time, the sediment falls out of the water column and deposits. Over time the sediment will either be incorporated into the substrate or be re-suspended for further transport.

5.2 Factors Influencing Erosion

The erosion potential of a site is principally determined by the soil type, vegetative cover, topography, climate, and season. These factors contribute to the detachment of soil particles and their transport off-site.

- **Soil Type** – Erodibility, the amount of energy needed to break down soil structure, is dependent on soil composition and texture. Soils with high erodibility require less energy to detach soil particles.
- **Vegetative Cover** – Vegetation shields soils from the impact energy of raindrops and traps suspended sediment from runoff.
- **Topography** – Steeper and longer slopes generate runoff with more velocity and energy to erode and transport more sediment.
- **Climate** – Rainfall frequency and intensity cumulatively contribute energy in the form of raindrop impact and runoff volume to detach and transport soil particles.
- **Season** – Seasonal variations in wind, temperature, humidity, and rainfall may create more ideal conditions for erosion.

5.3 Concepts of Erosion & Sediment Control

Principles of erosion and sedimentation control are based on minimizing the effects of the soil and climatologic factors just discussed. None of the following concepts provide a singular solution for controlling those factors, nor can they all be performed at every site. However, the integration of as many concepts as possible provides the most effective erosion and sedimentation control:

A. Compatible Site Planning
   - Minimize development within sensitive areas (e.g. highly erosive soils).
   - Limit the length and steepness of the designed slopes.
   - Maintain natural vegetative cover when possible.

B. Disturbed Areas Reduction
   - Minimize the extent of the disturbed area and the duration of exposure.
   - Phase or stage development so that only the areas that are actively being developed are disturbed.
   - Minimize large or critical area grading during the season of maximum erosion potential.

C. Disturbed Areas Protection
   - Complete grading as quickly as possible.
   - Establish permanent vegetation as soon as possible on disturbed areas.
   - Divert runoff from disturbed areas.

D. Sediment Retention within Site Boundaries
   - Filter runoff as it flows from a disturbed area.
   - Impound sediment-laden runoff temporarily so that the soil particles are deposited onsite.

The NPDES Phase II storm water regulations enacted by the Clean Water Act of 1972 and promulgated by Stormwater Phase II Final Rule (1999) require that any activity disturbing an acre or greater of land, or a smaller project part of a larger common plan for development or sale, obtain NPDES construction permit coverage. This regulation differs somewhat from the South Carolina state regulations relating to areas of disturbance. Any land disturbing activity in the *Beaufort County* that meets the aforementioned criteria of one acre or more of disturbance will need to will comply with the state process for permitting. Application and issuance of an approved permit under the South Carolina state regulations for erosion and sedimentation control will meet the requirements for coverage under NPDES Phase II as well (DHEC, 2012).

5.4 General Criteria

All construction site activities must adhere to the SCDHEC General Permit SC0010000 for Large and Small Site Construction Activities. In addition, the *Beaufort County* will require as a minimum, implementation of the following construction site BMPs:

Single Family Development, not part of a larger common plan of development:

1. Silt Fencing buried a minimum of 6 inches below disturbed grade, where applicable;
2. In areas where more than two feet of fill material has been placed or in areas adjacent to all wetlands, silt fencing meeting the requirements of SCDOT must be used;

3. Temporary gravel driveways a minimum of 15 feet by 10 feet, where applicable; and
4. Sediment barriers surrounding all catch basins or drop inlets on site and sediment socks on all catch basins or drop inlets adjoining to the site.

Single Family and Multi-Family Development, part of a larger common plan of development, and Non-residential Development:

1. Silt Fencing buried a minimum of 6 inches below disturbed grade;
2. Temporary gravel driveways a minimum of 15 feet by 10 feet;
3. Sediment barriers surrounding all catch basins or drop inlets on site and sediment socks on all catch basins or drop inlets adjoining to the site;
4. Flow dissipation devices, such as check dams, in all swales and ditches;
5. Temporary stabilization shall be placed within 7 days after construction activity is complete unless construction activity is going to resume within 21 days;
6. Floating pump suctions for all temporary or permanent ponds or pumping of excavations;
7. Discharge velocities shall be reduced to provide non-erosive flows from dewatering for all temporary or permanent ponds or pumping of excavations;
8. Site inspections must be performed by a *Beaufort County* qualified individual. Copies of inspection reports shall be provided to the *Beaufort County* within 7 days of inspection;
9. Temporary stockpile areas and appropriate BMPs to be identified on plans; and
10. Two rows of silt fence are required between land disturbing activities and adjacent wetlands.

Ch 6. Enforcement and Violations

Beaufort County is required to conform to the most recent revisions of the NPDES General Permit for Discharges from Regulated SMS4, permit #SCR03000, NPDES General Permit for Stormwater Discharges from Construction Activities, Permit #SCR100000, and the Southern Lowcountry Design Manual and Ordinance. Stormwater runoff can carry pollutants to our local waterways through a variety of means. In order to control these discharges, Beaufort County is required to enforce and issue violations to property owners, contractors, subcontractors, developers, etc that have land disturbance or BMP’s installed on property to ensure they are maintained and in compliance with the permits and ordinances cited above.

The escalating enforcement plan (EEP) was developed to help contractors manage and reduce potential impacts on active construction sites to the maximum extent practicable (MEP) through effective enforcement procedures.

- Any deficiencies or non-compliance issues identified during a County inspection will be reported to the project contractor, on-site supervisor, property owner, and/or engineer for addressing. Some corrective measures may require immediate, 48-hr, 72-hr, or 96-hr action depending on the nature of the violation.
- BMP’s experiencing frequent failures can be required by staff to be replaced with alternative control methods. All changes should be communicated with the Stormwater Management Department and documented in the OS-SWPPP.
- Failure to address concerns or implement required changes may result in notices of violation, stop work orders, or fines.
- Sites with repeated violations may be subject to additional compliance actions, special inspection schedules or inspections as determined by the Stormwater Management Department.

2. Enforcement

If the County determines a project is in noncompliance with the Stormwater Ordinance or SoLoCo Manual, then the inspector may direct conformity by proceeding with an appropriate enforcement action. The County uses enforcement actions that include verbal warnings, Notices of Violation, Stop Work Orders, and/or civil penalties. The enforcement mechanism to be utilized will depend on the circumstances as described in the following sections.

3. Notice of Violation

The inspector will issue a Notice of Violation (NOV) for the first offenses of non-compliance with the County Stormwater Ordinance. The purpose of the NOV is to give notice of the deficiencies, identify expected corrective results and provide a reasonable timeframe to the contractor/land owner/developer prior to the County taking further action to ensure compliance. All NOV’s shall be issued shall be issued per the ordinance and noted in the project file. A Notice of Violation may be issued in the following cases, but not limited to, when there is:

- Failure to coordinate an initial inspection (residential) or pre-construction meeting (commercial) prior to construction.

- Failure comply with the approved Stormwater design plans to include failure to properly install and maintain BMP measures.
- Failure to properly maintain permanent Stormwater management structures.
- Failure to comply with any portion of the Stormwater ordinance.

The contractor and land owner will be informed the inspection has failed inspection within 48-hrs of the failure. The inspector may issue a verbal Notice of Violation, but will also make the NOV available via an emailed PDF. Based on the severity of the failure and the discretion of the inspector, the contractor will be given 48 – 96 hrs to make corrective actions. The contractor may request an on-site meeting within the specified time frame to review site deficiencies and corrective actions taken. The contractor may request an extension to resolve violation issues, but it is at the discretion of the inspector to approve the request.

NOV's do not have to be issued for the same compliance failures before escalating to a Stop Work Order. A NOV will be void upon the next passed inspection.

4. Stop Work Order

An inspector will issue a Stop Work Order if compliance cannot be obtained through the issuance of NOV's or a violation is so severe immediate action must be taken. These actions can include, but are not limited to, the following:

- Construction Activities are occurring without County permits and/or an approved SWPPP.
- Past enforcement actions taken by the County have not been addressed with appropriate and prompt action to the satisfaction of the Stormwater Manager.
- Non-compliance with the approved plans has resulted in a health or safety issue.
- Offsite sedimentation resulting from non-compliance with the approved SWPPP has eliminated or severely degraded a use in a downstream water body or that such degradation is imminent.
- Non-compliance with the approved SWPPP has caused severe damage to adjacent land.
- Failure to comply with any other provisions of the Stormwater Ordinance.

If a Stop Work Order is issued, a sign will be placed at the main entrance of the site. All construction activities must immediately cease and will not begin again until the violation has been mitigated. A Stop Work Order will remain in effect for a minimum of 24 hours. The contractor or land owner must call the inspector to schedule a re-inspection. In the event the inspector is not satisfied with efforts of compliance, a fine may be issued in accordance with the Stormwater Ordinance. A stop work order will be void after the next passed inspection.

5. Civil Penalties

Violations may be subject the contractor/land owner to civil penalties outlined in the Stormwater Ordinance for each violation. Each day a violation continues constitutes a new and separate violation.

6. Criminal Penalties

In addition to any applicable civil penalties, and person who negligently, willfully, or intentionally violates any provision of the Ordinance shall be guilty of a misdemeanor and shall be punished within the jurisdictional limits of the magistrate's court. The Stormwater Manager may issue a notice to appear for a violation of this ordinance. Civil penalties imposed are outlined in the Stormwater Ordinance. Each day a violation continues constitutes a new and separate violation.

Chapter 99 STORMWATER MANAGEMENT[1]

ARTICLE I. IN GENERAL

Secs. 99-1—99-100. Reserved.

ARTICLE II. STORMWATER MANAGEMENT UTILITY

Sec. 99-101. Findings of fact.

The county council of Beaufort County, South Carolina, makes the following findings of fact:

(a) The professional engineering and financial analyses conducted on behalf of and submitted to the county properly assesses and defines the stormwater management problems, needs, goals, program priorities, costs of service, need for interlocal cooperation, and funding opportunities of the county.

(b) Given the problems, needs, goals, program priorities, costs of service, needs for interlocal cooperation, and funding opportunities identified in the professional engineering and financial analyses submitted to the county, it is appropriate to authorize the establishment of a separate enterprise accounting unit which shall be dedicated specifically to the management, construction, maintenance, protection, control, regulation, use, and enhancement of stormwater systems and programs in Beaufort County in concert with other water resource management programs.

(c) Stormwater management is applicable and needed throughout the unincorporated portions of Beaufort County, but interlocal cooperation between the county and the incorporated cities and towns within the county is also essential to the efficient provision of stormwater programs, services, systems, and facilities. Intense urban development in some portions of the county has radically altered the natural hydrology of the area and the hydraulics of stormwater systems, with many natural elements having been replaced or augmented by manmade facilities. Other areas of the county remain very rural in character, with natural stormwater systems predominating except along roads where ditches and culverts have been installed. As a result, the specific program, service, system, and facility demands differ from area to area in the county. While the county manages, operates, and improves stormwater programs, services, systems and facilities in the rural as well as urban areas, the need for improved stormwater management is greatest in the urban areas and nearby, including areas within incorporated cities and towns. Therefore, a stormwater utility service area subject to stormwater service fees should encompass, in so far as possible through interlocal agreements, the entirety of Beaufort County and the stormwater management utility service fee rate structure should reflect the amount of impervious area on individual properties and the runoff impact from water quantity and water quality.

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[1]Editor's note(s)—Ord. No. 2015/24 , adopted Sept. 28, 2015, amended and replaced ch. 99 to read as herein set out. Former ch. 99 pertained to the same subject matter, and derived from Ord. No. 2005/33 , adopted Sept. 22, 2005; and Ord. No. 2009/21 , adopted May 26, 2009.

(d) The stormwater needs in Beaufort County include, but are not limited to, protecting the public health, safety, and welfare. Provision of stormwater management programs, services, systems, and facilities therefore renders and/or results in both service and benefit to individual properties, property owners, citizens, and residents of the county and to properties, property owners, citizens, and residents of the county concurrently in a variety of ways as identified in the professional engineering and financial analyses.

(e) The service and benefit rendered or resulting from the provision of stormwater management programs, services, systems, and facilities may differ over time depending on many factors and considerations, including, but not limited to, location, demands and impacts imposed on the stormwater programs, systems, and facilities, and risk exposure. It is not practical to allocate the cost of the county's stormwater management programs, services, systems, and facilities in direct and precise relationship to the services or benefits rendered to or received by individual properties or persons over a brief span of time, but it is both practical and equitable to allocate the cost of stormwater management among properties and persons in proportion to the long-term demands they impose on the county's stormwater programs, services, systems, and facilities which render or result in services and benefits.

(f) Beaufort County presently owns and operates stormwater management systems and facilities that have been developed, installed, and acquired through various mechanisms over many years. The future usefulness and value of the existing stormwater systems and facilities owned and operated by Beaufort County, and of future additions and improvements thereto, rests on the ability of the county to effectively manage, construct, protect, operate, maintain, control, regulate, use, and enhance the stormwater systems and facilities in the county, in concert with the management of other water resources in the county and in cooperation with the incorporated cities and towns. In order to do so, the county must have adequate and stable funding for its stormwater management program operating and capital investment needs.

(g) The county council finds, concludes, and determines that a stormwater management utility provides the most practical and appropriate means of properly delivering stormwater management services and benefits throughout the county, and the most equitable means to fund stormwater services in the county through stormwater service fees and other mechanisms as described in the professional engineering and financial analyses prepared for the county.

(h) The county council finds, concludes, and determines that a schedule of stormwater utility service fees be levied upon and collected from the owners of all lots, parcels of real estate, and buildings that discharge stormwater or subsurface waters, directly or indirectly, to the county stormwater management system and that the proceeds of such charges so derived be used for the stormwater management system.

(i) The county council finds that adjustments and credits against stormwater utility service fees are an appropriate means to grant properties providing stormwater management program services that would otherwise be provided by the county and will afford Beaufort County cost savings. These reductions will be developed by the public works director and will be reviewed on an annual basis to allow for any modifications to practices required by Beaufort County.

The county council finds that both the total gross area and impervious area on each property are the most important factors influencing the cost of stormwater management in Beaufort County and, the runoff impact from water quantity and water quality.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-102. Establishment of a stormwater management utility and a utility enterprise fund.

There is hereby established within the environmental engineering division of Beaufort County a stormwater management utility for the purpose of conducting the county's stormwater management program. The county administrator shall establish and maintain a stormwater management utility enterprise fund in the county budget and accounting system, which shall be and remain separate from other funds. All revenues of the utility shall be placed into the stormwater management utility enterprise fund and all expenses of the utility shall be paid from the fund, except that other revenues, receipts, and resources not accounted for in the stormwater management utility enterprise fund may be applied to stormwater management programs, services, systems, and facilities as deemed appropriate by the Beaufort County Council. The county administrator may designate within the stormwater management utility enterprise fund such sub-units as necessary for the purpose of accounting for the geographical generation of revenues and allocation of expenditures pursuant to interlocal governmental agreements with the cities and towns of Beaufort County.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2020/18, 5-26-2020 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-103. Purpose and responsibility of the utility.

The Beaufort County Stormwater Management Utility is established for the purpose of managing, acquiring, constructing, protecting, operating, maintaining, enhancing, controlling, and regulating the use of stormwater drainage systems in the county. The utility shall, on behalf of the county and the citizens of the county: administer the stormwater management program; perform studies and analyses as required; collect service fees; system development fees, in-lieu of construction fees and other funding as allowed by law, and obtain and administer grants and loans as authorized by the county council; prepare capital improvement plans and designs; perform routine maintenance and remedial repair of the stormwater systems; acquire, construct, and improve stormwater systems; acquire necessary lands, easements, rights-of-way, rights-of-entry and use, and other means of access to properties to perform its duties; regulate the on-site control, conveyance, and discharge of stormwater from properties; obtain federal and state permits required to carry out its purpose; enter into operating agreements with other agencies; allocate funds pursuant to interlocal governmental agreements; educate and inform the public about stormwater management; and perform, without limitation except by law, any stormwater management functions and activities necessary to ensure the public safety, protect private and public properties and habitat, and enhance the natural environment and waters of the county.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-104. Limitation of scope of responsibility.

The purpose and responsibility of the stormwater management utility shall be limited by the following legal and practical considerations:

(a) Beaufort County owns or has legal access for purposes of operation, maintenance and improvement only to those stormwater systems and facilities which:

   (1) Are located within public streets, other rights-of-way, and easements;

   (2) Are subject to easements, rights-of-entry, rights-of-access, rights-of-use, or other permanent provisions for adequate access for operation, maintenance, monitoring, and/or improvement of systems and facilities; or

   (3) Are located on public lands to which the county has adequate access for operation, maintenance, and/or improvement of systems and facilities.

(b) Operation, maintenance, and/or improvement of stormwater systems and facilities which are located on private property or public property not owned by Beaufort County and for which there has been no public dedication of such systems and facilities for operation, maintenance, monitoring, and/or improvement of the systems and facilities shall be and remain the legal responsibility of the property owner, except as that responsibility may be otherwise affected by the laws of the State of South Carolina and the United States of America.

(c) It is the express intent of this article to protect the public health, safety, and welfare of all properties and persons in general, but not to create any special duty or relationship with any individual person or to any specific property within or outside the boundaries of the county. Beaufort County expressly reserves the right to assert all available immunities and defenses in any action seeking to impose monetary damages upon the county, its officers, employees and agents arising out of any alleged failure or breach of duty or relationship as may now exist or hereafter be created.

(d) To the extent any permit, plan approval, inspection or similar act is required by the county as a condition precedent to any activity or change upon property not owned by the county, pursuant to this or any other regulatory ordinance, regulation, or rule of the county or under federal or state law, the issuance of such permit, plan approval, or inspection shall not be deemed to constitute a warranty, express or implied, nor shall it afford the basis for any action, including any action based on failure to permit or negligent issuance of a permit, seeking the imposition of money damages against the county, its officers, employees, or agents.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-105. Boundaries and jurisdiction.

The boundaries and jurisdiction of the stormwater management utility shall encompass all those portions of unincorporated Beaufort County, as they may exist from time to time and such additional areas lying inside the corporate limits of those cities and towns in Beaufort County as shall be subject to interlocal agreements for stormwater management as approved by county council and participating municipal councils.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-106. Definitions.

Unless the context specifically indicates otherwise, the meaning of words and terms used in this article shall be as set forth in S.C. Code § 48-14-20, and 26 S.C. Code Regulation 72-301, mutatis mutandis.

Abatement. Any action deemed necessary by the county or its officers or agents to remedy, correct, control, or eliminate a condition within, associated with, or impacting a stormwater drainage system or the water quality of receiving waters shall be deemed an abatement action.

Adjustments. Adjustments shall mean a change in the amount of a stormwater service fee predicated upon the determination reached by the public works director and referenced to the adjustments and credit manual.

Bill class. Every property falls into one of several bill classes. The bill class determines the fee calculation of that property.

Condominiums. Properties with individual ownership of a particular dwelling unit in a building and the common right to share, with other co-owners, in the general and limited common elements of the real property.

Countywide infrastructure operation and maintenance and capital projects. The county maintains some typically larger infrastructure within each of the four municipalities in addition to within the unincorporated area.

The rate structure will allocate the costs for the county to maintain just the countywide drainage infrastructure across the entire rate base in all jurisdictions based on infrastructure linear feet per jurisdiction.

Customers of the stormwater management utility. Customers of the stormwater management utility shall be broadly defined to include all persons, properties, and entities served by and/or benefiting, directly and indirectly, from the utility's acquisition, management, construction, improvement, operation, maintenance, extension, and enhancement of the stormwater management programs, services, systems, and facilities in the county, and by its control and regulation of public and private stormwater systems, facilities, and activities related thereto.

Developed land. Developed land shall mean property altered from its natural state by construction or installation of improvements such as buildings, structures, or other impervious surfaces, or by other alteration of the property that results in a meaningful change in the hydrology of the property during and following rainfall events. Existing county maintained dirt roads which are improved and/or paved as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 and existing private dirt roads which are improved or paved and where the project is not related to a pending or proposed development of adjacent land are deemed not to constitute "developed land".

Exemption. Exemption shall mean not applying to or removing the application of the stormwater management utility service fee from a property. No permanent exemption shall be granted based on taxable or non-taxable status or economic status of the property owner.

Fixed costs. Costs associated with the public service provided equally to each property owner. These costs include, but are not limited to, the following: billing and collections, data management and updating, programming, and customer support.

Gross area. Gross area is the acreage of a parcel as identified by the Beaufort County Assessor records.

Hydrologic response. The hydrologic response of a property is the manner whereby stormwater collects, remains, infiltrates, and is conveyed from a property. It is dependent on several factors including, but not limited to, the size and overall intensity of development of each property, its impervious area, shape, topographic, vegetative, and geologic conditions, antecedent moisture conditions, and groundwater conditions and the nature of precipitation events. Extremely large undeveloped properties naturally attenuate but do not eliminate entirely the discharge of stormwater during and following rainfall events.

Jurisdictional infrastructure operations, maintenance and capital projects. Each of the five jurisdictions maintains its own stormwater drainage infrastructure and funds those costs from utility revenue. Revenue from this fee component will be returned to the service provider, the individual jurisdiction.

Impervious surfaces. Impervious surfaces shall be a consideration in the determination of the development intensity factor. Impervious surfaces are those areas that prevent or impede the infiltration of stormwater into the soil as it entered in natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, sidewalks, walkways, patio areas, driveways, parking lots, storage areas, compacted gravel and soil surfaces, awnings and other fabric or plastic coverings, and other surfaces that prevent or impede the natural infiltration of stormwater runoff that existed prior to development.

Minimum charge. A charge that reflects the minimum amount of demand a property will place on the service provider.

MS4 permit. Each jurisdiction within Beaufort County will be subject to the federally mandated MS4 permit requirements. Compliance requirements include, but are not limited to, monitoring, plan review, inspections, outreach and public education.

Nonresidential properties. Properties developed for uses other than permanent residential dwelling units and designated by the assigned land use code in the Beaufort County tax data system.

Other developed lands. Other developed lands shall mean, but not be limited to, mobile home parks, commercial and office buildings, public buildings and structures, industrial and manufacturing buildings, storage

buildings and storage areas covered with impervious surfaces, parking lots, parks, recreation properties, public and private schools and universities, research facilities and stations, hospitals and convalescent centers, airports, agricultural uses covered by impervious surfaces, water and wastewater treatment plants, and lands in other uses which alter the hydrology of the property from that which would exist in a natural state. Properties that are used for other than single-family residential use shall be deemed other developed lands for the purpose of calculating stormwater service fees.

Residential dwelling classifications. The following categories will identify the appropriate dwelling unit classifications to be utilized in applying the stormwater utility fee structure to the designations contained in the Beaufort County tax data system:

Single-family

Apartments

Townhouses

Condominiums

Mobile home

Salt water marsh. Those parcels, typically contiguous to water, identified as inundated daily due to tidal action and unbuildable. These properties are 100 percent below mean high tide and/or beyond established critical line as defined by the South Carolina Department of Health and Environmental Control's Office of Coastal Resource Management (DHEC-OCRM). The county tax assessor's office shall make this determination based on best available data.

Stormwater management programs, services, systems and facilities. Stormwater management programs, services, systems and facilities are those administrative, engineering, operational, regulatory, and capital improvement activities and functions performed in the course of managing the stormwater systems of the county, plus all other activities and functions necessary to support the provision of such programs and services. Stormwater management systems and facilities are those natural and manmade channels, swales, ditches, swamps, rivers, streams, creeks, branches, reservoirs, ponds, drainage ways, inlets, catch basins, pipes, head walls, storm sewers, lakes, and other physical works, properties, and improvements which transfer, control, convey or otherwise influence the movement of stormwater runoff and its discharge to and impact upon receiving waters.

Stormwater service fees. Stormwater service fees shall mean the service fee imposed pursuant to this article for the purpose of funding costs related to stormwater programs, services, systems, and facilities. These fees will be calculated based upon the impervious and gross area at an 80/20 allocation; stormwater service fee categories; any state agricultural exemptions or caps; an account administrative fee, countywide jurisdiction operation maintenance and capital project fees; and jurisdictional operation, maintenance and capital project fee.

Single-family unit (SFU). The single-family unit shall be defined as the impervious area measurements obtained from a statistically representative sample of all detached single-family structures within Beaufort County. The representative value will be 4,906 square feet.

Stormwater service fee categories. The appropriate categories for determining SFUs will be as follows:

	SFU Calculation (SFUs equal)
Tier 1: Single-family unit (≤2,521 square feet)	Dwelling units x 0.5
Tier 2: Single-family unit (2,522 to 7,265 square feet)	Dwelling units x 1
Tier 3: Single-family unit (≥7,266 square feet)	Dwelling units x 1.5
Mobile home	Dwelling units x 0.36
Apartments	Dwelling units x 0.39
Townhouses	Dwelling units x 0.60

Condominiums	Dwelling units x 0.27
Commercial	Impervious area * 4,906 sq. ft.*

* Commercial billed at a rate of one SFU per 4,906 square feet or a portion thereof.

Submerged property. Those parcels, typically contiguous to water, identified as eroded due to tidal action and unbuildable. These properties are 100 percent below mean low tide and/or beyond established critical line as defined by South Carolina Department of Health and Environment Control's Office of Coastal Resource Management (DHEC-OCRM). The county tax assessor's office shall make this determination based on best available data.

Townhomes. See Condominiums.

Variable costs. An impervious and gross area rate structure that allocates some cost to each of the two variables based on the amount of impervious surface and gross area.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2018/6, 3-12-2018 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-107. Reserved.

Editor's note(s)—Ord. No. 2016/38 , adopted Oct. 24, 2016, deleted § 99-107, which pertained to requirements for on-site stormwater systems; enforcement, methods, and inspections, and derived from Ord. No. 2015/24 , adopted Sept. 28, 2015.

Sec. 99-108. General funding policy.

(a) It shall be the policy of Beaufort County that funding for the stormwater management utility program, services, systems, and facilities shall be equitably derived through methods which have a demonstrable relationship to the varied demands and impacts imposed on the stormwater program, services, systems, and facilities by individual properties or persons and/or the level of service rendered by or resulting from the provision of stormwater programs, systems and facilities. Stormwater service fee rates shall be structured so as to be fair and reasonable, and the resultant service fees shall bear a substantial relationship to the cost of providing services and facilities throughout the county. Similarly situated properties shall be charged similar rentals, rates, fees, or licenses. Service fee rates shall be structured to be consistent in their application and shall be coordinated with the use of any other funding methods employed for stormwater management within the county, whether wholly or partially within the unincorporated portions of the county or within the cities and towns. Plan review and inspection fees, special fees for services, fees in-lieu of regulatory requirements, impact fees, system development fees, special assessments, general obligation and revenue bonding, and other funding methods and mechanisms available to the county may be used in concert with stormwater service fees and shall be coordinated with such fees in their application to ensure a fair and reasonable service fee rate structure and overall allocation of the cost of services and facilities.

(b) The cost of stormwater management programs, systems, and facilities subject to stormwater service fees may include operating, capital investment, and non-operating expenses, prudent operational and emergency reserve expenses, and stormwater quality as well as stormwater quantity management programs, needs, and requirements.

(c) To the extent practicable, adjustments to the stormwater service fees will be calculated by the Beaufort County Public Works Director or his/her designee in accordance with the standards and procedures adopted by the public works director's office.

(d) The stormwater service fee rate may be determined and modified from time to time by the Beaufort County Council so that the total revenue generated by said fees and any other sources of revenues or other resources allocated to stormwater management by the county council to the stormwater management utility shall be sufficient to meet the cost of stormwater management services, systems, and facilities, including, but not limited to, the payment of principle and interest on debt obligations. operating expense, capital outlays, nonoperating expense, provisions for prudent reserves, and other costs as deemed appropriate by the county council.

Beaufort County service fee rate will be based on impervious and gross area at an 80/20 allocation; stormwater service fee categories; any state agricultural exemptions or caps; an account administrative fee, countywide jurisdiction operation maintenance and jurisdictional operation, maintenance and capital project fee. The rates are set by the Beaufort County Stormwater Rate Study adopted August 24, 2015.

The gross area charge for all parcels, except master account properties for condominiums, is calculated in equivalent units as follows:

First 2 acres	$X
For every acre above 2 acres and up to 10 acres	0.5 x $X
For every acre above 10 acres, and up to 100 acres	0.4 x $X
For every acre above 100 acres	0.3 x $X

Condominium accounts will receive a minimum gross area charge of 0.2 x $X. The master account associated with the condominium subdivision will not receive a gross area charge.

Each municipal jurisdiction may have a different fee predicated upon the municipal jurisdiction's revenue needs. The stormwater service fee rates shall be adopted by the municipal jurisdictions and may be amended from time to time by the individual governing body.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-109. Exemptions and credits applicable to stormwater service fees.

Except as provided in this section, no public or private property shall be exempt from stormwater utility service fees. No exemption, credit, offset, or other reduction in stormwater service fees shall be granted based on the age, tax, or economic status, race, or religion of the customer, or other condition unrelated to the stormwater management utility's cost of providing stormwater programs, services, systems, and facilities. A stormwater management utility service fee credit manual shall be prepared by the public works director specifying the design and performance standards of on-site stormwater services, systems, facilities, and activities that qualify for application of a service fee credit, and how such credits shall be calculated.

(a) *Credits.* The following types of credits against stormwater service fees shall be available:

(1) Freshwater wetlands. All properties except those classified as detached single-family dwelling units may receive a credit against the stormwater service fee applicable to the property based on granting and dedicating a perpetual conservation easement on those portions of the property that are classified as freshwater wetlands and as detailed in the stormwater management utility service fee credit manual. The conservation easement shall remove that portion of the subject property from any future development.

(2) Salt water marsh. All properties except those classified as detached single-family dwelling units may receive a credit against the stormwater service fee applicable to the property based on those portions of the property that are classified as salt water marsh and as detailed in the stormwater management utility service fee credit manual.

(3) Submerged properties. All properties may receive a credit against the stormwater service fee applicable to the property based on those portions of the property that are classified as submerged and as detailed in the stormwater management utility service fee credit manual.

(4) Those properties that apply for consideration of an adjustment shall satisfy the requirements established by the Beaufort County Public Works Director or his/her designee and approved reduced stormwater service fee.

(b) *Exemptions.* The following exemptions from the stormwater service fees shall be allowed:

(1) Improved public road rights-of-way that have been conveyed to and accepted for maintenance by the state department of transportation and are available for use in common for vehicular transportation by the general public.

(2) Improved public road rights-of-way that have been conveyed to and accepted for maintenance by Beaufort County and are available for use in common for vehicular transportation by the general public.

(3) Improved private roadways that are shown as a separate parcel of land on the most current Beaufort County tax maps and are used by more than one property owner to access their property.

(4) Improved private roadways that are not shown as a separate parcel of land on the most current Beaufort County tax maps but are used by more than one property owner to access their property.

(5) Railroad tracks shall be exempt from stormwater service fees. However, railroad stations, maintenance buildings, or other developed land used for railroad purposes shall not be exempt from stormwater service fees.

(6) Condominium boat slips shall be exempt from stormwater service fees.

(7) Properties determined by the assessor having 100 percent of the gross area of the property submerged, salt water marsh, or freshwater wetland will not receive an administrative charge, if applicable in the utility rate structure, after the applicable credit defined in paragraph (a) above has been applied to the account.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2020/18, 5-26-2020 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-110. Stormwater service fee billing, delinquencies and collections.

(a) *Method of billing.* A stormwater service fee bill may be attached as a separate line item to the county's property tax billing or may be sent through the United States mail or by alternative means, notifying the customer of the amount of the bill, the date the fee is due (January 15), and the date when past due (March 17 - see Title 12, Section 45-180 of the South Carolina State Code). The stormwater service fee bill may be billed and collected along with other fees, including, but not limited to, the Beaufort County property tax billing, other Beaufort County utility bills, or assessments as deemed most effective and efficient by the Beaufort County Council. Failure to receive a bill is not justification for non-payment. Regardless of the party to whom the bill is initially directed, the owner of each parcel of land shall be ultimately obligated to pay such fees and any associated fines or penalties, including, but not limited to, interest on delinquent service fees. If a customer is under-billed or if no bill is sent for a particular property, Beaufort County may retroactively bill for a period of up to one-year, but shall not assess penalties for any delinquency during that previous unbilled period.

(b) *Declaration of delinquency.* A stormwater service fee shall be declared delinquent if not paid within 60 days of the date of billing or upon the date (March 17) of delinquency of the annual property tax billing if the stormwater service fee is placed upon the annual property tax billing or enclosed with or attached to the annual property tax billing.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-111. Appeals.

Any customer who believes the provisions of this article have been applied in error may appeal in the following manner and sequence:

(a) An appeal of a stormwater service fee must be filed in writing with the Beaufort County Public Works Director, or his/her designee within 30 days of the fee being mailed or delivered to the property owner and stating the reasons for the appeal. In the case of stormwater service fee appeals, the appeal shall include a survey prepared by a registered land surveyor or professional engineer containing information on the impervious surface area and any other feature or conditions that influence the development of the property and its hydrologic response to rainfall events.

(b) Using information provided by the appellant, the county public works director or his/her designee shall conduct a technical review of the conditions on the property and respond to the appeal in writing within 30 days after receipt of the appeal. In response to an appeal, the county public works director or his/her designee may adjust the stormwater service fee applicable to the property in conformance with the general purposes and intent of this article.

(c) A decision of the public works director or his/her designee that is adverse to an appellant may be further appealed to the county administrator or his/her designee within 30 days of the adverse decision. The appellant, stating the grounds for further appeal, shall deliver notice of the appeal to the county administrator or his designee. The county administrator or his designee shall issue a written decision on the appeal within 30 days. All decisions by the county administrator or his designee shall be served on the customer personally or by registered or certified mail, sent to the billing address of the customer. All decisions of the county administrator or his designee shall be final.

(d) The appeal process contained in this section shall be a condition precedent to an aggrieved customer seeking judicial relief. Any decisions of the county administrator or his designee may be reviewed upon application for writ of certiorari before a court of competent jurisdiction, filed within 30 days of the date of the service of the decision.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-112. No suspension of due date.

No provision of this article allowing for an administrative appeal shall be deemed to suspend the due date of the service fee with payment in full. Any adjustment in the service fee for the person pursuing an appeal shall be made by refund of the amount due.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-113. Enforcement and penalties.

Any person who violates any provision of this article may be subject to a civil penalty of not more than $1,000.00, or such additional maximum amount as may become authorized by state law, provided the owner or

other person deemed to be in violation has been notified of a violation. Notice shall be deemed achieved when sent by regular United States mail to the last known address reflected on the county tax records, or such other address as has been provided by the person to the county. Each day of a continuing violation may be deemed a separate violation. If payment is not received or equitable settlement reached within 30 days after demand for payment is made, a civil action may be filed on behalf of the county in the circuit court to recover the full amount of the penalty. This provision on penalties shall be in addition to and not in lieu of other provisions on penalties, civil or criminal, remedies and enforcement that may otherwise apply.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-114. Investment and reinvestment of funds and borrowing.

Funds generated for the stormwater management utility from service fees, fees, rentals, rates, bond issues, other borrowing, grants, loans, and other sources shall be utilized only for those purposes for which the utility has been established as specified in this article, including, but not limited to: regulation; planning; acquisition of interests in land, including easements; design and construction of facilities; maintenance of the stormwater system; billing and administration; water quantity and water quality management, including monitoring, surveillance, private maintenance inspection, construction inspection; public information and education, and other activities which are reasonably required. Such funds shall be invested and reinvested pursuant to the same procedures and practices established by Title 12, Section 45-70 of the South Carolina State Code for investment and reinvestment of funds. County council may use any form of borrowing authorized by the laws of the State of South Carolina to fund capital acquisitions or expenditures for the stormwater management utility. County council, in its discretion and pursuant to standard budgetary procedures, may supplement such funds with amounts from the general fund.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-115. Responsibilities of the stormwater management utility.

The county stormwater management utility shall perform adequate studies throughout the area served by the utility to determine the following:

(1) Baseline study of water quality in the receiving waters;

(2) Identification of pollutants carried by stormwater runoff into the receiving waters;

(3) Recommended mitigation efforts to address pollutants carried by stormwater runoff into the receiving waters;

(4) Inventory of the existing drainage system;

(5) Recommended maintenance practices and standards of the existing drainage system;

(6) Identification of capital improvements to the system to include construction or installation of appropriate BMPs;

(7) A five-year spending plan;

(8) Ensure compliance with the federally mandated MS4 permit requirements;

(9) Efficient utility administration including, but not limited to, billing, collection, defining rate structures, data management and customer support.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-116. Stormwater management utility board.

(1) *Purpose.* In compliance with and under authority of Beaufort County Ordinance 2001/23, the Beaufort County Council hereby establishes the stormwater management utility board (hereinafter referred to as the "SWU board") to advise the council as follows:

(a) To determine appropriate levels of public stormwater management services for residential, commercial, industrial and governmental entities within Beaufort County;

(b) To recommend appropriate funding levels for provision of services in the aforementioned sectors;

(c) To advise the staff of the stormwater management utility on master planning efforts and cost of service/rate studies; and

(d) To support and promote sound stormwater management practices that mitigates non-point source pollution and enhances area drainage within Beaufort County.

Municipal councils are encouraged to organize similar boards to advise them on stormwater management programs and priorities within their boundaries.

In keeping with discussions held during the formation of the stormwater utility, it is anticipated that the municipalities will appoint staff professionals as their representative on the advisory board.

(2) *Stormwater districts.* Stormwater districts are hereby established as follows:

District 1 - City of Beaufort

District 2 - Town of Port Royal

District 3 - Town of Hilton Head Island

District 4 - Town of Bluffton

District 5 - Unincorporated Sheldon Township

District 6 - Unincorporated Port Royal Island

District 7 - Unincorporated Lady's Island

District 8 - Unincorporated St. Helena Island Islands East

District 9 - Unincorporated Bluffton Township and Daufuskie Island

(3) Membership.

(a) The SWU board is formed in accordance with Beaufort County Ordinance 92-28 and shall consist of a total of seven voting representatives from each of the following districts as noted below:

No. of Reps.	Stormwater District	Area
1	5	Unincorporated Sheldon Township
1	6	Unincorporated Port Royal Island
1	7	Unincorporated Lady's Island
1	8	Unincorporated St. Helena Island Islands East
2	9	Unincorporated Bluffton Township and Daufuskie Island
1	—	"At large"

All members of the SWU board will be appointed by county council and shall be residents of those districts or "at large" members from unincorporated Beaufort County.

(b) The SWU board shall also consist of one nonvoting (ex officio) representative from the following districts:

Stormwater District	Municipality
1	City of Beaufort
2	Town of Port Royal
3	Town of Hilton Head Island
4	Town of Bluffton

All ex officio members from municipalities shall be appointed by their respective municipal councils for four-year terms.

(c) All citizen members shall be appointed for a term of four years. The terms shall be staggered with one or two members appointed each year.

(d) While no other eligibility criteria is established, it is recommended that members possess experience in one or more of the following areas: Stormwater management (drainage and water quality) issues, strategic planning, budget and finance issues or established professional qualifications in engineering, construction, civil engineering, architectural experience, commercial contractor or similar professions.

(4) Officers.

(a) *Officers.* Selection of officers and their duties as follows:

1. *Chairperson and vice-chair.* At an annual organizational meeting, the members of the SWU board shall elect a chairperson and vice-chairperson from among its members. The chair's and vice-chair's terms shall be for one year with eligibility for reelection. The chair shall be in charge of all procedures before the SWU board, may administer oaths, may compel the attendance of witnesses, and shall take such action as shall be necessary to preserve order and the integrity of all proceedings before the SWU board. In the absence of the chair, the vice-chair shall act as chairperson.

2. *Secretary.* The county professional staff member shall appoint a secretary for the SWU board. The secretary shall keep minutes of all proceedings. The minutes shall contain a summary of all proceedings before the SWU board, which include the vote of all members upon every question, and its recommendations, resolutions, findings and determinations, and shall be attested to by the secretary. The minutes shall be approved by a majority of the SWU board members voting. In addition, the secretary shall maintain a public record of SWU board meetings, hearings, proceedings, and correspondence.

3. *Staff.* The public works director shall be the SWU board's professional staff.

(b) *Quorum and voting.* Four SWU board members shall constitute a quorum of the SWU board necessary to take action and transact business. All actions shall require a simple majority of the number of SWU board members present.

(c) *Removal from office.* The county council, by a simple majority vote, shall terminate the appointment of any member of the SWU board and appoint a new member for the following reasons:

1. Absent from more than one-third of the SWU board meetings per annum, whether excused or unexcused;

2. Is no longer a resident of the county;

3. Is convicted of a felony; or

4. Violated conflict of interest rules.

Moreover, a member shall be removed automatically for failing to attend any three consecutive regular meetings.

(d) *Vacancy.* Whenever a vacancy occurs on the SWU board, the county council shall appoint a new member within 60 days of the vacancy, subject to the provisions of this section. A new member shall serve out the former member's term.

(e) *Compensation.* The SWU board members shall serve without compensation, but may be reimbursed for such travel, mileage and/or per diem expenses as may be authorized by the county council-approved budget.

(5) Responsibilities and duties.

(a) Review and recommend to the county council for approval, a comprehensive Beaufort County Stormwater Management Master Plan and appropriate utility rate study which is in accordance with the South Carolina Stormwater Management and Sediment Reduction Act; and

(b) Review and comment to the county administrator on the annual stormwater management utility enterprise fund budget; and

(c) Cooperate with the South Carolina Department of Health and Environmental Control (DHEC), Office of Coastal Resource Management (OCRM), the Oversight Committee of the Special Area Management Plan (SAMP), the Beaufort County Clean Water Task Force as well as other public and private agencies having programs directed toward stormwater management programs; and

(d) Review and make recommendations concerning development of a multiyear stormwater management capital improvement project (CIP) plan; and

(e) Review and advise on proposed stormwater management plans and procurement procedures; and

(f) Provide review and recommendations on studies conducted and/or funded by the utility; and

(g) Review and advise on actions and programs to comply with regulatory requirements, including permits issued under the State of South Carolina National Pollutant Discharge Elimination System (NPDES) general permit for stormwater discharges from regulated small municipal separate storm sewer systems (MS4).

(6) *Meetings.* Meetings of the SWU board shall be held as established by the SWU board and county staff on a quarterly and an as needed basis and a calendar will be prepared giving the date, time and location of such meetings. Additionally, meetings may be called by the chairperson or at the request of county staff. The location of all SWU board meetings shall be held in a public building in a place accessible to the public. The following shall apply to the conduct of all meetings:

(a) *Meeting records.* The SWU board shall keep a record of meetings, resolutions, findings, and determinations. The SWU board may provide for transcription of such hearings and proceedings, or portions of hearings and proceedings, as may be deemed necessary.

(b) *Open to public.* All meetings and public hearings of the SWU board shall be open to the public.

(c) *Recommendations or decisions.* All recommendations shall be by show of hands of all members present. A tie vote or failure to take action shall constitute a denial recommendation. All recommendations shall be accompanied by a written summary of the action and recommendations.

(d) *Notice and agenda.* The SWU board must give written public notice of regular meetings at the beginning of each calendar year. The SWU board must post regular meeting agendas at the meeting place 24 hours before any meeting. Notices and agenda for call, special or rescheduled meetings must

be posted at least 24 hours before such meetings. The SWU board must notify any persons, organizations and news media that request such notification of meetings.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Secs. 99-117—99-199. Reserved.

ARTICLE III. REGULATORY GENERAL PROVISIONS

Sec. 99-200. Authority.

This article is adopted pursuant to the authority conferred upon the Beaufort County (county) by the South Carolina Constitution, the South Carolina General Assembly and in accordance with Federal Clean Water Act, the South Carolina Pollution Control Act, and regulations promulgated there under.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-201. Findings.

The county council makes the following findings:

(a) Beaufort County's waters contain some of the few remaining pristine shellfish harvesting areas in the southern coastal counties of South Carolina. Many of its waters have been designated by the State of South Carolina as Outstanding Resource Waters. This use has historical and traditional significance to the area. It is in the public interest that the condition of these areas be maintained and preserved for future generations. Uncontrolled stormwater runoff may have significant, adverse impact on the health, safety and general welfare of the county and the quality of life of its citizens by transporting pollutants into receiving waters and by causing erosion and/or flooding. Development and redevelopment may alter the hydrologic response of local watersheds and increases stormwater runoff rates and volumes, flooding, soil erosion, stream channel erosion, non-point pollution, and sediment transport and deposition, as well as reducing groundwater recharge. These changes in stormwater runoff may contribute to increased quantities of water-borne pollutants and alterations in hydrology which are harmful to public health, safety, and welfare, as well as to the natural environment.

(b) Point source pollution may have significant, adverse impact on the health, safety and general welfare of the county and the quality of life of its citizens by transporting pollutants into receiving waters. The allowance of discharge pipes and outfalls for non-stormwater discharges, illegal dumping, and improper handling of accidental spills and intentional disposals increase the quantities of water-borne pollutants which are harmful to public health, safety, and welfare, as well as to the natural environment.

(c) The effects of point and non-point source pollution, such as uncontrolled runoff, have shown evidence of degradation of the county's receiving waters; thereby adversely affecting the unique qualities of the county's receiving waters, its recreational opportunities and commercial, oystering, boating and fishing, the ecosystem's ability to naturally reproduce and thrive, and the general ability of the area to sustain its natural estuarine resources.

(d) These deleterious effects can be managed and minimized by applying proper design and well-planned controls to manage stormwater runoff from development and redevelopment sites, manage existing natural features that maintain hydrology and provide water quality control, and eliminate potential sources of pollution to receiving waters. Public education regarding the cause and effect of these types

of pollutions and the implementation of the controls and management policies is key to fundamentally changing public behavior.

(e) This article is not in conflict with any development agreements to which the county is a party and does not prevent the development set forth in any development agreement unless impairments to the county's receiving waters is linked to this development.

(f) This article is essential to the public health, safety or welfare and shall apply to any development that is subject to a development agreement.

(g) Laws of general application throughout the county necessary to protect health, safety and welfare are anticipated and are provided for in development agreements.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-202. Purpose.

(a) It is the purpose of this article to guide development in Beaufort County to protect, maintain, and enhance the environment of the county and the short- and long-term public health, safety, and general welfare of the citizens of the county by establishing requirements and procedures to control the potential adverse effects of increased stormwater runoff associated with both future development, re-development, and existing developed land. Proper management of stormwater runoff will minimize damage to public and private property, ensure a functional drainage system, reduce the effects of development on land and stream channel erosion, attain and maintain water quality standards, enhance the local environment associated with the drainage system, reduce local flooding, reduce pollutant loading to the maximum extent practicable and maintain to the extent practicable the pre-developed runoff characteristics of the area, and facilitate economic development while minimizing associated pollutant, flooding, and drainage impacts.

(b) This article specifically authorizes and enables the county to:

(1) Prohibit illicit discharges to the stormwater system and receiving waters.

(2) Define procedures for site plan design, review, inspection, and enforcement relative to stormwater management. Establish decision-making processes surrounding land development or redevelopment activities that protect the integrity of local aquatic resources.

(3) Control the discharge of spills, dumping or disposal of materials other than stormwater to the stormwater system and receiving waters.

(4) Address specific categories of non-stormwater discharges and similar other incidental non-stormwater discharges.

(5) Control importation of water that adversely impacts our receiving waters.

(6) Require temporary erosion and sediment controls to protect water quality to the maximum extent practicable during construction activities, in accordance with current state regulations.

(7) Define procedures for receipt and consideration of information submitted by the public.

(8) Address runoff, particularly volume, rate, and quality through the control and treatment of stormwater with stormwater management facilities and/or best management practices (BMPs).

(9) Develop post-construction stormwater quality performance standards, through enforcement of minimum design standards for BMPs.

(10) Ensure effective long-term operation and maintenance of BMPs.

(11) Carry out all inspection, surveillance, monitoring, and enforcement procedures necessary to determine compliance and noncompliance with this article and stormwater permit conditions including the prohibition of illicit discharges to the county's stormwater system and the protection of water quality of the receiving waters.

(12) Development, implement, and enforce regulations any and all other programs or policies to comply with the Municipal Separate Stormsewer System (MS4) permit issued by South Carolina Department of Health and Environmental Control (DHEC).

(13) Establish design criteria in the most current version of the Southern Lowcountry Stormwater Design Manual for structural and nonstructural stormwater management practices that can be used to meet the minimum post-development stormwater management standards and design criteria;

(14) Establish that Better Site Design (BSD) and site planning has been incorporated, documented, and presented in the development/redevelopment design process.

(15) Maintain structural and nonstructural stormwater management practices to ensure that they continue to function as designed and pose no threat to public safety.

(16) Streamline administrative procedures for the submission, review, approval and disapproval of stormwater management plans and for the inspection of approved land development projects.

(17) If any of the stormwater management standards, as defined in this chapter and in the most current version of the Southern Lowcountry Stormwater Design Manual cannot be attained on the site (due to impractical site characteristics or constraints), a maximum extent practicable analysis shall be prepared and submitted by the applicant for review, discussion, and ultimate approval or rejection of the jurisdiction. Any uncontrolled post-development stormwater quantity or quality volume shall be intercepted and treated in one or more off-site stormwater management practices or a fee-in-lieu shall be required.

(18) The stormwater management practices of approved plans shall provide volume control and at least an 80 percent reduction in total suspended solids loads, 30 percent reduction of total nitrogen load, and 60 percent reduction in bacteria load.

(c) The article requires prudent site planning, including special considerations for the purposes of preserving natural drainage ways incorporating on-site stormwater detention and infiltration to minimize runoff from individual sites to receiving waters by use of effective runoff management, structural and non-structural BMPs, drainage structures, and stormwater facilities. Establish that better site design (BSD) and site planning has been incorporated, documented, and presented in the development/redevelopment design process.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-203. Definitions.

The following definitions shall apply in articles III, IV, V, and VI this chapter. Any term not herein defined shall be given the definition, if any, as is found elsewhere in the Code of Ordinances of Beaufort County, including the community development code (CDC) ordinance.

Administrators. The public works director, the stormwater manager and other individuals designated by the county administrator, from time to time, to administer interpret and enforce this article.

Best management practices ("BMP"). Stormwater management practices, either structural, non-structural or natural that has been demonstrated to effectively control movement of stormwater, pollutants, prevent degradation of soil and water resources, and that are compatible with the planned land use.

Clean Water Act. The Federal Water Pollution Control Act, as amended, codified at 33 U.S.C § 1251 et seq.

Community development code ("CDC"). A form based code to regulate zoning and development in Beaufort County.

County. The Beaufort County, South Carolina.

County council. The publicly elected official of Beaufort County, South Carolina.

Department. The stormwater department, or any duly authorized representatives thereof as designated by the county administrator.

Development. All project construction, modification, or use of any lot, parcel, building, or structure on land and on water. Existing dirt roads which are improved and/or paved as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 and existing private dirt roads which are improved or paved and where the project is not related to a pending or proposed development of adjacent land are deemed not to constitute "development".

Disconnected impervious areas or disconnected impervious surfaces. Those non-contiguous impervious areas or impervious surfaces which produce stormwater runoff that discharges through or across a pervious area or surface (i.e. vegetated cover), of sufficient width to reduce or eliminate pollutants associated with stormwater runoff, prior to discharge to the stormwater system.

Environment. The complex of physical, chemical, and biotic factors that act upon an ecological community and ultimately determine its form and survival.

Evapotranspiration. The sum of evaporation and plant transpiration from the earth's land surface to atmosphere.

Excess stormwater volume. The additional volume of stormwater runoff leaving the site over and above the runoff volume which existed pre-development.

Illicit connection. A connection to the county's stormwater system or receiving water which results in a discharge that is not composed entirely of stormwater runoff and has a detrimental effect on the stormwater system or receiving water except, those granted coverage by an active NPDES permit.

Illicit discharge. Any activity, which results in a discharge to the county's stormwater system or receiving waters that is not composed entirely of stormwater except:

(a) Discharge pursuant to an NPDES permit; and

(b) Other allowable discharges as defined and exempted in this article.

Impervious surface. As defined in the county's best management practices (BMP) manual.

Improper disposal. Any disposal through an illicit discharge, including, but not limited to, the disposal of used oil and toxic materials resulting from the improper management of such substances.

Land disturbance or *land disturbing activity.* The use of land by any person that results in a change in the natural vegetated cover or topography, including clearing that may contribute to or alters the quantity and/or quality of stormwater runoff.

Maintenance. Any action necessary to preserve stormwater management facilities in proper working condition, in order to serve the intended purposes set forth in this article and to prevent structural failure of such facilities.

MS4. Municipal separate storm sewer system.

NPDES. National Pollutant Discharge Elimination System (see "Clean Water Act.")

Natural resources. Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources.

Outfall. The point where county's stormwater system discharges to waters of the United States or the State of South Carolina.

Person. Any and all persons, natural or artificial and includes any individual, association, firm, corporation, business trust, estate, trust, partnership, two or more persons having a joint or common interest, or an agent or employee thereof, or any other legal entity.

Pollutant. Those manmade or naturally occurring constituents that when introduced to a specific environment creates a deleterious effect. Typical pollutants found in stormwater include, but are not limited to, sediment (suspended and dissolved), nutrients (nitrogen and phosphorus, etc.), oxygen demanding organic matter, heavy metals (iron, lead, manganese, etc.), bacteria and other pathogens, oil and grease, household hazardous waste (insecticide, pesticide, solvents, paints, etc.) and polycyclic aromatic hydrocarbons (PAHs).

Property owner or *owner.* The legal or equitable owner of land.

Receiving waters. All natural water bodies, including oceans, salt and freshwater marsh areas, lakes, rivers, streams, ponds, wetlands, and groundwater which are located within the jurisdictional boundaries of the county. Stormwater management ponds, manmade wetlands, ditches, and swales constructed for the sole purpose of controlling and treating stormwater are not considered receiving waters.

Record drawings. A set of drawings prepared by and certified by a South Carolina registered professional engineer or landscape architect that accurately represents the actual final configuration of the stormwater and other related infrastructure constructed in a development.

Redevelopment. As defined in the county's best management practices (BMP) manual.

Regulation. Any regulation, rule or requirement and promulgated by the county pursuant to this article.

Southern Lowcountry Stormwater Design Manual. "The Manual for Stormwater Best Management and Design Practices (BMP)" establishes technical standards as referenced and incorporated into the community development code (CDC).

Stormwater. Stormwater runoff, precipitation runoff, and surface runoff.

Stormwater management. The collection, conveyance, storage, treatment and disposal of stormwater in a manner to meet the objectives of this article and its terms, including, but not limited to, measures that control the increased volume and rate of stormwater runoff and water quality impacts caused by manmade changes to the land.

Stormwater management program, services, systems facilities. Those administrative, engineering, operational, regulatory, and capital improvement activities and functions performed in the course of managing the stormwater systems of the county, plus all services. Stormwater management systems and facilities are those natural and manmade channels, swales, ditches, swamps, rivers, streams, creeks, branches, reservoirs, ponds, drainage ways, inlets, catch basins, pipes, head walls, storm sewers, lakes, and other physical works, properties, and improvements which transfer, control, convey or otherwise influence the movement of stormwater runoff and its discharge to and impact upon receiving waters.

Stormwater management plan or *SWMP.* The set of drawings and other documents that comprise all of the information and specifications for the programs, drainage systems, structures, BMPs, concepts, and techniques for the control of stormwater.

Stormwater pollution prevention plan or *SWPPP.* Erosion prevention and sediment control (EPSC). Also see "stormwater management plan".

Stormwater system. The conveyance or system of conveyances (including roads with drainage systems, highways, right-of-way, private streets, catch basins, curbs, gutters, ditches, manmade channels, storm drains, detention ponds, and other stormwater facilities) which is designed or used for collecting or conveying stormwater.

Structural best management practices ("BMP"). A device designed and constructed to trap and filter pollutants from runoff.

Total impervious surface. All impervious surfaces on a site regardless if they are directly connected to another and that is not constructed using permeable pavement technology.

Utility. Beaufort County Stormwater Utility as established by county article chapter 99, article II.

Waiver. The modification of the minimum stormwater management requirements contained in these articles and the most current version of the Southern Lowcountry Stormwater Design Manual for specific circumstances where strict adherence of the requirements would result in unnecessary hardship and not fulfill the intent of this article.

Water quality. Those characteristics of stormwater runoff that relate to the physical, chemical, biological, or radiological integrity of water.

Water quantity. Those characteristics of stormwater runoff that relate to the rate and volume of the stormwater runoff.

Wetlands. As defined by the Army Corps of Engineers and generally means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar type areas.

Working day. Monday through Friday, excluding all county-observed holidays.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2018/6 , 3-12-2018; Ord. No. 2020/18 , 5-26-2020; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-204. Applicability.

Beginning with and subsequent to its effective date, this article shall be applicable to:

(a) All development and redevelopment.

(b) Any illicit discharges.

(c) The provisions of this article shall apply throughout the unincorporated areas of the county.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-205. Regulations.

The county council, may, in its discretion, amend or change this article, or adopt additional regulations to implement this article in order to comply with the state regulations, administer the stormwater management department, or to otherwise further the goal of protecting the quality of the receiving waters into which the stormwater system discharges.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-206. County stormwater management administration.

Stormwater management will be administered by the public works department and the stormwater department to administer and implement the regulations of this article as set forth in the most current version of the Southern Lowcountry Stormwater Design Manual. The manual may include design standards, procedures and

criteria for conducting hydrologic, hydraulic, pollutant load evaluations, and downstream impact for all components of the stormwater management system. It is the intention of the manual to establish uniform design practices; however, it neither replaces the need for engineering judgment nor precludes the use of information not submitted. Other accepted engineering procedures may be used to conduct hydrologic, hydraulic and pollutant load studies if approved by the public works director.

The manual will contain at a minimum the following components:

(a) Construction activity application contents and approval procedures;

(b) Construction completion and closeout processes;

(c) Hydrologic, hydraulic, and water quality design criteria (i.e., design standards) for the purposes of controlling the runoff rate, volume, and pollutant load. Suggested reference material shall be included for guidance in computations needed to meet the design standards;

(d) Information and requirements for new and re-development projects in special protection areas necessary to address TMDLs, known problem areas and other areas necessary to protect, maintain, and enhance water quality and the environment of Beaufort County and the public health, safety, and general welfare of the citizens of Beaufort County.

(e) Construction document requirements;

(f) Long-term maintenance and maintenance plan;

(g) Minimum easement requirements;

(h) Required and recommended inspection schedules and activities for all components of the stormwater management system, including construction related BMPs.

The manual will be updated periodically to reflect the advances in technology and experience.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2020/18 , 5-26-2020; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-207. Administrators of operations, power and duties.

(a) The administrators, or designee, shall administer, implement, and enforce provisions of this article on behalf of the county.

(b) In addition to the powers and duties that may be conferred by other provisions of the county and other laws, the administrators shall have the following powers and duties under this article:

(1) To create the Southern Lowcountry Stormwater Design Manual. The manual may be used to convey design and engineering standards, construction management processes and procedures, and other aspects necessary for compliance with this chapter;

(2) To review and approve, approve with conditions, or disapprove applications for approval of a stormwater management plan pursuant to this article;

(3) To make determinations and render interpretations of this article;

(4) To establish application requirements, schedules and fees for submittal and review of applications, receipt of appeals, in accordance with the standards for county development permits and stormwater permits under the county's CDC ordinance and this article;

(5) To review and make recommendations to the applications for development or redevelopment approvals;

(6) To enforce the provisions of this article in accordance with its enforcement provisions;

(7) To maintain records, maps, and official materials related enforcement, or administration of this article;

(8) To provide expertise and technical assistance;

(9) To take any other action necessary to administer the provisions of this article.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-208. Coordination with other agencies.

The administrators will coordinate the county's activities with other federal, state, and local agencies, which manage and perform functions relating to the protection of receiving waters.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-209. Cooperation with other governments.

The county may enter into agreements with other governmental and private entities to carry out the purposes of this article. These agreements may include, but are not limited to, enforcement, resolution of disputes, cooperative monitoring, and cooperative management of stormwater systems and cooperative implementation of stormwater management programs.

Nothing in this article or in this section shall be construed as limitation or repeal of any ordinances of these local governments or of the powers granted to these local governments by the South Carolina Constitution or statues, including, without limitation, the power to require additional or more stringent stormwater management requirements within their jurisdictional boundaries.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-210. Stormwater management standards.

(a) Reference to best management practices can be found in the most current version of the Southern Lowcountry Stormwater Design Manual. The administrators shall use the policy, criteria, and information, including technical specifications and standards, in the most current version of the Southern Lowcountry Stormwater Design Manual as the basis for decisions about stormwater plans and about the design, implementation and performance of structural and non-structural stormwater systems. The stormwater management standards shall describe in detail how post-development stormwater runoff will be controlled and managed, the design of all stormwater facilities and practices, and how the proposed project will meet the requirements of this article. The most current version of the Southern Lowcountry Stormwater Design Manual includes a list of acceptable stormwater treatment practices, including the specific design criteria for each stormwater practice. These standards will be updated as technology improves.

(b) Relationship of stormwater management standards to other laws and regulations. If the specifications or guidelines of the standards are more restrictive or apply a higher standard than other laws or regulations, that fact shall not prevent application of the specifications or guidelines in the standards.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-211. Review of stormwater management plans.

Stormwater management plans shall be reviewed as a component of the development plan review process by the administrators. They will be reviewed for compliance with standards in this article and requirements in the

CDC and the most current version of the Southern Lowcountry Stormwater Design Manual Procedures are outlined in the most current version of the Southern Lowcountry Stormwater Design Manual. Requests for meetings and submission of plans will be submitted to stormwater department. The expected process will be in accordance with the standard procedures for applications described in the community development code.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-212. Approvals.

(a) *Effect of approval.* Approval authorizes the applicant to go forward with only the specific plans and activity authorized in the plan. The approval shall not be construed to exempt the applicant from obtaining other applicable approvals from local, state, and federal authorities.

(b) *Time limit/expiration.* Time limit, expiration and extensions shall be in accordance with the county's community development code.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-213. Appeals.

(a) *Scope of appeal.* Any person aggrieved by a decision of the administrators may appeal the same by filing an interim written notice of appeal, with the administrators within 30 days of the issuance of said decision or notice of violation. The interim notice of appeal must specify with reasonable practicality the grounds of the appeal and relief sought. The stormwater management utility board (SWUB) will review and provide a decision within 15 days after the next scheduled board meeting following the appeal. The decision of the SWUB shall be final. Appeals to SWUB's decision shall be processed in accordance with state law.

(b) Standards.

(1) The SWUB is limited to the following determinations for an administrative appeal:

a. The administrators made an error in reviewing whether a standard was met. The record must indicate that an error in judgment occurred or facts, plans, or regulations were misread in determining whether the particular standard was met.

b. Where conflicting evidence exists, the appeal is limited to determining what evidence or testimony bears the greatest credibility in terms of documentation and qualifications of those making the determination.

c. The administrators made the decision on standards not contained in this chapter or other county ordinances, regulations, or state law, or a standard more strict or broad was applied. This chapter does not permit administrators to consider or create standards not officially adopted.

d. An error in applying a standard or measuring a standard was made.

(2) The board, on an appeal, shall not hear any evidence or make any decision based on financial hardships.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-214—99-299. Reserved.

ARTICLE IV. STORMWATER MANAGEMENT STANDARDS TO BE APPLIED

Sec. 99-300. General requirements.

(a) All development and redevelopment, including highways, shall use site planning, design, construction. and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume and duration of flow.

(b) All development shall connect impervious surfaces to vegetative surfaces to the maximum extent practicable.

(c) Stormwater runoff shall be controlled in a manner that:

(1) Promotes positive drainage from structures resulting from development.

(2) Includes the use of vegetated conveyances, such as swales and existing natural channels to promote infiltration and evapotranspiration.

(3) Reduces runoff velocities and maintains sheet flow condition to prevent erosion and promote infiltration.

(4) Limits its interaction with potential pollutant sources that may become water-borne and create non-point source pollution.

(5) Promotes reuse of excess stormwater volume to increase evapotranspiration.

(d) Natural vegetative buffers play an integral part in minimizing the volume of stormwater runoff by promoting infiltration and increasing evaportranspiration to reduce stormwater volume to receiving waters and acting as a first line of treatment of water quality pollution. Development shall observe the buffer requirements of the county's CDC ordinance or if applicable the relevant development agreement, concept plan, and/or approved master plan.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-301. Stormwater design requirements for development.

Developments which incorporates engineered stormwater collection, conveyance, and storage systems shall be designed to the criteria established in the ~~latest~~ most current version of county's Southern Lowcountry Stormwater Design Manual.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-302. BMP requirements.

(a) Effectiveness of infiltration practices is dependent on the site conditions. The most current version of the Southern Lowcountry Stormwater Design Manual outlines guidance for properly siting infiltration practices and shall be reviewed prior to the design phase.

(b) The owners of all new developments that receive a stormwater permit from the county shall be required to perform stormwater quantity monitoring at their expense to ensure compliance with the provisions of this article and ensure that volume reduction plans are operated as intended.

(c) All construction and implementation of erosion and sediment control BMPs shall comply with the requirements of the South Carolina Stormwater Management and Sediment Reduction Act and submit reports in accordance with the most current version of the Southern Lowcountry Stormwater Design Manual.

(d) The county reserves the right to perform other monitoring as it deems appropriate to determine compliance with the State Sediment and Erosion Control Act.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-303. Reserved.

(Ord. No. 2016/38 , 10-24-2016)

Sec. 99-304. Waiver.

Individuals seeking a waiver in connection with a stormwater plan may submit to the public works director a request for a waiver from the requirements of this article if exceptional circumstances applicable to a site exist, such that the applicant can provide rational documentation and justification to support a waiver.

Waivers may be granted for water quantity control only and best management practices to achieve water quality goals will still be required.

(a) *Request of waiver at staff level.* A written request for a waiver is required and shall state the specific waiver sought and the reasons, with supporting data, a waiver should be granted. The request shall include all information necessary to evaluate the proposed waiver. Requests must outline the need for such a waiver, such as site constraints, soil characteristics, or similar engineering limitations. Cost shall not be considered cause for a waiver. The applicant will address the four areas of consideration for waiver approval as follows:

(1) What exceptional circumstances to the site are evident?

(2) What unnecessary hardship is being caused?

(3) How will denial of the waiver be inconsistent with the intent of the ordinance?

(4) How will granting waiver comply with intent of ordinance?

(b) *Review of waivers.* The administrators will conduct a review of the request and will issue a decision within 15 working days of receiving the request.

(c) *Appeal of decision.* Any person aggrieved by the decision of the administrators concerning a waiver request may appeal such decision in accordance with section 99-213 above.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-305. Maintenance; general requirements.

(a) *Function of BMPs as intended.* The owner of each structural BMP installed pursuant to this article shall maintain and operate it to preserve and continue its function in controlling stormwater quality and quantity at the degree or amount of function for which the structural BMP was designed.

(b) *Right of county to inspection.* Every structural BMP installed pursuant to this article shall be made accessible for adequate inspection by the county.

(c) *Annual maintenance inspection and report.* The person responsible for maintenance of any structural BMP installed pursuant to this article shall submit to the administrator(s) an inspection report from a qualified inspector or registered South Carolina Professional Engineer. The inspection report, at a minimum, shall contain all of the following:

(1) The name and address of the land owner;

(2) The recorded book and page number of the lot of each structural BMP or a digital representation of the geographic location of each structural BMP;

(3) A statement that an inspection was made of all structural BMPs;

(4) The date the inspection was made;

(5) A statement that all inspected structural BMPs are performing properly and comply with the terms and conditions of the approved maintenance agreement required by this article;

(6) The original signature and seal of the engineer inspecting the structural BMPs; and

(7) Digital photographs of the structural BMPs and pertinent components integral to its operation, including, but not limited to, inlet/outlet control structures, downstream receiving channel/area, embankments and spillways, safety features, and vegetation.

An original inspection report shall be provided to the administrators beginning one year from the date of final inspection of the completed structural BMP and each year thereafter on or before the date of the record drawings certification.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-306. Operation and maintenance agreement.

(a) Prior to the conveyance or transfer of any lot or building site requiring a structural BMP pursuant to this article, the applicant or owner of the site must execute an operation and maintenance agreement (see the most current version of the Southern Lowcountry Stormwater Design Manual for form) that shall be binding on all subsequent owners of the site, portions of the site, and lots or parcels served by the structural BMP. Until the transference of all property, sites, or lots served by the structural BMP, the original owner or applicant shall have primary responsibility for carrying out the provisions of the maintenance agreement.

(b) The operation and maintenance agreement must be approved by the administrators prior to plan approval, and it shall be referenced on the final plat and shall be recorded with the county register of deeds upon final plat approval. If no subdivision plat is recorded for the site, then the operations and maintenance agreement shall be recorded upon the approval of a certificate of completion with the county register of deeds to appear in the chain of title of all subsequent purchasers under generally accepted searching principles. A copy of the recorded maintenance agreement shall be given to the administrators within 14 days following its recordation.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-307. Deed recordation and indications on plat.

The applicable operations and maintenance agreement pertaining to every structural BMP shall be referenced on the final plat and in covenants and shall be recorded with the county register of deeds upon final plat approval.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-308. Records of installation and maintenance activities.

The owner of each structural BMP shall keep records of inspections, maintenance, and repairs for at least five years from the date of the record and shall submit the same upon reasonable request to the administrator(s).

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-309. Nuisance.

The owner of each stormwater BMP shall maintain it so as not to create or result in a nuisance condition, such as, but not limited to, flooding, erosion, excessive algal growth, overgrown vegetation, mosquito breeding habitat, existence of unsightly debris, or impairments to public safety and health. Maintenance practices must not lead to discharges of harmful pollutants.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-310—99-399. Reserved.

ARTICLE V. ILLICIT DISCHARGES AND CONNECTIONS TO THE STORMWATER SYSTEM

Sec. 99-400. Illicit discharges.

No person shall cause or allow the discharge, emission, disposal, pouring, or pumping directly or indirectly to any stormwater conveyance, receiving water, or upon the land in manner and amount that the substance is likely to reach a stormwater conveyance or the receiving waters, any liquid, solid, gas, or other substance (including animal waste), other than stormwater.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-401. Non-stormwater discharges.

(a) Non-stormwater discharges associated with the following activities are allowed provided that acceptable BMPs are followed:

   (1) Water line and hydrant flushing;

   (2) Landscape irrigation, unless it leads to excess SW volume discharge;

   (3) Diverted stream flows;

   (4) Rising ground waters;

   (5) Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));

   (6) Uncontaminated pumped ground water;

   (7) Discharges from potable water sources (with dechlorination BMP utilized);

   (8) Foundation drains;

   (9) Air conditioning condensation;

(10) Reuse water;

(11) Springs;

(12) Water from crawl space pumps;

(13) Footing drains;

(14) Individual residential car washing;

(15) Flows from riparian habitats and wetlands;

(16) Dechlorinated swimming pool discharges: typically less than one part per million;

(17) Street wash water;

(18) Other non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under EPA authority, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the storm drain system;

(19) Discharges specified in writing by the authorized agency/entity, as being necessary to protect public health and safety;

(20) Dye testing is an allowable discharge, but requires a verbal notification to the authorized enforcement agency prior to the test; and

(21) Firefighting.

(22) The public works director may develop procedures for allowing other non-stormwater discharges.

(b) Prohibited substances include, but are not limited to: Oil, anti-freeze, chemicals, animal waste, paints, garbage, and litter.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-402. Illicit connections.

(a) Connections to a receiving water and/or stormwater conveyance system that allow the discharge of non-stormwater, other than the exclusions described in subsection 99-401(a) above are unlawful. Prohibited connections include, but are not limited to, floor drains, waste water from washing machines or sanitary sewers, wash water from commercial vehicle washing or steam cleaning, and waste water from septic systems.

(b) Where such connections exist in violation of this section and said connections were made prior to the adoption of this article or any other article prohibiting such connections, the property owner or the person using said connection shall remove or correct the connection immediately upon notice.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-403. Spills.

(a) Spills or leaks of polluting substances released, discharged to, or having the potential to released or discharged to a receiving water or the stormwater conveyance system, shall be immediately contained, controlled, collected, and properly disposed. All affected areas shall be restored to their preexisting condition.

(b) Persons in control of the polluting substances shall immediately report the release or discharge to persons owning the property on which the substances were released or discharged, shall within two hours of such an event notify the nearest fire department (which will also notify the administrators), and all required federal and state agencies of the release or discharge. Notification shall not relieve any person of any expenses related to the restoration, loss, damage, or any other liability which may be incurred as a result of said spill or leak, nor shall such notification relieve any person from other liability which may be imposed by state or other law.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-404. Nuisance.

Illicit discharges and illicit connections which exist within the unincorporated county are hereby found, deemed, and declared to be dangerous and prejudicial to the public health, and welfare, and are found, deemed, and declared to be public nuisances. Such public nuisances shall be abated in accordance with the procedures set forth in subsection 99-503(c) and (d).

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-405. Suspension of a MS4 discharge due to an illicit discharge.

(a) Any person discharging to the MS4 in violation of this article may have their MS4 access terminated if such termination would abate or reduce an illicit discharge. The authorized administrators notify a violator of the proposed termination of its MS4 access. The violator may petition the authorized enforcement agency for a reconsideration and hearing.

(b) A person commits a violation if the person reinstates MS4 access to premises terminated pursuant to this section, without the prior approval of the authorized administrators.

(c) The Beaufort County, South Carolina administrators may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge that presents or may present imminent and substantial danger to the environment, or to the health or welfare of persons, or to the MS4 or waters of the United States. If the violator fails to comply with a suspension order issued in an emergency, the authorized enforcement agency may take such steps as deemed necessary to prevent or minimize damage to the MS4 or waters of the United States, or to minimize danger to persons.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-406—99-499. Reserved.

ARTICLE VI. INSPECTION, ENFORCEMENT, AND CORRECTION

Sec. 99-500. Inspections.

The county administrators will maintain the right to inspect any and all stormwater systems within its jurisdiction as outlined below:

(a) An inspector designated by the administrators, bearing proper credentials and identification, may enter and inspect all properties for regular inspections, periodic investigations, monitoring, observation

measurement, enforcement, sampling and testing, to ensure compliance with the provisions of this article.

(b) Upon refusal by any property owner to permit an inspector to enter or continue an inspection, the inspector may terminate the inspection or confine the inspection to areas concerning which no objection is raised. The inspector shall immediately report the refusal and the grounds to the administrators. The administrators will promptly seek the appropriate compulsory process.

(c) In the event that the administrators or inspector reasonably believes that discharges from the property into the county's stormwater system or receiving waters may cause an imminent and substantial threat to human health or the environment, the inspection may take place at any time after an initial attempt to notify the owner of the property or a representative on site. The inspector shall present proper credentials upon reasonable request by the owner or representative.

(d) The Beaufort County, South Carolina, administrators shall have the right to set up on any permitted facility such devices as are necessary in the opinion of the authorized enforcement agency to conduct monitoring and/or sampling of the facility's stormwater discharge.

(e) The Beaufort County, South Carolina, administrators have the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure stormwater flow and quality shall be calibrated to ensure their accuracy.

(f) Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the authorized administrators and shall not be replaced. The costs of clearing such access shall be borne by the operator.

(g) Unreasonable delays in allowing the Beaufort County, South Carolina, administrators access to a permitted facility is a violation of a stormwater discharge permit and of this article. A person who is the operator of a facility with a NPDES permit to discharge stormwater associated with industrial activity commits an offense if the person denies the authorized enforcement agency reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this article.

(h) Inspection reports will be maintained in a permanent file at the offices of the administrators.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-501. Notice and warning.

(a) Upon the county's attention to a violation of this article, the administrators shall investigate the violation and prepare a report concerning the violation. If a violation exists, a notice of violation shall be delivered within five working days to any person occupying the property or linked to a discharge, whether the person is the owner, renter, or lessee. If the nature of the violation is not correctable, a stop work order shall be issued immediately. If no one is present or refuses to accept the notice, the administrators shall post the notice of violation on the residence or building entrance.

(b) The notice of violation shall contain the following:

(1) The address and tax ID number of the property.

(2) The section of this chapter being violated.

(3) The nature and location of the violation and the date by which such violation shall be removed or abated.

(4) A notice of the penalty for failing to remove or abate the violation, stating that if the nuisance recurs by the same apparent occupant, owner, or person in charge, a notice of violation, stop work order, or notice to appear will be issued without further notice.

(5) The notice shall specify the number of days in which the violation shall be removed or abated, which time shall be not less than three days nor more than ten days, except in emergency cases.

(c) If the violation occurs where the residence or building is unoccupied, the property may be posted as provided in this section. If the property is unimproved, the notice may be placed on a tree, a stake, or other such object as available.

(d) A written notice containing the same information as the notice of violation shall be sent to the owner or any other person having control of the property at the last known address of the owner, or at the address of the person having control, by U.S. mail or email.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-502. Recurring violations.

Once a notice has been delivered pursuant to this article and the same violation recurs on the same lot or tract of land by the same person previously responsible, no further notice of violation need be given. Each day a violation continues after the expiration of the warning period to abate such a violation shall constitute a separate offence. Thereafter, the county may issue a stop work order, or such person deemed responsible may be notified to appear in court to answer to the charge against such person.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-503. Failure to act upon notice of violation.

Upon neglect or failure to act upon the notice of violation, and/or stop work order given as provided in sections 99-501 and 99-502, the county shall issue a notice to appear and shall follow the procedures as follows:

(a) *Service of notice to appear.* If a stop work order is given and, after the time for removal or abatement has lapsed, the property is reinspected and the administrator or designee finds and determines the violation has not been removed or abated, the administrator or designee shall fill out and sign, as the complainant, a complaint and information form or a notice to appear. The notice to appear shall include the following:

(1) Name of the occupant, owner, or person in charge of the property.

(2) The address or tax ID number of the property on which the violation is occurring.

(3) This chapter section or other reference the action or condition violates.

(4) The date on which the case will be on the court docket for hearing.

(5) Any other information deemed pertinent by the county official.

The original copy of the notice to appear shall be forwarded to the clerk of the court for inclusion on the court's docket for the date indicated on the notice to appear.

(b) *Notice to appear; delivery by mail.* If no one is found at the property to accept a notice to appear for failure to remove or abate a violation, the administrator or designee shall fill out and sign the notice to appear as the complainant and deliver the original plus one copy to the clerk of the court. The clerk shall verify or insert the date the case has been set for hearing before the court. The clerk shall mail the copy by certified mail to the person named in the notice to appear at that person's last known address.

(c) *Abatement by county; costs assessed to person responsible.* If the occupant, owner, or person in charge of the property for which a warning notice has been given fails to remove or abate the violation in the time specified in the notice, whether on public or private property, the administrator or designee may, if severe conditions exist that affect health, welfare, safety or severe environmental degradation, remove the violation and thereby abate the violation. If such conditions exist, the administrator or designee may lawfully enter upon the property on which the violation remains unabated to remove or abate such violation at the cost of the person responsible for creating or maintaining the violation. The violation will be subject to civil fines reflecting the cost to the county, as prosecuted by the county attorney.

(d) *Payment of costs; special tax bill or judgment.* All costs and expenses incurred by the county in removing or abating any violation on any private property may be assessed against the property as a lien on the property. Alternatively, the cost of removing or abating the violation may be made part of the judgment by the judge, in addition to any other penalties and costs imposed if the person charged either pleads or is found guilty of causing, creating, or maintaining a violation.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-504. Penalty for violation.

(a) Enforcement of this article shall fall under the jurisdiction of both the Beaufort County Public Works Department and Beaufort County Codes Enforcement. Officers and inspectors shall have the authority to exercise full discretion in deciding whether to issue a notice of violation, stop work order, or fine when investigating complains that arise under this article.

(b) Any person, group, firm, association, or corporation violating any section of this chapter, or the requirements of an approved Beaufort County Stormwater Permit, shall be guilty of a misdemeanor and, upon conviction thereof, shall pay such penalties as the court may decide, as prescribed by state law, not to exceed $1000.00 or 30 days' imprisonment for each violation. Each day during which such conduct shall continue shall subject the offender to the liability prescribed in this article.

(c) In addition to the penalties established and authorized in subsection (a) of this section, the county attorney may take other actions at law or in equity as may be required to halt, terminate, remove, or otherwise eliminate any violations of this chapter.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-505. Interpretation.

(a) *Meaning and intent.* All provisions, terms, phrases, and expressions contained in this article shall be construed according to the general and specific purposes set forth in section 99-202, purpose. If a different or more specific meaning is given for a term defined elsewhere in county's Code of Ordinances or in an existing development agreement, the meaning and application of the term in this article shall control for purposes of application of this article.

(b) *Text controls in event of conflict.* In the event of a conflict or inconsistency between the text of this article and any heading, caption, figure, illustration, table, or map, the text shall control.

(c) *Authority for interpretation.* The administrators have, after consultation with county attorney, authority to determine the interpretation of this article. Any person may request an interpretation by submitting a written request to the administrators who shall respond in writing within 30 days. The administrators shall keep on file a record of all written interpretations of this article.

(d) *References to statutes, regulations, and documents.* Whenever reference is made to a resolution, article, statute, regulation, manual (including the most current version of the Southern Lowcountry Stormwater Design Manual), or document, it shall be construed as a reference to the most recent edition of such that has been finalized and published with due provision for notice and comment, unless otherwise specifically stated.

(e) *Delegation of authority.* Any act authorized by this article to be carried out by the county administrator may be carried out by his or her designee.

(f) Usage.

(1) *Mandatory and discretionary terms.* The words "shall," "must," and "will" are mandatory in nature, establishing an obligation or duty to comply with the particular provision. The words "may" and "should" are permissive in nature.

(2) *Conjunctions.* Unless the context clearly indicates the contrary, conjunctions shall be interpreted as follows: The word "and" indicates that all connected items, conditions, provisions or events apply. The word "or" indicates that one or more of the connected items, conditions, provisions or events apply.

(3) *Tense, plurals, and gender words used in the present tense include the future tense.* Words used in the singular number include the plural number and the plural number includes the singular number, unless the context of the particular usage clearly indicates otherwise. Words used in the masculine gender include the feminine gender, and vice versa.

(g) *Measurement and computation.* Lot area refers to the amount of horizontal land area contained inside the lot lines of a lot or site.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-506. Conflict of laws.

This article is not intended to modify or repeal any other ordinance, rule, regulation or other provision of law. The requirements of this article are in addition to the requirements of any other ordinance, rule, regulation or other provision of law, and where any provision of this article imposes restrictions different from those imposed by any other ordinance, rule, regulation or other provision of law, whichever provision is more restrictive or imposes higher protective standards for human or environmental health, safety, and welfare, shall control.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-507. Severability.

If the provisions of any section, subsection, paragraph, subdivision or clause of this article shall be adjudged invalid by a court of competent jurisdiction, such judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision or clause of this article.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Appendix B: Infiltration Testing and Geotechnical Requirements

Table of Contents

B.1 General Notes Pertinent to All Geotechnical Testing

A geotechnical report may be required for all underground stormwater best management practices (BMPs), including infiltration-based practices, filtering systems, and storage practices, as well as stormwater ponds and wetlands. The following must be taken into account when producing this report.

- Testing is to be conducted at the direction of a qualified professional. This professional shall either be a registered professional engineer, soils scientist, or geologist and must be licensed in the State.
- Soil boring or test pit information is to be obtained from at least one location on the site. Additional borings or test pits are required within the proposed BMP facility under three conditions: (1) when the soils or slopes vary appreciably from the findings in the initial boring or test pit, (2) when the groundwater level is found to be significantly higher than the initial boring or test pit indicated, and (3) when the groundwater level may adversely affect the performance of the proposed BMP facilities. However, the location, number, and depth of borings or test pits shall be determined by a qualified professional, and be sufficient to accurately characterize the site soil conditions.
- Log any indications of water saturation to include both perched and groundwater table levels; include descriptions of soils that are mottled or gleyed. Depth to the groundwater table (with 24-hour readings) must be included in the boring logs/geotechnical report.
- Laboratory testing must include grain size analysis. Additional tests such as liquid limit and plastic limit tests, consolidation tests, shear tests and permeability tests may be necessary where foundation soils or slopes are potentially unstable based on the discretion of the qualified professional.
- The geotechnical report must include soil descriptions from each boring or test pit, and the laboratory test results for grain size. Based upon the proposed development, the geotechnical report may also include evaluation of settlement, bearing capacity and slope stability of soils supporting the proposed structures.
- All soil profile descriptions should provide enough detail to identify the boundary and elevations of any problem (boundary/restrictions) conditions such as fills and seepage zones, type and depth of rock, etc.

In addition to the testing requirements described above, infiltration tests must be performed for all BMPs in which infiltration will be relied upon, including permeable pavement systems, bioretention, infiltration, and dry swales. Specific requirements for infiltration testing are discussed below.

B.2 Initial Feasibility Assessment

The feasibility assessment is conducted to determine whether full-scale infiltration testing is necessary, screen unsuitable sites, and reduce testing costs. However, a designer or landowner may opt to skip the initial feasibility assessment at his or her discretion and begin with soil borings.

The initial feasibility assessment typically involves existing data, such as the following:

- On-site septic percolation testing, which can establish historic percolation rates, water table, and/or depth to bedrock. Percolation tests are different than tests for coefficient of permeability or infiltration rate;
- Previous geotechnical reports prepared for the site or adjacent properties; or
- Natural Resources Conservation Service (NRCS) Soil Mapping.

If the results of initial feasibility assessment show that a suitable infiltration rate (typically greater than 0.5 inches per hour) is possible or probable, then test pits must be dug or soil borings drilled to determine the saturated hydraulic conductivity (K_{sat}).

B.3 Test Pit/Boring Requirements for Infiltration Tests

- Excavate a test pit or drill a standard soil boring to a depth of 2 feet below the proposed BMP bottom.
- Do not construct, maintain or abandon a well in a manner that may create a point source or non-point source of pollutants to waters of the State, impair the beneficial uses of waters of the State, or pose a hazard to public health and safety or the environment.
- Determine depth to groundwater table if within 2 feet of proposed bottom.
- Determine Unified Soil Classification System (USCS) and/or United Sates Department of Agriculture (USDA) textures at the proposed bottom to 2 feet below the bottom of the BMP.
- Determine depth to bedrock (if within 2 feet of proposed bottom).
- Include the soil description in all soil horizons. Perform the infiltration test at the proposed bottom of the practice. If any of the soil horizons below the proposed bottom of the infiltration practice (within 2 feet) appear to be a confining layer, additional infiltration tests must be performed on this layer (or layers), following the procedure described below.
- The location of the test pits or borings shall correspond to the BMP locations; a map or plan that clearly and accurately indicates the locations(s) of the test pits or soil borings must be provided with the geotechnical report.

Table 1 indicates the number of test pits or soil borings and subsequent infiltration tests that must be performed per BMP. In cases where multiple BMPs are proposed in 1 area with generally uniform conditions, a circular shape that fully encompasses all of the BMPs may be substituted for the “area of practice” that determines the number of required infiltration tests.

Table 1. Number of Infiltration Tests Required per BMP.

Area of Practice (ft^2)	Minimum Number of Test Pits/Soil Borings
< 1,000	1
1,000–1,999	2
2,000–9,999	3
≥ 10,000	Add 1 test pit/soil boring for each additional 10,000 ft^2 of BMP.

When one test pit or boring is required, it must be located as near to the testing area as possible. When more than one test pit or boring is necessary for a single BMP or area, the pit or boring locations must be equally spaced throughout the proposed area, as directed by the qualified professional. The reported saturated hydraulic conductivity for a BMP shall be the median or geometric mean (area-weighted average) of the observed results from the soil boring/test pit locations.

B.4 Infiltration Testing Requirements

The following tests are acceptable for use in determining soil infiltration rates. The geotechnical report shall include a detailed description of the test method and published source references:

1) Constant Head Bore-Hole Infiltration Tests (also referred to as bore-hole permeameter tests and constant-head well permeameter tests). These types of tests determine saturated hydraulic conductivity (coefficient of permeability) by measuring the rate of water flow to a borehole. Analytical solutions utilize principles of Darcy's Law, borehole geometry, and head (or multiple heads) of water in determining saturated hydraulic characteristics. Where the soil characteristics meet all of the above described requirements for infiltration BMPs, the hydraulic gradient element of Darcy's Law is often estimated as 1 for determining infiltration rate.

   One published standard developed by the United States Bureau of Reclamation for this method is USBR 7300-89. Some of the commercially available equipment is listed below:

   - Aardvark Permeameter
   - Amoozemeter
   - Guelph Permeameter
   - Johnson Permeameter

2) Testing Requirements for Infiltration, Bioretention, and Sand Filer Subsoils, as modified below. The data obtained from this infiltration testing procedure shall be used to calculate the saturated hydraulic conductivity (see Section B.5 Saturated Hydraulic Conductivity Calculations).
   a. Install solid casing in the boring or test pit to the proposed BMP bottom or other required test depth (i.e. confining layer encountered within 2 feet below the BMP bottom). When installing casing, drive the casing between 3 to 5 inches below the test surface to promote a good casing-to-soil seal.
   b. Remove any smeared, soiled surfaces, and provide a natural soil interface into which water may infiltrate. Remove all loose material from the casing. At the tester's/registered professional's discretion, a 2-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scouring and sediment. Fill the casing with clean, potable water 24 inches above the test surface (24 inches of head), and allow to presoak for 24 hours.

c. Protect the open borehole with suitable cover such as a sanitary well cap and steel plate with surrounding sandbags to prevent the introduction of surface water runoff, trash, debris, and other pollutants.

d. Twenty-four hours later, refill the casing with approximately 24 inches of clean water (24 inches of head), and monitor the water level for 1 hour, recording the depth of water at the beginning and end of the test.

e. Repeat step 4 (filling the casing each time) three additional times, for a total of four observations. At the registered professional's discretion, the saturated hydraulic conductivity calculations may be performed based on the values recorded during the average of the four readings or the last observation. The testing interval can be increased at the discretion of the registered professional.

All soil borings and test pits shall be properly backfilled after conclusion of the tests. A person shall not construct, maintain or abandon a well in a manner that may create a point source or non-point source of pollutants to waters of the State, impair the beneficial uses of waters of the State, or pose a hazard to public health and safety or the environment. To prevent a soil boring from becoming a conduit for stormwater or other contaminants to enter groundwater and create a low-permeability seal against vertical fluid migration, follow these steps:

1) Use a positive displacement technique, inject a sodium-based bentonite slurry through a tremie pipe at least 1 inch in diameter starting at the bottom of the borehole. The slurry shall be composed of 2 pounds of sodium-based bentonite powder to 1 gallon of water.
2) If the borehole is too narrow to accommodate a tremie pipe or the borehole is less than 10 feet deep, slowly place uncoated, medium-sized, sodium-based bentonite chips in the borehole to create a 2-foot lift of chips measured from the bottom of the borehole.
3) Tamp down the bentonite chips to prevent bridging.
4) Using a ratio of 1 gallon of water to 12.5 pounds of bentonite chips, add potable water to the borehole and allow 15 to 30 minutes to elapse to ensure proper hydration of the bentonite chips.
5) Adjust these instructions as necessary in accordance with the manufacturer's instructions, providing that the resulting seal will have an effective hydraulic conductivity of no more than 1 × 10-7 cm/s.
6) The process should be repeated until the boring is filled 1 to 2 feet from the ground surface.
7) The remainder of the borehole should be backfilled with material to match the surrounding cover and must not include the use of a coal-tar product.

Further details are provided in SCDHEC Regulations R.61-71, Well Standards.

Note: If the infiltration testing procedure reveals smells or visual indications of soil or groundwater contamination then the boring or test hole must be filled in accordance with wellhead protection best practices, unless laboratory analysis determines groundwater or soil is not contaminated.

B.5 Saturated Hydraulic Conductivity Calculations

To convert the field infiltration measurements to a saturated hydraulic conductivity value (K_{sat}), the following calculations must be performed.

$$K_{sat} = \frac{\pi D}{11(t_2 - t_1)} \times \ln(H_1 / H_2)$$

where:

K_{sat} = saturated hydraulic conductivity (in/hr)

D = casing diameter (in) (minimum 4 inches)

t_2 = recorded end time of test (hr)

t_1 = recorded beginning time of test (hr)

H_1 = head in casing measured at time t_1 (ft)

H_2 = head in casing measured at time t_2 (ft)

This equation was adapted by the U.S. Bureau of Reclamation in 1975 from Lambe and Whitman, 1969.

B.6 <u>Infiltration Restrictions</u>

If a Phase I Environmental Site Assessment identifies a Recognized Environmental Concern at a site indicating that site contamination is likely or present; or if DHEC is aware of upgradient or downgradient contaminant plumes, the presence of a brownfield or historic hotspot use, such as any of the following current or previous uses, then an impermeable liner must be used for BMPs, and infiltration is prohibited.

- Leaking underground storage tank (LUST),
- Above ground storage tanks (AST),
- Gas stations,
- Vehicle maintenance or repair facility,
- Dry cleaner,
- Transformer sub-station,
- Waste transfer or holding facility,
- Print shop,
- Chemical storage warehouse,
- Illicit hazardous wastes generator,
- Greenhouse with unlined floor,
- Septic system,
- Cement or asphalt plant, or
- Dump or landfill.

If an ASTM Phase II Environmental Site Assessment is performed based on a DHEC-approved workplan and DHEC reviews the results and determines that stormwater infiltration BMPs may impact on-site contamination by the following means, then an impermeable liner must be used for BMPs, and infiltration is prohibited.

- Spreading of contamination vertically or horizontally at the site,
- Increasing on-site groundwater contamination by leaching contaminants from the soil,

- Causing or enhancing contaminant migration to go offsite,
- Interfering with contaminant remedial activities,
- Decreasing or reversing the natural degradation of contaminants, or
- Causing a pollutant discharge to a surface water body.

If DHEC concludes there is no evidence of a Recognized Environmental Concern based on ASTM Phase I and II Environmental Site, and there is no current site use that could result in the foreseeable creation of a Recognized Environmental Concern, then impermeable liners are not required, and infiltration is not restricted.

Appendix C: Soil Compost Amendment Requirements

Table of Contents

C.1 Introduction

Soil amendment (also called soil restoration) is a technique applied after construction to deeply till compacted soils and restore their porosity by amending them with compost. These soil amendments can be used to enhance the performance of impervious cover disconnections and grass channels.

C.2 Physical Feasibility and Design Applications

Amended soils are suitable for any pervious area where soils have been or will be compacted by the grading and construction process. They are particularly well suited when existing soils have low infiltration rates (HSG C and D) and when the pervious area will be used to filter runoff (downspout disconnections and grass channels). The area or strip of amended soils should be hydraulically connected to the stormwater conveyance system. Soil restoration is recommended for sites that will experience mass grading of more than a foot of cut and fill across the site.

Compost amendments are not recommended where any of the following exists:

- Existing soils have high infiltration rates (e.g., HSG A and B), although compost amendments may be needed at mass-graded B soils in order to maintain infiltration rates.
- The water table or bedrock is located within 1.5 feet of the soil surface.
- Slopes exceed 10% (compost can be used on slopes exceeding 10% as long as proper soil erosion and sediment control measures are included in the plan).
- Existing soils are saturated or seasonally wet.
- They would harm roots of existing trees (keep amendments outside the tree drip line).
- The downhill slope runs toward an existing or proposed building foundation.

- Areas that will be used for snow storage.

C.3 Design Criteria

C.3.1 Performance

When Used in Conjunction with Other Practices. As referenced in several of the Chapter 4 Stormwater Best Management Practices (BMPs) specifications, soil compost amendments can be used to enhance the performance of allied practices by improving runoff infiltration. The specifications for each of these practices contain design criteria for how compost amendments can be incorporated into those designs:

- Impermeable Surface Disconnection – See Section 4.6 Impervious Surface Disconnection.
- Grass Channels – See Section 4.7 Open Channel Systems.

C.3.2 Soil Testing

Soil tests are required during two stages of the compost amendment process. The first testing is done to ascertain preconstruction soil properties at proposed amendment areas. The initial testing is used to determine soil properties to a depth 1 foot below the proposed amendment area, with respect to bulk density, pH, salts, and soil nutrients. These tests should be conducted every 5,000 square feet and are used to characterize potential drainage problems and determine what, if any, further soil amendments are needed.

The second soil test is taken at least 1 week after the compost has been incorporated into the soils. This soil analysis should be conducted by a reputable laboratory to determine whether any further nutritional requirements, pH adjustment, and organic matter adjustments are necessary for plant growth. This soil analysis must be done in conjunction with the final construction inspection to ensure tilling or subsoiling has achieved design depths.

C.3.3 Determining Depth of Compost Incorporation

The depth of compost amendment is based on the relationship of the surface area of the soil amendment to the contributing area of impervious cover that it receives. Table C.1 presents some general guidance derived from soil modeling by Holman-Dodds (2004) that evaluates the required depth to which compost must be incorporated. Some adjustments to the recommended incorporation depth were made to reflect alternative recommendations of Roa Espinosa (2006), Balousek (2003), Chollak and Rosenfeld (1998), and others.

Table 1 indicates the number of test pits or soil borings and subsequent infiltration tests that must be performed per BMP. In cases where multiple BMPs are proposed in 1 area with generally uniform conditions, a circular shape that fully encompasses all of the BMPs may be substituted for the "area of practice" that determines the number of required infiltration tests.

Table 1. Method to Determine Compost and Incorporation Depths.

Ratio of Area of Contributing Impervious Cover to Soil Amendment[a] (IC/SA)	Compost Depth[b] (in.)	Incorporation Depth (in.)	Incorporation Method
0.5	3[c]	12[c]	Tiller
0.75	4[c]	18[c]	Subsoiler
1.0[d]	6[c]	24[c]	Subsoiler

[a] IC = contrib. impervious cover (ft^2) and SA = surface area of compost amendment (ft^2)

[b] Average depth of compost added
[c] Lower end for B soils, higher end for C/D soils
[d] In general, IC/SA ratios greater than 1 should be avoided

Once the area and depth of the compost amendments are known, the designer can estimate the total amount of compost needed, using an estimator developed by TCC, (1997):

$$CC = AA \times DD \times 0.0031$$

where:

C = compost needed (yd^3)
A = area of soil amended (ft^2)
D = depth of compost added (in)

C.3.4 Compost Specifications

The basic material specifications for compost amendments are outlined below:

- Compost shall be derived from plant material and provided by a member of the U.S. Composting Seal of Testing Assurance (STA) program. See https://compostingcouncil.org/ for a list of local providers.
- Alternative specifications and/or certifications, such as Clemson University or the US Department of Agriculture, may be substituted, as authorized by *<local jurisdiction>*. In all cases, compost material must meet standards for chemical contamination and pathogen limits pertaining to source materials, as well as reasonable limits on phosphorus and nitrogen content to avoid excessive leaching of nutrients.
- The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions that promote anaerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have a moisture content that has no visible free water or dust produced when handling the material. It shall meet the following criteria, as reported by the U.S. Composting Council STA Compost Technical Data Sheet provided by the vendor:

  a. 100% of the material must pass through a half-inch screen
  b. The pH of the material shall be between 6 and 8
  c. Manufactured inlet material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight
  d. The organic matter shall be between 35%–65%
  e. Soluble salt content shall be less than 6.0 mmhos/cm
  f. Maturity must be greater than 80%
  g. Stability shall be 7 or less
  h. Carbon/nitrogen ratio shall be less than 25:1
  i. Trace metal test result must equal “pass”
  j. The compost must have a dry bulk density ranging from 40–50 lb/ft^3

C.4 Construction Sequence

The construction sequence for compost amendments differs depending whether the practice will be applied to a large area or a narrow filter strip, such as in a rooftop disconnection or grass channel. For larger areas, a typical construction sequence is as follows:

1) **Soil Erosion and Sediment Control.** When areas of compost amendments exceed 2,500 square feet install soil erosion and sediment control measures, such as silt fences, are required to secure the area until the surface is stabilized by vegetation.
2) **Deep Till.** Deep till to a depth of 12 to 18 inches after the final building lots have been graded prior to the addition of compost.
3) **Dry Conditions.** Wait for dry conditions at the site prior to incorporating compost.
4) **Compost.** Incorporate the required compost depth (as indicated in Table 1) into the tilled soil using the appropriate equipment. Level the site. Seeds or sod are required to establish a vigorous grass cover. To help the grass grow quickly, lime or irrigation is recommended.
5) **Vegetation.** Ensure surface area is stabilized with vegetation.
6) **Construction Inspection.** Construction inspection by a qualified professional involves digging a test pit to verify the depth of amended soil and scarification. A rod penetrometer should be used to establish the depth of uncompacted soil at a minimum of 1 location per 10,000 square feet.

C.5 Maintenance

C.5.1 First-Year Maintenance Operations

In order to ensure the success of soil compost amendments, the following tasks must be undertaken in the first year following soil restoration:

- **Initial inspections.** For the first 6 months following the incorporation of soil amendments, the site should be inspected by a qualified professional at least once after each storm event that exceeds 1/2-inch of rainfall.
- **Spot Reseeding.** Inspectors should look for bare or eroding areas in the contributing drainage area (CDA) or around the soil restoration area and make sure they are immediately stabilized with grass cover.
- **Fertilization.** Depending on the amended soils test, a one-time, spot fertilization may be needed in the fall after the first growing season to increase plant vigor.
- **Watering.** Water once every 3 days for the first month, and then weekly during the first year (April through October), depending on rainfall.

C.5.2 Ongoing Maintenance

There are no major ongoing maintenance needs associated with soil compost amendments, although the owners may want to de-thatch the turf every few years to increase permeability. The owner should also be aware that there are maintenance tasks needed for filter strips, grass channels, and reforestation areas. The maintenance inspection checklist for an area of Soil Compost Amendments can be accessed in Appendix F Maintenance Inspection Forms.

C.5.3 Maintenance Agreement

A Maintenance Agreement that includes all maintenance responsibilities to ensure the continued stormwater performance for the BMP is required. The Maintenance Agreement specifies the property owner's primary maintenance responsibilities and authorizes the Beaufort County Public Works staff to access the property for inspection or corrective action in the event the proper maintenance is not performed. The Maintenance Agreement is attached to the deed of the property as attached to the land. It is to be recorded in the Register of Deeds in the County office. Maintenance responsibilities on government properties must be defined through a partnership agreement or a memorandum of understanding.

Appendix D: Conceptual Design Checklist

D.1 Design Checklist

This checklist serves as a guide for the consultant in the preparation and for the reviewer in the evaluation of a Stormwater Management Plan (SWMP). Any questions regarding items contained herein should be referred to the *Beaufort County Public Works Department.* Applicable page number or section in the Southern Lowcountry Stormwater Design Manual is included for reference.

NOTE: PLANS SUBMITTED WITHOUT A COMPLTED CHECKLIST MAY BE RETURNED WITHOUT REVIEW

Site/Project Name:		Date:	
Consultant:		Applicant:	
Phone Number:		Phone Number:	
Email Address:		Email Address:	

☐**Conceptual Plan** or ☐**Final Plan**

Consultant: Please complete the checklist below. A box in the Conceptual or Final checklist columns indicates the item is required for a complete application submittal.

	Conceptual	Final
A. Narrative Information		
1. Cover Sheet with Project Name, Engineer's Contact Information, Developer's Contact Information, Contractors Contact Information. Information required: Name, mailing address, telephone, email.	Δ	Δ
2. Site development plan and stormwater management narrative	Δ	Δ
3. Assess potential application of green infrastructure practices in the form of better site planning and design techniques. Low impact development practice should be used to the maximum extent practicable during the creation of a stormwater management concept plan. A demonstration of better site planning is required. The following site information and practices shall be considered: a. Soil type (from Soil Study); b. Depth of ground water on site; c. Whether the type of development proposed is a hotspot as defined by the Ordinance and Design Manual and address how this influences the concept proposal; d. Protection of primary and secondary conservation areas; e. Reduced clearing and grading limits; f. Reduced roadway lengths and widths; g. Reduced parking lot and building footprints to minimize impervious surface; h. Soil restoration; i. Site reforestation/revegetation; j. Impervious area disconnection;	Δ	

k. Green roof; and l. Permeable pavement		
4. Stormwater Pollution Prevention Plan (SWPPP) or Erosion and Sediment Control narrative (for projects disturbing over an acre)	Δ	Δ
5. Information regarding the mitigation of any off-site impacts anticipated as a result of the proposed development. Not applicable for all projects.		Δ
6. Construction specifications	Δ	Δ
B. Site Plan		
1. Standard drawing size (24 x 36 inches)	Δ	Δ
2. A plan showing property boundaries and the complete address of the property	Δ	Δ
3. Lot number or property identification number designation (if applicable)	Δ	Δ
4. Property lines (include longitude and latitude)	Δ	Δ
5. Location of easements (if applicable)		Δ
6. A legend identifying all symbols used on the plan	Δ	Δ
7. Location and size of existing and proposed utilities (including gas lines, sanitary lines, telephone lines or poles, electric utilities and water mains), structures, roads, and other paved areas		Δ
8. Existing and proposed topographic contours	Δ	Δ
9. Show drainage patterns, property ridge line(s) and building finish elevation on the grading plan.		Δ
10. Material and equipment staging areas	Δ	Δ
11. Clearly note on plans: - A right-of-way permit shall be obtained prior to performing construction activity in the right-of-way - Chlorinated disinfected water shall not be discharged into the stormwater system - Call before you dig note and number		Δ
12. Soil information for design purposes	Δ	Δ
13. Area(s) of soil disturbance	Δ	Δ
14. Site drainage area(s) (SDAs) within the limits of disturbance (LOD) and contributing to the LOD		Δ
15. Contributing drainage area (CDA) to each BMP		Δ
16. Location(s) of BMPs, marked with the BMP ID Numbers to agree with the BMP design summary list		Δ
17. Delineation of existing and proposed land covers including natural cover, compacted cover, and impervious surfaces.	Δ	Δ

18. Site fingerprint map of the location of existing stream(s), wetlands, or other natural features within the project area; tree and vegetation survey; and preservation area(s)	Δ	Δ
19. All plans and profiles must be drawn at a scale of 1 in. = 10 ft, 1 in. = 20 ft, 1 in. = 30 ft, 1 in. = 40 ft, 1 in. = 50 ft, or 1 in. = 100 ft. Although, 1 in. = 10 ft, 1 in = 20 ft, and 1 in. = 30 ft, are the most commonly used scales. Vertical scale for profiles must be 1 in. = 2 ft, 1 in. = 4 ft, 1 in. = 5 ft, or 1 in. = 10 ft	Δ	Δ
20. Drafting media that yield first- or second-generation, reproducible drawings with a minimum letter size of No. 4 (1/8 inch)	Δ	Δ
21. Applicable flood boundaries and FEMA map identification number for sites lying wholly or partially within the 100-year floodplain (if applicable)	Δ	Δ
C. Design and As-Built Certification		
1. Statement and seal by a registered professional engineer licensed in the State of South Carolina that the site design, land covers, and design of the BMPs conform to engineering principles applicable to the treatment and disposal of stormwater pollutants		Δ
2. Submission one set of the As-Built drawings sealed by a registered professional engineer licensed in the State of South Carolina within 21 days after completion of construction of the site, all BMPs, land covers, and stormwater conveyances. *Comes at close out*		Δ
3. For a project consisting entirely of work in the public right-of-way (PROW), the submission of a Record Drawing certified by an officer of the project contracting company is acceptable if it details the as-built construction of the BMP and related stormwater infrastructure.		Δ
D. Maintenance of Stormwater BMPs		
1. BMP maintenance access easements shall not be located on pipe easements.		Δ
2. A minimum 20’ wide maintenance access easement is provided around stormwater detention ponds and from publicly accessible road has been provided.		Δ
3. A maintenance plan that identifies routine and long-term maintenance needs and a maintenance schedule		Δ
4. For regulated projects, a maintenance agreement stating the owner’s specific maintenance responsibilities identified in the maintenance plan and maintenance schedule. These must be exhibits recorded with the property deed at the Recorder of Deeds.		Δ
5. For applicants using Rainwater Harvesting, submission of third-party testing of end-use water quality may be required at equipment commissioning.		Δ
E. Stormwater Retention Volume Computations		

1. Calculation(s) of the required SWRv for the entire site within the LOD and each SDA within the LOD		∆
2. Calculation(s) for each proposed BMP demonstrating retention value towards SWRv in accordance with Chapters 2 and 4 Stormwater Best Management Practices (BMPs)		∆
3. For Rainwater Harvesting BMP, calculations demonstrating the annual water balance as determined using the Rainwater Harvesting Retention Calculator		∆
4. For proprietary and non-proprietary BMPs outside Chapter 4, complete documentation defined in Chapter 4.15		∆
5. Document off-site stormwater volume where required.		∆
6. Document the 8-steps of the MEP process in Chapter 3.8.		∆
7. Compliance Calculator sheets identifying that proposed BMP(s) meet standards for water quality		∆
F. Pre/Post-Development Hydrologic Computations		
1. A summary of soil conditions and field data		∆
2. Pre- and post-project curve number summary table		∆
3. Pre and post construction peak flow summary table for the 2, 10, 25, 50 and the 100-year 24-hour storm events for each SDA within the project's LOD		∆
4. Flow control structure elevations		∆
G. Hydraulic Computations		
1. Existing and proposed SDA must be delineated on separate plans with the flow paths used for calculation of the times of concentration		∆
2. Hydraulic capacity and flow velocity for drainage conveyances, including ditches, swales, pipes, inlets.		∆
3. Plan profiles for all open conveyances and pipelines, with energy (kinetic) and hydraulic gradients for the 25-year and 100-year, 24-hour storms		∆
4. The proposed development layout including the following:		∆
a) Location and design of BMP(s) on site, marked with the BMP ID Numbers		∆
b) A list of design assumptions (e.g., design basis, 2 through 25-year return periods)		∆
c) The boundary of the CDA to the BMP		∆
d) Schedule of structures (a listing of the structures, details, or elevations including inverts)		∆
e) Manhole to manhole listing of pipe size, pipe type, slope, computed velocity, and computed flow rate (i.e., a storm drain pipe schedule		∆
5. Demonstrate downstream conveyance system capacity for the development.		∆

H. **Erosion and Sediment Control Plans**		
1. Provide erosion and sediment control drawings and detail sheets required by the CSWPPP	Δ	Δ
2. Show dewatering setup to ensure no negative off-site impacts result from the discharge	Δ	Δ
3. Provide erosion and sediment control inspection forms required by the CSWPPP		Δ
I. Supporting Documentation (written report)		
1. Pre- and Post-development curve number selection		Δ
2. Time of concentration calculation		Δ
3. Travel time calculation		Δ
4. Hydrologic computations supporting peak discharges assumed for each SDA within the project's LOD for the 2-, 10-, 25-, and 50-year, 24-hour storm events		Δ
5. Provide downstream and surrounding neighborhood area analysis to identify any existing capacity shortfalls or flooding based on the 10% rule.		Δ
6. SCDHEC's Construction Stormwater Pollution Prevention Plan (C-SWPPP)		Δ

The engineering features of all stormwater best management practices (BMPs), stormwater infrastructure, and land covers (collectively the "Facility") have been designed/examined by me and found to be in conformity with the standard of care applicable to the treatment and disposal of stormwater pollutants. The Facility has been designed in accordance with the specification required under Chapter 99 of the Beaufort County Ordinance.

Seal Signed Date

License Number:		Expiration Date:	

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** ______________________

____

Date: ______________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of practice (check all that apply)		
a. Bioretention		
b. Dry Swale		
d. Residential Rain Garden		
e. Infiltration Practice		
f. Filtration Practice		
2. For Bioretention		
a. Standard Design		
b. Enhanced Design		
3. Practice Location		
a. Open to Surface		
b. Underground		
4. Filtration Media		
a. No filtration media (e.g., stone reservoir only)		
b. Sand		
c. Bioretention Soil Mix		
d. Peat		
e. Other		
5. Hydraulic configuration		
a. On-line		
b. Off-line		
6. Type of pretreatment		
a. Separate pretreatment cell		
b. Sedimentation chamber/manhole		
c. Grass channel		
d. Grass filter strip		
e. Gravel or stone flow spreader		
f. Gravel diaphragm		
g. Other		Type of pretreatment:
7. If designed for infiltration (i.e., no underdrain OR infiltration sump below underdrain):		
a. Soil boring logs and infiltration testing report provided		
b. Field-measured infiltration rate of at least 0.5 in/hr (preferred 1-4 in/hr)		Field-measured rate:

A. Contributing Drainage Area
0 = Good condition. Well maintained, no action required.

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item							Comments
1. Excessive trash/debris	0	1	2	3	N/A		
2. Bare/exposed soil	0	1	2	3	N/A		
3. Evidence of erosion	0	1	2	3	N/A		
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A		

B. Pretreatment

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Maintenance access to pretreatment facility	0	1	2	3	N/A	
2. Excessive trash/debris/sediment	0	1	2	3	N/A	
3. Evidence of standing water	0	1	2	3	N/A	
a. Ponding	☐					
b. Noticeable odors	☐					
c. Water stains	☐					
d. Presence of algae or floating aquatic vegetation	☐					
4. Evidence of clogging	0	1	2	3	N/A	
5. Dead vegetation/exposed soil	0	1	2	3	N/A	
6. Evidence of erosion	0	1	2	3	N/A	

C. Inlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Inlets provide stable conveyance into practice	0	1	2	3	N/A	
2. Excessive trash/debris/sediment accumulation at inlet	0	1	2	3	N/A	
3. Evidence of erosion at/around inlet	0	1	2	3	N/A	

D. Practice

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item			Comments
1.	Maintenance access	0 1 2 3 N/A	
2.	Condition of structural components	0 1 2 3 N/A	
3.	Condition of hydraulic control components	0 1 2 3 N/A	
4.	Excessive trash/debris/sediment	0 1 2 3 N/A	
5.	Evidence of erosion	0 1 2 3 N/A	
6.	Evidence of oil/chemical accumulation	0 1 2 3 N/A	
7.	Evidence of standing water:	0 1 2 3 N/A	
	a. Ponding	☐	
	b. Noticeable odors	☐	
	c. Water stains	☐	
	d. Presence of algae or floating aquatic vegetation	☐	
8.	Underdrain system (if equipped)	0 1 2 3 N/A	
	a. Broken	☐	
	b. Clogged	☐	
9.	Vegetation	0 1 2 3 N/A	
	a. Plant composition consistent with approved plans	☐	
	b. Presence of invasive species/weeds	☐	
	c. Dead vegetation/exposed soil	☐	

E. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item			Comments
1.	Outlets provide stable conveyance out of practice	0 1 2 3 N/A	
2.	Excessive trash/debris/sediment accumulation at outlet	0 1 2 3 N/A	
3.	Evidence of erosion at/around outlet	0 1 2 3 N/A	

☐ Inspected
☐ Not Inspected

F. Miscellaneous

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

Item		Comments
1. Complaints from local residents	0 1 2 3 N/A	
2. Mosquito proliferation	0 1 2 3 N/A	
3. Encroachment on practice or easement by buildings or other structures	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
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Sketch of Practice

(note problem areas)

Infiltration/Filtration/Bioretention/Dry Swale Practice
Maintenance Inspection Checklist

Permeable Pavement

Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of practice (check all that apply)		
a. Standard design		
b. Infiltration design		
c. Infiltration sump design		
2. Pavement Type		
a. Pervious concrete		
b. Porous asphalt		
c. Concrete grid pavers		
d. Permeable interlocking concrete pavers		
e. Other:		
3. External drainage area?		
a. Yes		Ratio:
b. No		
4. Pretreatment (if landscaped/turf areas in drainage area)		
a. Yes		Type:
b. No		
5. If designed for infiltration (e.g., no underdrain OR infiltration sump below underdrain):		
b. Soil boring logs and infiltration testing report provided		
c. Field-measured infiltration rate indicated		Field-measured rate:

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						**Comments**
1. Excessive trash/debris	0	1	2	3	N/A	
2. Bare/exposed soil	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A	

5	Excessive grit, sand, or other clogging agents on upgradient pavement that drains onto permeable pavement	0	1	2	3	N/A	

B. Pretreatment (if applicable to landscaped/turf drainage area)

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Maintenance access to pretreatment facility	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment	0	1	2	3	N/A	
3.	Evidence of standing water						
	a. Ponding	0	1	2	3	N/A	
	b. Noticeable odors	0	1	2	3	N/A	
	c. Water stains	0	1	2	3	N/A	
	d. Presence of algae or floating aquatic vegetation	0	1	2	3	N/A	
4.	Evidence of clogging	0	1	2	3	N/A	
5.	Dead vegetation/exposed soil	0	1	2	3	N/A	
6.	Evidence of erosion	0	1	2	3	N/A	

C. Evidence of Materials Storage or Resurfacing of Permeable Pavement

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Evidence of storage of sand, mulch, soil, construction staging, power washing, or other activities that can clog pavement	0	1	2	3	N/A	
2.	Evidence of resealing or resurfacing of permeable pavement surface	0	1	2	3	N/A	

D. Practice

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Maintenance access to practice	0	1	2	3	N/A	
2.	Condition of structural components	0	1	2	3	N/A	

3. Condition of hydraulic control components	0	1	2	3	N/A	
4. Excessive trash/debris/sediment on pavement surface	0	1	2	3	N/A	
5. Evidence of damaged pavers and/or cracked/broken surface	0	1	2	3	N/A	
6. Evidence of oil/chemical accumulation	0	1	2	3	N/A	
7. Evidence of clogging:						
a. Ponding/water standing in observation wells	0	1	2	3	N/A	
b. Noticeable odors	0	1	2	3	N/A	
c. Water stains	0	1	2	3	N/A	
8. Underdrain system (if equipped)	0	1	2	3	N/A	
a. Broken	0	1	2	3	N/A	
b. Clogged	0	1	2	3	N/A	
9. Vegetation (e.g., grass in grid pavers) if present	0	1	2	3	N/A	
a. Grass or vegetation needs mowing or maintenance	0	1	2	3	N/A	
b. Excessive growth of weeds	0	1	2	3	N/A	
c. Dead vegetation	0	1	2	3	N/A	

E. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Complaints from local residents	0	1	2	3	N/A	
2. Spring clean-up conducted?	0	1	2	3	N/A	
3. Vacuum sweeping without water spray (2 -- 4 time annually)	0	1	2	3	N/A	
4. Encroachment on practice or easement by buildings or other structures	0	1	2	3	N/A	

Inspector's Summary:

Permeable Pavement

Maintenance Inspection Checklist

Photographs	
Photo ID	**Description**
1.	
2.	
3.	
4.	
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Sketch of Practice

(note problem areas)

Green Roof
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: ___________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of vegetated roof (check all that apply)		
a. Extensive - shallow soil		
b. Intensive - deep soil		
c. Other		Type:
2. Type of plant cover (check all that apply)		
a. Sedums		
b. Shrubs		
c. Trees		
d. Other		Type:

A. Practice

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		**Comments**
1. Maintenance access to practice	0 1 2 3 N/A	
2. Condition of structural components	0 1 2 3 N/A	
3. Condition of hydraulic control components	0 1 2 3 N/A	
4. Excessive trash/debris/sediment	0 1 2 3 N/A	
5. Evidence of leaking in waterproof	0 1 2 3 N/A	
6. Evidence of perforated root barrier	0 1 2 3 N/A	
7. Evidence of standing water:	0 1 2 3 N/A	
a. Ponding	☐	
b. Noticeable odors	☐	
c. Water stains	☐	
d. Presence of algae	☐	
8. Roof drain system	0 1 2 3 N/A	
a. Broken	☐	
b. Clogged	☐	
9. Vegetation	0 1 2 3 N/A	
a. Plant composition consistent with approved plans	☐	
b. Presence of invasive species/weeds	☐	
c. Plants appear nutrient deficient	☐	
d. Evidence of birds/pests removing plants	☐	
e. Dead/sparse vegetation soil	☐	

B. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item		Comments
1.	Roof drain conveyance is clogged	0 1 2 3 N/A	
2.	Excessive trash/debris/sediment accumulation at roof drain outlets	0 1 2 3 N/A	
3.	Evidence of erosion at/around outlet	0 1 2 3 N/A	

C. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item		Comments
1.	Complaints from local residents	0 1 2 3 N/A	
2.	Mosquito proliferation	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
2.	
3.	
4.	
5.	
6.	
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Sketch of Practice

(note problem areas)

Rainwater Harvesting
Maintenance Inspection Checklist

Party Responsible for Maintenance: ____________________

Contact: ____________________

Phone Number: ____________________

E-mail: ____________________

Practice ID: ____________________

Location: ____________________

GPS Coordinates: ____________________

Inspector(s): ____ **Mailing Address:** ____________________

Date: __________ **Time:** __________

A. Contributing Drainage Area (Roof Area) 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.							
☐ Inspected							
☐ Not Inspected							
Item							**Comments**
1. Excessive leaves and debris in gutters/downspouts	0	1	2	3	N/A		
2. Other materials/debris on roof surface (e.g., excessive bird droppings)	0	1	2	3	N/A		
3. Clear overhanging trees/vegetation over roof surface	0	1	2	3	N/A		

B. Pretreatment 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐ Inspected						
☐ Not Inspected						
Item						**Comments**
1. Maintenance access to pretreatment facility	0	1	2	3	N/A	
2. Check first flush diverters/filters for proper functioning (e.g., not bypassing too much water). Clean debris from filter screens.	0	1	2	3	N/A	Sediment marker reading:

C. Inlets 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.						
☐ Inspected						
☐ Not Inspected						
Item						**Comments**
1. Check all conveyances into tank; remove debris; check for clogging	0	1	2	3	N/A	

2.	Patch any holes or gaps.	0	1	2	3	N/A	

D. Tank or Cistern

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item							Comments
1.	Maintenance access to practice	0	1	2	3	N/A	
2.	Check storage tank lids	0	1	2	3	N/A	
	a. Vents and screens on inflow/outflow spigots	0	1	2	3	N/A	
	b. Lids in place, properly secured	0	1	2	3	N/A	
3.	Overflow pipes & downstream flow path	0	1	2	3	N/A	Cause:
	a. Debris/clogging in overflow pipes	0	1	2	3	N/A	Cause:
	b. Erosion, excessive debris, clogging of flow path	0	1	2	3	N/A	Cause:
	c. Condition of downstream secondary runoff reduction practice (see applicable checklist)	0	1	2	3	N/A	Cause:
4.	Sediment build-up in tank	0	1	2	3	N/A	
5.	Backflow preventer	0	1	2	3	N/A	
6.	Structural integrity	0	1	2	3	N/A	
	a. Tank and foundation	0	1	2	3	N/A	
	b. Pump and pump housing	0	1	2	3	N/A	
	c. Pipes	0	1	2	3	N/A	
	d. Electrical system and housing	0	1	2	3	N/A	
7.	Water Quality Devices	0	1	2	3	N/A	
8.	Mosquitos	0	1	2	3	N/A	
	a. Mosquito screens; check gaps and holes	0	1	2	3	N/A	
	b. Evidence of mosquito larvae in tank or manholes	0	1	2	3	N/A	

E. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item							Comments
1.	Complaints from local residents	0	1	2	3	N/A	
2.	Mosquito proliferation	0	1	2	3	N/A	
3.	Encroachment on practice or easement by buildings or other structures	0	1	2	3	N/A	
4.	Adequate safety signage	0	1	2	3	N/A	

Inspector's Summary:

Rainwater Harvesting
Maintenance Inspection Checklist

Photographs	
Photo ID	**Description**
1.	
2.	
3.	
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Sketch of Practice

(note problem areas)

Impervious Surface Disconnection
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

Key Questions

Item	X	Comments
1. Type of impervious area disconnected		
a. Rooftop		
b. Parking		
c. Other		
2. Type of disconnection surface		
a. Managed turf areas		
b. Forest cover or preserved open space		
c. Soil compost amended filter path		
3. Type of forest cover or open space (if applicable)		
a. Forest		
b. Meadow/Brush		
c. Other		
4. Vegetative Cover Condition		
a. Good		
b. Average		
c. Poor		
5. Meets width/length requirement		

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		Comments
1. Excessive trash/debris	0 1 2 3 N/A	
2. Excessive landscape waste/yard clippings	0 1 2 3 N/A	

B . Inflow Points

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected

☐	Not Inspected						
	Item						**Comments**
1.	Inflow points (e.g. downspouts, curb cuts, edge of pavement, level spreader) provide stable conveyance into practice	0	1	2	3	N/A	
2.	Runoff enters pervious area as sheet flow	0	1	2	3	N/A	
3.	Excessive trash/debris/sediment	0	1	2	3	N/A	
4.	Evidence of erosion at/around inflow points	0	1	2	3	N/A	
5.	Level spreader functional, if applicable	0	1	2	3	N/A	

C . Practice (Pervious Area Receiving Runoff)

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐	Inspected						
☐	Not Inspected						
	Item						**Comments**
1.	Maintenance access to area	0	1	2	3	N/A	
2.	Downspouts or surface impervious area drains to the receiving pervious area (doesn't bypass)	0	1	2	3	N/A	
3.	Receiving pervious areas retain dimensions as shown on plans and are in good	0	1	2	3	N/A	
4.	Excessive trash/debris/sediment	0	1	2	3	N/A	
5.	Evidence of standing water:	0	1	2	3	N/A	
	a. Ponding	☐					
	b. Noticeable odors	☐					
	c. Water stains	☐					
	d. Presence of algae or floating aquatic vegetation	☐					
6.	Evidence of erosion	0	1	2	3	N/A	
7	Evidence of oil/chemical accumulation	0	1	2	3	N/A	
8.	Vegetation	0	1	2	3	N/A	
	a. Plant composition consistent with approved plans	0	1	2	3	N/A	
	b. Presence of invasive species/weeds	0	1	2	3	N/A	
	c. Dead vegetation/exposed soil	0	1	2	3	N/A	
	d. Disturbance to natural vegetation or excessive maintenance (e.g. mowing, tree cutting)	0	1	2	3	N/A	
	e. Restoration planting survival, if	0	1	2	3	N/A	
9.	Conservation area signs (if applicable)	0	1	2	3	N/A	
10.	Level spreader (if applicable)	0	1	2	3	N/A	

D . Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.

Impervious Surface Disconnection
Maintenance Inspection Checklist

2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Complaints from local residents	0	1	2	3	N/A	
2.	Mosquito proliferation	0	1	2	3	N/A	
3.	Encroachment on pervious area or easement by buildings or other structures	0	1	2	3	N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
2.	
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Sketch of Practice

(note problem areas)

Dry Detention Practices
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

Mailing Address: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ______________________

Date: __________ **Time:** __________

Key Questions		
Item	**X**	**Comments**
1. Type of detention practice		
a. Dry Pond		
b. Underground Detetention Vault and/or Tank		
c. Other		Type:

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						**Comments**
1. Excessive trash/debris	0	1	2	3	N/A	
2. Bare/exposed soil	0	1	2	3	N/A	
3. Evidence of erosion	0	1	2	3	N/A	
4. Excessive landscape waste/yard clippings	0	1	2	3	N/A	
5. Oils, greases, paints and other harmful substances disposed of in drainage area.	0	1	2	3	N/A	

B. Forebay/Pretreatment

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						**Comments**
1. Maintenance access to pretreatment facility	0	1	2	3	N/A	
2. Excessive trash/debris accumulation	0	1	2	3	N/A	
3. Excessive sediment accumulation	0	1	2	3	N/A	Sediment marker reading:
4. Evidence of clogging	0	1	2	3	N/A	
5. Dead vegetation/exposed soil	0	1	2	3	N/A	
6. Evidence of erosion	0	1	2	3	N/A	

Dry Detention Practices

MaintenanceInspection Checklist

C. Inlets 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.							
☐ Inspected							
☐ Not Inspected							
Item							**Comments**
1. Inlets provide stable conveyance into	0	1	2	3	N/A		
2. Excessive trash/debris/sediment accumulation at inlet	0	1	2	3	N/A		
3. Evidence of erosion at/around inlet	0	1	2	3	N/A		
4. Damaged pipes or components	0	1	2	3	N/A		
5. Inflow hindered by soil height, build up of sediment and/or grass	0	1	2	3	N/A		

D. Practice 0 = Good condition. Well maintained, no action required. 1 = Moderate condition. Adequately maintained, routine maintenance needed. 2 = Degraded condition. Poorly maintained, routine maintenance and repair needed. 3 = Serious condition. Immediate need for repair or replacement.							
☐ Inspected							
☐ Not Inspected							
Item							**Comments**
1. Maintenance access to practice	0	1	2	3	N/A		
2. Sediment accumulation	0	1	2	3	N/A		
3. Abnormally high or low water levels	0	1	2	3	N/A	Cause:	
4. Evidence of pollution/hotspot runoff	0	1	2	3	N/A	Cause:	
5. Berm(s)/embankment(s)	0	1	2	3	N/A		
a. Cracking, bulging, or sloughing	0	1	2	3	N/A		
b. Soft spots or sinkholes	0	1	2	3	N/A		
c. Evidence of erosion/bare spots	0	1	2	3	N/A		
d. Evidence of animal burrows	0	1	2	3	N/A		
e. Presence of woody vegetation	0	1	2	3	N/A		
6. Riser/outlet	0	1	2	3	N/A	Type of riser:	
a. Maintenance access to riser	0	1	2	3	N/A		
b. Structural condition of riser	0	1	2	3	N/A		
c. Condition of joints	0	1	2	3	N/A		
d. Trash/debris accumulation	0	1	2	3	N/A		
e. Woody growth within 5 ft. of outlet	0	1	2	3	N/A		
f. Emergency spillway eroding or failing	0	1	2	3	N/A		
7. Low flow orifice	0	1	2	3	N/A		
a. Trash/debris accumulation	0	1	2	3	N/A		
b. Adjustable control valve accessible and operational	0	1	2	3	N/A		
9. Vegetation	0	1	2	3	N/A		
a. Plant composition consistent with approved plans	0	1	2	3	N/A		
b. Presence of invasive species/weeds	0	1	2	3	N/A		
c. Dead vegetation/exposed soil	0	1	2	3	N/A		

d. Reinforcement planting recommended ☐

E. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		Rating	Comments
1.	Outlets provide stable conveyance out of practice	0 1 2 3 N/A	
2.	Excessive trash/debris/sediment accumulation at outlet	0 1 2 3 N/A	
3.	Evidence of erosion at/around outlet/outfall	0 1 2 3 N/A	
4.	Evidence of leaking/clogging of trash racks or reversed slope pipes	0 1 2 3 N/A	

F. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		Rating	Comments
1.	Complaints from local residents	0 1 2 3 N/A	
2.	Mosquito proliferation	0 1 2 3 N/A	
3.	Encroachment on practice or easement by buildings or other structures	0 1 2 3 N/A	
4.	Adequate safety signage	0 1 2 3 N/A	

Inspector's Summary:

Photographs

Dry Detention Practices

MaintenanceInspection Checklist

Photo ID	Description
1.	
2.	
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Sketch of practice

(note problem areas)

Created: 2021-07-22 09:11:36 [EST]

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ______________

Key Questions		
Item	**X**	**Comments**
1. Type of stormwater practice (check all that apply)		
a. Stormwater wetland basin		
b. Stormwater multi-cell wetland or pond/wetland combination		
c. Subsurface gravel wetland		
d. Wet pond		
d. Other		Type:
2. Type of pretreatment facility (check all that apply)		*Pretreatment must be provided*
a. Sediment forebay		
b. Other		Type:

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item		**Comments**
1. Excessive trash/debris	0 1 2 3 N/A	
2. Bare/exposed soil	0 1 2 3 N/A	
3. Evidence of erosion	0 1 2 3 N/A	
4. Excessive landscape waste/yard clippings	0 1 2 3 N/A	
5. Oils, greases, paints and other harmful substances disposed of in drainage area.	0 1 2 3 N/A	

B. Pretreatment

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item	**Comments**

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

1.	Maintenance access to pretreatment facility	0	1	2	3	N/A	
2.	Excessive trash/debris accumulation	0	1	2	3	N/A	
3.	Excessive sediment accumulation	0	1	2	3	N/A	Sediment marker reading:
4.	Evidence of clogging	0	1	2	3	N/A	
5.	Dead vegetation/exposed soil	0	1	2	3	N/A	
6.	Evidence of erosion	0	1	2	3	N/A	

C. Inlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Inlets provide stable conveyance into	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment accumulation at inlet	0	1	2	3	N/A	
3.	Evidence of erosion at/around inlet	0	1	2	3	N/A	
4.	Damaged pipes or components	0	1	2	3	N/A	
5.	Inflow hindered by soil height, build up of sediment and/or grass	0	1	2	3	N/A	
6.	Asphalt/concrete crumbling at inlets	0	1	2	3	N/A	

D. Practice

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Maintenance access to practice	0	1	2	3	N/A	
2.	Sediment accumulation	0	1	2	3	N/A	
	Bathymetric study recommended						
3.	Abnormally high or low water levels	0	1	2	3	N/A	Cause:
4.	Evidence of pollution/hotspot runoff	0	1	2	3	N/A	Cause:
5.	Berm(s)/embankment(s)	0	1	2	3	N/A	
	a. Cracking, bulging, or sloughing	0	1	2	3	N/A	
	b. Soft spots or sinkholes	0	1	2	3	N/A	
	c. Evidence of erosion/bare spots	0	1	2	3	N/A	
	d. Evidence of animal burrows	0	1	2	3	N/A	
	e. Presence of woody vegetation	0	1	2	3	N/A	

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

6. Riser/outlet	0	1	2	3	N/A	Type of riser:
a. Maintenance access to riser	0	1	2	3	N/A	
b. Structural condition of riser	0	1	2	3	N/A	
c. Condition of joints	0	1	2	3	N/A	
d. Trash/debris accumulation	0	1	2	3	N/A	
e. Woody growth within 5 ft. of outlet	0	1	2	3	N/A	
f. Emergency spillway eroding, or failing	0	1	2	3	N/A	
7. Low flow orifice	0	1	2	3	N/A	
a. Trash/debris accumulation	0	1	2	3	N/A	
b. Adjustable control valve accessible and operational	0	1	2	3	N/A	
8. Pond drain (underdrain) system (if applicable)	0	1	2	3	N/A	
a. Broken	0	1	2	3	N/A	
b. Clogged	0	1	2	3	N/A	
c. Adjustable control valve accessible and operational	0	1	2	3	N/A	
9. Vegetation	0	1	2	3	N/A	
a. Plant composition consistent with approved plans	0	1	2	3	N/A	
b. Presence of invasive species/weeds	0	1	2	3	N/A	
c. Dead vegetation/exposed soil	0	1	2	3	N/A	
d. Reinforcement planting recommended	☐					

E. Outlets

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						Comments
1. Outlets provide stable conveyance out of practice	0	1	2	3	N/A	
2. Excessive trash/debris/sediment accumulation at outlet	0	1	2	3	N/A	
3. Evidence of erosion at/around outlet/outfall	0	1	2	3	N/A	
4. Evidence of polluted water being released – discoloration, odor, staining, etc.	0	1	2	3	N/A	

F. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

Stormwater Wet Pond/Wetland
Maintenance Inspection Checklist

☐ Inspected
☐ Not Inspected

Item							Comments
1.	Complaints from local residents	0	1	2	3	N/A	
2.	Mosquito proliferation	0	1	2	3	N/A	
3.	Encroachment on practice or easement by buildings or other structures	0	1	2	3	N/A	
4.	Adequate safety signage	0	1	2	3	N/A	

Inspector's Summary:

Photographs

Photo ID	Description
1.	
2.	
3.	
4.	
5.	
6.	
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10.	

Sketch of practice

(note problem areas)

Grass Swale

Maintenance Inspection Checklist

Party Responsible for Maintenance: ______________________

Contact: ______________________

Phone Number: ______________________

E-mail: ______________________

____

Practice ID: ______________________

Location: ______________________

GPS Coordinates: ______________________

Inspector(s): ____ **Mailing Address:** __________

____

Date: __________ **Time:** ____________

A. Contributing Drainage Area

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Excessive trash/debris	0	1	2	3	N/A	
2.	Bare/exposed soil	0	1	2	3	N/A	
3.	Evidence of erosion	0	1	2	3	N/A	
4.	Excessive landscape waste/yard clippings	0	1	2	3	N/A	
5.	Impervious area added	0	1	2	3	N/A	

B. Inflow Points

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

	Item						Comments
1.	Inflow points (e.g. curb cuts, edge of pavement, pipes) provide stable conveyance into the channel	0	1	2	3	N/A	
2.	Excessive trash/debris/sediment accumulation at inflow points	0	1	2	3	N/A	
3.	Evidence of erosion at/around inflow points	0	1	2	3	N/A	

C. Practice (Grass Swale)

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected

Grass Swale
Maintenance Inspection Checklist

☐ Not Inspected							
Item							**Comments**
1. Swale remains vegetated; no concrete, rip-rap, or other lining has been added	0	1	2	3	N/A		
2. Grade ensures positive flow	0	1	2	3	N/A		
3. Evidence of erosion	0	1	2	3	N/A		
4. Sediment accumulation	0	1	2	3	N/A		
5. Excessive trash/debris accumulation	0	1	2	3	N/A		
6. Evidence of oil/chemical accumulation	0	1	2	3	N/A		
7. Vegetation condition	0	1	2	3	N/A		
a. Mowing as needed to maintain 4"-6" grass height.	0	1	2	3	N/A		
b. 90% turf cover in practice.	0	1	2	3	N/A		
8. Check dams in place	0	1	2	3	N/A		
9. Signs of erosion around or under check dams	0	1	2	3	N/A		

D. Miscellaneous

0 = Good condition. Well maintained, no action required.
1 = Moderate condition. Adequately maintained, routine maintenance needed.
2 = Degraded condition. Poorly maintained, routine maintenance and repair needed.
3 = Serious condition. Immediate need for repair or replacement.

☐ Inspected
☐ Not Inspected

Item						**Comments**
1. Complaints from local residents	0	1	2	3	N/A	
2. Mosquito breeding	0	1	2	3	N/A	
3. Encroachments (e.g. filling, fences, obstructions, etc.)	0	1	2	3	N/A	

Inspector's Summary:

Created: 2021-07-22 09:11:36 [EST]

Grass Swale
Maintenance Inspection Checklist

Photographs	
Photo ID	**Description**
1.	
2.	
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Sketch of Practice

(note problem areas)

Grass Swale

Maintenance Inspection Checklist

Appendix G: Compliance Calculator Spreadsheet Instructions

Table of Contents

G.1 Introduction

The compliance calculator spreadsheet (Appendix H) was created to allow a designer to quickly analyze multiple LID options and check them against the watershed area's water quality design requirements. As is clear from the specifications, each LID BMP has different design requirements, equations, and standards that determine its effectiveness. Depending upon the site, it can become difficult to determine which BMP(s) best meets the requirements. With the compliance calculator, it is easier to examine different combinations of BMPs in order to find the best option or set of options. The compliance calculator is also to be used by the plan reviewer to quickly verify the compliance status of a plan.

It is important to note that the compliance calculator is not a model, and while it can be used as a design tool, it does not replace the needed efforts of a competent designer. The numbers in the spreadsheet don't guarantee that a BMP meets the specifications, is appropriate for its location, or is generally well-designed.

G.2 Compliance Calculator Spreadsheet Guidance

The following guidance explains how to use each of the worksheets in the compliance calculator spreadsheet (Appendix H).

Note: All cells highlighted in blue are user input cells. Cells highlighted in gray are calculation cells, and cells highlighted in yellow are constant values that generally should not be changed.

Site Data Sheet

1. Enter the name of the proposed project on **line 9**.
2. Enter the pre-development land cover areas (in acres) of forest/open space cover, turf cover, impervious cover and BMP cover for the site for Natural Resource Conservation Service (NRCS) soil types A, B, C, and D in cells C24-C27, E24-E27, G24-G27, and I24-I27, respectively.
3. Verify/enter the NRCS runoff curve numbers for each land use/soil type combination in cells D24-D27, F24-F27, H24-H27, and J24-J27. Default values have already been included in these cells, but they can be changed if necessary.
4. Enter the post-development land cover areas (in acres) of forest cover/open space, turf cover, impervious cover and BMP cover on the site for Natural Resource Conservation Service (NRCS) soil types A, B, C, and D in cells C34-C37, E34-E37, G34-G37, and I34-I37, respectively.
5. Verify/enter the NRCS runoff curve numbers for each land use/soil type combination in cells D34-D37, F34-F37, H34-H37, and J34-J37. As with the pre-development entries, default values have already been included in these cells, but they can be changed if necessary.

BMP Sheet

1. Apply BMPs to the drainage area to address the required water quality volume by indicating the area in square feet (sf) of forest cover, turf cover, and impervious cover to be treated by a given BMP in **Columns B, C, and D**. This will likely be an iterative process. The available BMPs include the following:
   - Bioretention – No Underdrain
   - Bioretention - IWS
   - Bioretention - Standard
   - Permeable Pavement - Enhanced
   - Permeable Pavement - Standard
   - Infiltration
   - Green Roof
   - Green Roof – Irrigated
   - Rainwater Harvesting
   - Impervious Surface Disconnection
   - Grass Channel
   - Grass Channel – Amended Soils
   - Dry Swale
   - Wet Swale
   - Regenerative Stormwater Conveyance (RSC)
   - Filtering Systems
   - Storage Practices
   - Stormwater Ponds
   - Stormwater Wetlands
   - Proprietary Practice
   - Planted Tree
   - Preserved Tree
2. Enter the BMP's surface area (sf) in Column E and storage volume (cf) in Column F.
3. If a Stormwater Pond is used for irrigation the contributing drainage area and storage volume (determined from the Rainwater Harvesting Calculator) are entered in the Rainwater Harvesting cells B24, C24, D24, E24 and F24, respectively. The Stormwater Pond row remains empty unless there are other ponds used that are not used for irrigation.
4. If other Rainwater Harvesting BMPs are used, the Rainwater Harvesting Calculator is used to determine the contributing drainage area and storage volume inputs to the BMP worksheet.
5. The volume from direct drainage to the BMP is calculated and reported in **Column E**. Note that the total disturbed area is reflected as the sum of impervious cover (**Column D**), turf cover (**Column C**) and forest/open space cover (**Column B**) draining to the practice.
6. If more than one BMP will be employed in series, any overflow from upstream BMPs will be accounted for in **Column M**.

7. The total volume captured by the practice (V_{CAP}) is reported in **Column N** and is equal to the following:

$$W_{CCCCCC} = MMMMMMMMMMMMMM(SSSS, W_{UUUU} + W_{DDDD})$$

Where:

WQv_{CAP}	=	Water Quality Volume captured by the practice (cf) (**Column N)**
Sv	=	Storage Volume (cf) (**Column F)**
V_{US}	=	Volume of runoff from upstream practice (cf) (**Column M)**
V_{DD}	=	Volume of runoff from direct discharge (cf) (**Column L)**

8. The Runoff Reduction or Pollutant Removal Efficiency (%) for each BMP (from Table 2.3) is reported in **Columns H-K**.

9. The Water Quality Volume Credited is calculated in **Column O**, and is equal to the following:

$$WWWWSS_{CCCC} = MMMMMMMMMMMMMM\ oooo\ (SSSS \times CCCC, VV_{CCCCCC})$$

Where:

WQv_{CR}	=	Water Quality Volume Credited (cf)
Sv	=	Storage Volume (cf) **(Column F)**
CR	=	Credit (fraction)
V_{CAP}	=	Volume Captured by the Practice (cf) **(Column N)**

10. The Remaining Water Quality Volume **(Column P)** is calculated as:

$$WWWWSS_{CC} = VV_{UUUU} + VV_{DDDD} - WWWWSS_{CCCC}$$

Where:

WQv_R	=	Water Quality Volume Remaining (cf) **(Column O)**
V_{US}	=	Volume from Upstream Practices (cf) **(Column M)**
V_{DD}	=	Volume from Direct Drainage (cf) **(Column L)**

11. Any runoff volume remaining can be directed to a downstream BMP by selecting a practice from the pull-down menu in **Column G**. Selecting a BMP from the menu will automatically direct the runoff volume remaining to **Column M (volume from upstream practices)** for the appropriate BMP.

12. Planted Trees. Input the number of planted and preserved trees of each size class in cells F38-F42 (retention values correspond to Table 4.62 and 4.63 in design manual).

13. The Target Retention Volume (WQv_T) is reported in **Cell B49**, from corresponding **Cell C42** on the **Site Data Tab**.

14. The Water Quality Volume Provided (WQv_P), is calculated in **Cell C49** as a combination of the retention values for all BMPs and trees (Cells O17-O42)

15. The fraction of target achieved (either by practice or by the entire site as appropriate) is calculated in **Cells F31-F35).** The % of target achieved is calculated as follows:

$$TT = MMMMMMMMMMMMMM\ oooo\left(\frac{WWWWSS_{CC}}{WWWWSS_{TT}}, 1\right)$$

Where:

T	=	Treatment (fraction)

WQv_P = Water Quality Volume Provided (cf)
WQv_T = Water Quality Volume Target (cf)

16. **Cells D49, 52, 54, 58, and 61** determine if the site target has been reached as follows:
   - Overall Retention Goal
     - Target Retention Volume
   - General Stormwater Management Watershed Area Minimum Requirements
     - Target Retention Volume (1.16 in storm)
     - Target TSS Removal
     - Target Nitrogen Removal
     - Target Bacteria Removal
   - Savannah River Special Watershed Protection Area Minimum Requirements
     - Target Retention Volume (1.16 in storm)
     - Target TSS Removal
     - Target Nitrogen Removal
     - Target Bacteria Removal

Channel and Flood Protection

This sheet assists with calculation of Adjusted Curve Numbers that can be used to calculate peak flows associated with the 2- to 100-year storm events.

17. Enter the appropriate depths for the 2-year, 10-year, 25-year and 100-year 24-hour storms (as provided in Table 2.4) on **Line 5**.
18. The Total Site Area (from the **Site Data** Tab), is reported in **Cell C7**.
19. Detention Storage Volume (cf) is calculated in **Cell C8**, and refers to the total storage provided in all LID practices using the following equation:

$$VV_{DDUU} = \sum_{LLLLDD\ BBBBCCBB} SSSS_{BBBBCC} \cdot IICCII_{BBBBCC}$$

Where:

V_{DS} = Volume in Site Detention Storage (cf)
Sv_{BMP} = Storage Volume Provided in Each BMP (cf) (from **Column F** of the **BMPs** Tab)
IRD_{BMP} = Infiltration, Retention or Detention Credit for Each BMP (from **Column J** of the **BMPs** Tab)

Note that, while other practices such as ponds provide detention, it is assumed that design engineers will explicitly account for this detention in a Pond Routing program.

20. As indicated in the Site Data sheet, each cover type is associated with a NRCS curve number. **Cells D15–G22** show the pre-development land cover areas and curve numbers that were indicated on the Site Data Sheet. Using these curve numbers, a weighted curve number is calculated in **cell G24**.
21. **Cells D29–G36** show the post-development land cover areas and curve numbers that were indicated on the Site Data Sheet. Using these curve numbers, a weighted curve number is calculated in **cell G38**.
22. Using NRCS methodology, **Line 42** calculates the pre-development runoff volume (inches) for the various storm events.

Potential Abstraction

$$SS = \frac{1000}{(CCCC - 10)}$$

Where:

S = potential abstraction (in.)
CN = weighted curve number

Runoff Volume

$$WW = \frac{(PP - 0.2 \cdot SS)^2}{(PP + 0.8 \cdot SS)}$$

Where:

Q = runoff volume (in.)
P = precipitation depth for a given 24-hour storm (in.)
S = potential abstraction (in.)

23. **Line 43** calculates the post-development runoff volume based solely on land cover (without regard to the BMPs selected on the BMP sheet). **Line 44** then subtracts the runoff reduction volume provided by BMPs, from **Cell C8**.
24. Based upon the reduced runoff volumes calculated in line 44, the spreadsheet then calculates corresponding reduced curve numbers for each storm event. This Adjusted Curve Number is reported on **Line 45**.
25. **Line 46** compares the pre-development runoff volume in line 42 with the post-development (with BMPs) runoff volume in line 44. If the post-development volume (with BMPs) is less than or equal to the pre-development volume for a given storm event, then it is assumed that detention will not be required. If the post-development volume (with BMPs) is greater than the pre-development volume for a given storm event, then detention will be necessary, and the Adjusted Curve Numbers form line 45 should be used to calculate the post-development peak runoff rates.

Southern Low Country Stormwater Compliance Calculator - Updated 8/20/20

	data input cells
	calculation cells
	constant values

Site Data

Site Name:

Watershed Protection Area

Design Storm (in.)	#N/A

	Runoff Coefficients			
	Soil Type A	Soil Type B	Soil Type C	Soil Type D
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95
BMP	0.95	0.95	0.95	0.95

Indicate Pre-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

	Area (square feet)										
Cover Type	Soil Type A	CN	Soil Type B	CN	Soil Type C	CN	Soil Type D	CN	Total	**% Cover**	Rv
Forest Cover/Open Space		30		55		70		77	0	0%	0
Turf Cover		39		61		74		80	0	0%	0
Impervious Cover		98		98		98		98	0	0%	0
BMP		98		98		98		98	0	0%	0
Total	0		0		0		0		0	0%	0.00

Indicate Post-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

	Area (square feet)										
Cover Type	Soil Type A	CN	Soil Type B	CN	Soil Type C	CN	Soil Type D	CN	Total	**% Cover**	Rv
Forest Cover/Open Space		30		55		70		77	0	0%	0
Turf Cover		39		61		74		80	0	0%	0
Impervious Cover		98		98		98		98	0	0%	0
BMP		98		98		98		98	0	0%	0
Total	0		0		0		0		0	0%	0.0000

Stormwater Retention Volume (cf)	**No SWMP Required**

Southern Low Country Stormwater Compliance Calculator - Updated 8/20/20

Site Drainage Area 1

Indicate Post-Development Land Cover and Runoff Curve Numbers in the Site's Disturbed Area

	Area (square feet)						
Cover Type	Soil Type A	Soil Type B	Soil Type C	Soil Type D	Total	**% Cover**	Rv
Forest Cover/Open Space					0	0%	0
Turf Cover					0	0%	0
Impervious Cover					0	0%	0.95
BMP					0	0%	0.95
Total	0	0	0	0	0	0%	0

BMPs

	Contributing Drainage Area				Storage Volume Provided by BMP (cubic feet)	Downstream BMP	Water Quality Credits				Retention (cf)			
	Forest Cover Draining to BMP Area (square feet)	Turf Cover Draining to BMP Area (square feet)	Impervious Cover Draining to BMP Area (square feet)	BMP Surface Area Area (square feet)			Runoff Reduction	TSS % Removal	Total N % Removal	Bacteria % Removal	Volume from Direct Drainage	Volume from Upstream Practices	Total Volume Captured by BMP	Volume Credited
Bioretention - No Underdrain							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Bioretention - IWS							75%	85%	85%	80%	#N/A	0	#N/A	#N/A
Bioretention - Standard							60%	85%	75%	80%	#N/A	0	#N/A	#N/A
Permeable Pavement - Enhanced							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Permeable Pavement - Standard							30%	80%	45%	30%	#N/A	0	#N/A	#N/A
Infiltration							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Green Roof							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Rainwater Harvesting							100%	100%	100%	100%	#N/A	0	#N/A	#N/A
Impervious Surface Disconnection							40%	80%	40%	40%	#N/A	0	#N/A	#N/A
Grass Channel							10%	50%	25%	30%	#N/A	0	#N/A	#N/A
Grass Channel - Amended Soils							20%	50%	35%	30%	#N/A	0	#N/A	#N/A
Dry Swale							60%	85%	70%	80%	#N/A	0	#N/A	#N/A
Wet Swale							0%	80%	25%	60%	#N/A	0	#N/A	#N/A
RSC							0%	80%	40%	80%	#N/A	0	#N/A	#N/A
Filtering Systems							0%	80%	30%	80%	#N/A	0	#N/A	#N/A
Storage Practices							0%	60%	10%	60%	#N/A	0	#N/A	#N/A
Stormwater Ponds							0%	80%	30%	60%	#N/A	0	#N/A	#N/A
Stormwater Wetlands							0%	80%	25%	60%	#N/A	0	#N/A	#N/A
Proprietary Practice											#N/A	0	#N/A	#N/A
					Input Number of Trees									
Planted Tree - Small							5 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Planted Tree - Large							10 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Preserved Tree - Small							10 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Preserved Tree - Large							20 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Preserved Tree - Special							30 cf/tree	N/A	N/A	N/A	N/A	N/A	N/A	0
Totals	**0.00**	**0.00**	**0.00**		**0.00**									

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Southern Low Country Stormwater Compliance Calculator - Updated 8/20/20

Detention Calculations

Site Area (square feet)

Storage Volume Provided by BMPs 0

Land Area		A Soils	B Soils	C Soils	D Soils
Forest Cover	CN	30	55	70	77
Turf Cover	CN	39	61	74	80
Impervious Cover	CN	98	98	98	98
BMP	CN	98	98	98	98

Land Area		A Soils	B Soils	C Soils	D Soils
Forest Cover	CN	30	55	70	77
Turf Cover	CN	39	61	74	80
Impervious Cover	CN	98	98	98	98
BMP	CN	98	98	98	98

Pre-Development Runoff Volume (in)
Post Development Runoff Volume (in) with no BMPs
Post-Development Runoff Volume (in) with BMPs

2-year storm v (in)	10-year storm v (in)	25-year storm v (in)	100-year storm v (in)	CN	S
0.00	0.01	0.10	0.49	25	30.00
0.00	0.01	0.12	0.54	25.5	29.22
0.00	0.02	0.15	0.60	26.1	28.31
0.00	0.02	0.16	0.62	26.3	28.02
0.00	0.02	0.17	0.64	26.5	27.74
0.00	0.03	0.18	0.66	26.7	27.45
0.00	0.03	0.19	0.68	26.9	27.17
0.00	0.04	0.21	0.73	27.3	26.63
0.00	0.05	0.22	0.75	27.5	26.36
0.00	0.05	0.23	0.77	27.7	26.10
0.00	0.06	0.24	0.79	27.9	25.84
0.00	0.06	0.25	0.81	28.1	25.59
0.00	0.07	0.26	0.83	28.3	25.34
0.00	0.26	0.62	1.45	33.5	19.85
0.00	0.28	0.64	1.48	33.8	19.59
0.00	0.28	0.65	1.50	33.9	19.50
0.01	0.32	0.70	1.58	34.6	18.90
0.04	0.47	0.93	1.94	37.4	16.74
0.06	0.54	1.04	2.11	38.7	15.84
0.07	0.58	1.09	2.18	39.2	15.51
0.11	0.68	1.23	2.39	40.8	14.51
0.12	0.71	1.28	2.45	41.3	14.21
0.12	0.72	1.29	2.47	41.4	14.15
0.12	0.72	1.30	2.48	41.5	14.10
0.12	0.73	1.31	2.49	41.6	14.04
0.13	0.73	1.31	2.51	41.7	13.98
0.13	0.74	1.32	2.52	41.8	13.92
0.13	0.75	1.33	2.53	41.9	13.87
0.13	0.75	1.34	2.55	42	13.81
0.14	0.76	1.35	2.56	42.1	13.75
0.14	0.77	1.36	2.57	42.2	13.70
0.14	0.77	1.37	2.59	42.3	13.64
0.14	0.78	1.38	2.60	42.4	13.58
0.15	0.79	1.39	2.61	42.5	13.53
0.15	0.80	1.40	2.63	42.6	13.47
0.19	0.88	1.52	2.80	43.9	12.78
0.19	0.89	1.53	2.81	44	12.73
0.19	0.90	1.54	2.83	44.1	12.68
0.19	0.91	1.55	2.84	44.2	12.62
0.20	0.91	1.56	2.85	44.3	12.57

Watershed Protection Area	Design Storm
General Stormwater Management Watershed Area	1.16
Savannah River Special Watershed Protection Area	1.16
Bacteria and Shellfish Special Watershed Protection Area	1.95

0%
100%

0%
80%

Appendix I: General Design Criteria and Guidelines

Table of Contents

I.1 Hydrology and Runoff Determination

I.1.1 Acceptable Hydrologic Methods and Models

The following are the acceptable methodologies and computer models for estimating runoff hydrographs before and after development. These methods are used to predict the runoff response from given rainfall information and site surface characteristic conditions. The design storm frequencies used in all of the hydrologic engineering calculations will be based on design storms required in this guidebook unless circumstances make consideration of another storm intensity criterion appropriate:

- Rational Method (limited to sites under 10 acres)
- Urban Hydrology for Small Watersheds TR-55 (TR-55)
- Storage-Indication Routing
- HEC-1, WinTR-55, TR-20, and SWMM Computer Models

These methods are given as valid in principle and are applicable to most stormwater management design situations in the Southern Lowcountry. Other methods may be used when the Southern Lowcountry reviewing authority approves their application.

Note: Of the above methods, TR-55 and SWMM allow for the easiest correlation of the benefits of retention BMPs used to meet the stormwater retention volume (SWRv) with peak flow detention requirements and are therefore strongly recommended.

The following conditions shall be assumed when developing predevelopment, pre-project, and post-development hydrology, as applicable:

- For new development sites the runoff conditions shall be computed independent of existing developed land uses and conditions and shall be based on “Meadow in good condition” or better, assuming good hydrologic conditions and land with grass cover (NEH, 2004).
- For infill and redevelopment sites the predeveloped condition is the condition at the time of project submittal.
- Post-development conditions shall be computed for future land use assuming good hydrologic and appropriate land use conditions. If an NRCS CN Method-based approach, such as TR-55, is used, this curve number (CN) may be reduced based upon the application of retention BMPs, as indicated in the General Retention Compliance Calculator (Appendix H). This CN reduction will reduce the required detention volume for a site, but it should not be used to reduce the size of conveyance infrastructure.
- The rainfall intensity - duration - frequency curve should be determined from the most recent version of the Hydrometeorological Design Studies Center’s Precipitation Frequency Data Server (NOAA Atlas 14, Volume 2).
- Predevelopment Time of Concentration (Tc) shall be based on the sum total of computed or estimated overland flow time and travel in natural swales, streams, creeks and rivers, but never less than 6 minutes.
- Post-development Time of Concentration shall be based on the sum total of the inlet time and travel time in improved channels or storm drains but shall not be less than 6 minutes.
- Site drainage areas exceeding 10 acres that are heterogeneous with respect to land use, soils, RCN or Time of Concentration (Tc) shall require a separate hydrologic analysis for each sub-area.
- Hydrologic soil groups (HSGs) approved for use in the <local jurisdiction> are contained in the US Department of Agriculture Web Soil Survey. Where the HSG is not available through the Soil Survey due to the listed soil type being “Urban Soils” or similar, an HSG of C shall be used.

I.1.1.1 Urban Hydrology for Small Watersheds TR-55

Chapter 6 of Urban Hydrology for Small Watersheds TR-55, Storage Volume for Detention Basins, or TR-55 shortcut procedure, is based on average storage and routing effects for many structures and can be used for multistage outflow devices. Refer to TR-55 for more detailed discussions and limitations.

Information Needed

To calculate the required storage volume using TR-55, the predevelopment hydrology, along with the post-development hydrology for the 2, 10 and 25-year, 24-hour storm events are needed. The predevelopment hydrology is based on natural conditions (meadow) and will determine the site’s predevelopment peak rate of discharge, or allowable release rate, *qo*.

The post-development hydrology may be determined using the reduced CNs calculated in the General Retention Compliance Calculator or more detailed routing calculations. This will determine the site’s post-development peak rate of discharge, or inflow for the 2, 10 and 25-year, 24-hour storm events, and the site’s post-developed runoff in inches. Note that this method does not require a hydrograph. Once the above parameters are known, the TR-55 Manual can be used to approximate the storage volume required for each design storm.

Procedure

1) Determine the peak development inflows, q_i, and the allowable release rates, q_o, from the hydrology for the appropriate design storm.

Using the ratio of the allowable release rate (q_O) to the peak developed inflow (q_i)—or q_O/q_i—for the design storms, use Figure 1 to obtain the ratio of storage volume (V_S) to runoff volume (V_R)—for Type III storms.

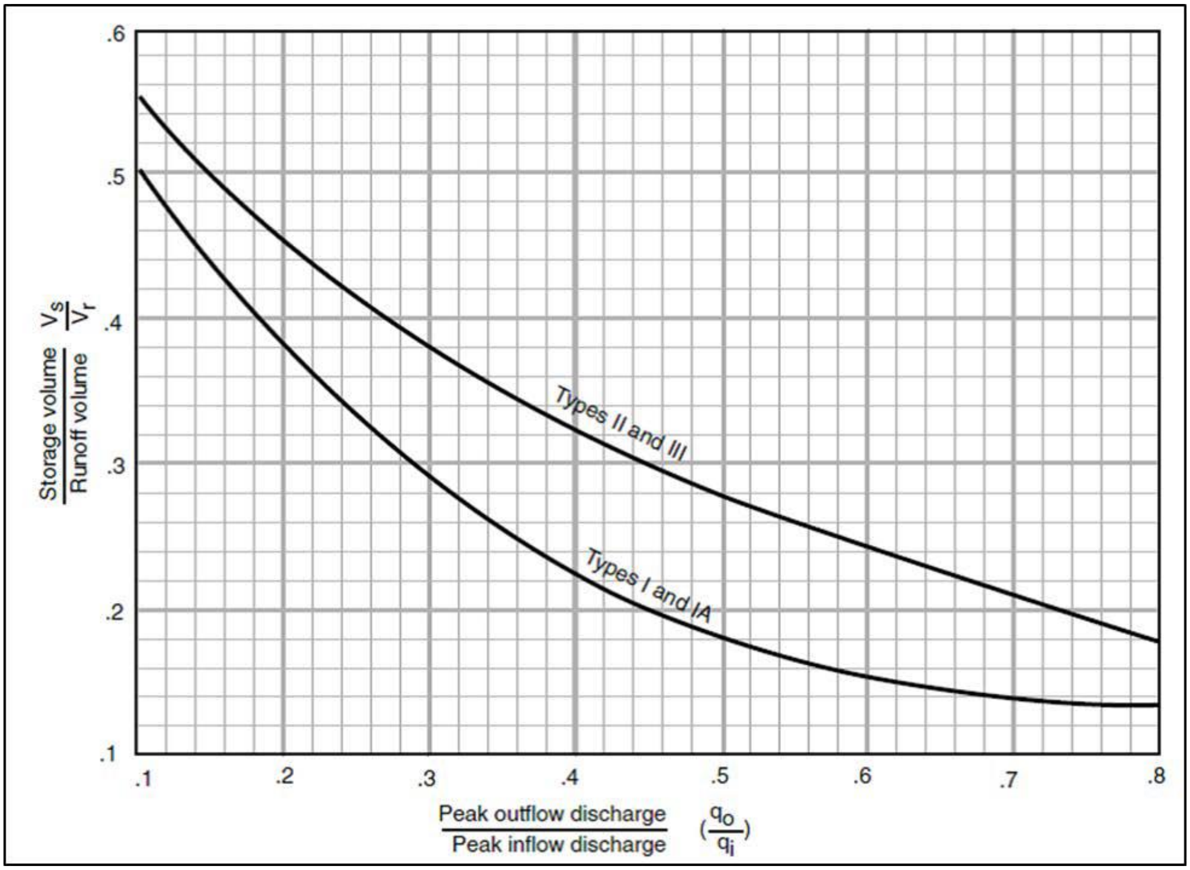


Figure 1. Approximate detention basin routing for rainfall Types I, IA, II, and III.

2) Determine the runoff volume V_R.

$$W_{\mathrm{R}} = \frac{QQ}{12} \times SSSSSS$$

where:

V_R	= post-development runoff for the design storm (ft^3)
Q	= post-development runoff for the design storm (in)
12	= conversion factor (inches to feet)
SDA	= site drainage area (ft^2)

3) Multiply the V_S/V_R ratios from Step 1 by the runoff volume (V_R) from Step 2 to determine the required storage volumes (V_S) in acre-feet.

$$\frac{VV_{SS}}{VV_{RR}} \, VV_{RR} = VV_{SS}$$

The design procedure presented above may be used with Urban Hydrology for Small Watersheds TR-55 Worksheet 6a. The worksheet includes an area to plot the stage-storage curve, from which actual elevations corresponding to the required storage volumes can be derived. The characteristics of the stage-storage curve are dependent upon the topography of the proposed storage practice and the outlet structure, and it may be best developed using a spreadsheet or appropriate hydraulics software.

Limitations
This routing method is less accurate as the q_O/q_i ratio approaches the limits shown in Figure 1. The curves in Figure 1 depend on the relationship between available storage, outflow device, inflow volume, and shape of the inflow hydrograph. When storage volume (V_S) required is small, the shape of the outflow hydrograph is sensitive to the rate of the inflow hydrograph. Conversely, when V_S is large, the inflow hydrograph shape has little effect on the outflow hydrograph. In such instances, the outflow hydrograph is controlled by the hydraulics of the outflow device and the procedure therefore yields consistent results. When the peak outflow discharge (q_O) approaches the peak inflow discharge (q_i) parameters that affect the rate of rise of a hydrograph, such as rainfall volume, CN, and Time of Concentration, become especially significant.

The procedure should not be used to perform final design if an error in storage of 25% cannot be tolerated. Figure 1 is biased to prevent under-sizing of outflow devices, but it may significantly overestimate the required storage capacity. More detailed hydrograph development and storage indication routing will often pay for itself through reduced construction costs.

I.1.1.2 Storage-Indication Routing

Storage-Indication Routing may be used to analyze storage detention practices. This approach requires that the inflow hydrograph be developed through one of the methods listed in this appendix (TR-55, WinTR-55, SWMM, etc.), as well as the required maximum outflow, q_o. Using the stage-discharge relationship for a given combination outlet devices, the detention volume necessary to achieve the maximum outflows can be determined.

I.1.1.3 HEC-1, WinTR-55, TR-20, ICPR and SWMM Computer Models

If the application of the above computer models is needed, the complete input data file and print-out will be submitted with the Stormwater Management Plans (SWMPs). Submission of SWMPs shall include the following computer model documentation:

- For all computer models, supporting computations prepared for the data input file shall be submitted with the SWMPs.
- Inflow-outflow hydrographs shall be computed for each design storm presented graphically and submitted for all plans.
- Schematic (node) diagrams must be provided for all routings.

I.1.2 Stormwater Volume Peak Discharge

The peak rate of discharge for individual design storms may be required for several different components of water quality BMP design. While the primary design and sizing factor for most stormwater retention BMPs is the design Stormwater Retention Volume (SWRv), several design elements will require a peak rate of discharge for specified design storms. The design and sizing of pretreatment cells, level spreaders, by-pass diversion structures, overflow riser structures, grass swales, and water quality swale geometry, etc. all require a peak rate of discharge in order to ensure non-erosive conditions and flow capacity.

The peak rate of discharge from an SDA can be calculated from any one of several calculation methods discussed in this appendix. The two most commonly used methods of computing peak discharges for peak runoff calculations and drainage system design are NRCS TR-55 CN methods (NRCS TR-55, 1986) and the Rational Formula. The Rational Formula is limited to 10 acre drainage areas. It is highly sensitive to the Time of Concentration and rainfall intensity, and therefore should only be used with reliable Intensity-Duration-Frequency (IDF) curves or tables for the rainfall depth and region of interest (Claytor & Schueler, 1996).

The NRCS CN methods are very useful for characterizing complex sub-watersheds and SDAs and estimating the peak discharge from large storms (greater than 2 inches), but it can significantly underestimate the discharge from small storm events (Claytor and Schueler, 1996). Since the SWRv is based on smaller storm events, this underestimation of peak discharge can lead to undersized diversion and overflow structures, potentially bypassing a significant volume of the design SWRv around the retention practice. Undersized overflow structures and outlet channels can cause erosion of the BMP conveyance features that can lead to costly and frequent maintenance.

In order to maintain consistency and accuracy, the following Modified CN Method is recommended to calculate the peak discharge for the SWRv rain event. The method utilizes the Small Storm Hydrology Method (Pitt, 1994) and NRCS Graphical Peak Discharge Method (USDA, 1986) to provide an adjusted CN that is more reflective of the runoff volume from impervious areas within the SDA. The design rainfall is a NRCS Type III distribution, so the method incorporates the peak rainfall intensities common in the eastern United States, and the time of concentration is computed using the method outlined in TR-55.

The following steps describe how to calculate the SWRv peak rate of discharge (q_{pSWRv}) for the 85th percentile rain (1.16-inch) event.

1) **Calculate the adjusted CN for the site or contributing drainage area (CDA).**
The following equation is derived from the NRCS CN Method and is described in detail in the National Engineering Handbook Part 630 Chapter 10: Estimation of Direct Runoff from Storm Rainfall and NRCS TR-55 Chapter 2: Estimating Runoff:

$$CN = \frac{1{,}000}{10 + 5P + 10Q_a - 10(Q_a^2 + 1.25Q_aP)^{0.5}}$$

where:

CN	= adjusted curve number
P	= rainfall (in, 1.16 or 1.95 in)
Q_a	= runoff volume (watershed inches), equal to SWRv/SDA

Note: When using hydraulic/hydrologic model for sizing a retention BMP or calculating the SWRv peak discharge, designers must use this modified CN for the CDA to generate runoff equal to the SWRv for the design rainfall event.

2) **Compute the site drainage area's time of concentration (*Tc*).**
TR-55 Chapter 3: Time of Concentration and Travel Time provides a detailed procedure for computing the Tc.

3) **Calculate the stormwater retention volume peak discharge (q_{pSWRv}).**
The q_{pSWRv} is computed using the following equation and the procedures outlined in TR-55, Chapter 4: Graphical Peak Discharge Method. Designers can also use WinTR-55 or an equivalent TR-55 spreadsheet to compute q_{pSWRv}:

- Read initial abstraction (I_a) from TR-55 Table 4.1 or calculate using I_a = 200/CN −2
- Compute I_a/P (P = 1.16)
- Read the Unit Peak Discharge (q_u) from Exhibit 4-II using Tc and I_a/P
- Compute the q_{pSWRv} peak discharge:

$$qqqq_{SSSSRRSS} = qq_{uu} \times SS \times QQ_{aa}$$

where:

q_{pSWRv}	= stormwater retention volume peak discharge (ft^3/sec)
q_u	= unit peak discharge (ft^3/sec/mi^2/in)
A	= site drainage area (mi^2)
Q_a	= runoff volume (watershed inches), equal to SWRv/SDA

This procedure is for computing the peak flow rate for the 85th and 95th percentile rainfall events. Calculations of peak discharge from larger storm events for the design of drainage systems, culverts, etc., should use published CNs and computational procedures.

I.2 Storm Sewer Collection System

I.2.1 Introduction

The focus of *the Southern Lowcountry Stormwater Design Manual* is to define standards and specifications for design, construction and maintenance of BMPs required to meet post construction stormwater performance objectives. Design of the conveyance of stormwater runoff within the public right-of-way (PROW) must follow the current requirements in SCDOT's Requirements for Hydraulic Studies, Part 2 Requirements for Roadway Drainage (SCDOT, 2009). These are incorporated by reference with the following notes pertinent to the *<local jurisdiction>*.

I.2.2 Clearance with Other Utilities

- All proposed and existing utilities crossing or parallel to designed storm sewer systems must be shown on the plan and profile.
- Storm drain and utility crossings must not have less than a 45-degree angle between them.
- Minimum vertical and horizontal clearances, wall to wall, must be provided between storm drainage lines and other utilities as defined by the Beaufort-Jasper Water & Sewer Authority.

I.2.3 Pipe Systems

- The pipe sizes used for any part of the storm drainage system within the PROW must be designed in accordance with the current requirements in SCDOT's Requirements for Hydraulic Studies, Part 2 Requirements for Roadway Drainage. (SCDOT, 2009)

- The material and installation of the storm drain for any part of public storm sewer must be designed in accordance with the current requirements in SCDOT's Requirements for Hydraulic Studies, Part 2 Requirements for Roadway Drainage (SCDOT, 2009). An exception to the SCDOT list is spiral ribbed aluminum pipe (SRAP), which is not an acceptable pipe material for brackish waters. Materials shall be RCP, CAAP, HDPE or HP Storm per AASHTO standards for H20/H25 loading and installation per ASTM/AASHTO standards. Durability must be 100 years or greater per SCDOT standards.
- An alternative overflow path for the 100-year storm is to be shown on the plan view if the path is not directly over the pipe. Where applicable, proposed grading must ensure that overflow will be into attenuation facilities designed to control the 100-year storm.
- A pipe schedule tabulating pipe length by diameter and class is to be included on the drawings. Public and private systems must be shown separately.
- Profiles of the proposed storm drains must be shown on the drawings and indicate size, type, and class of pipe, percent grade, existing ground and proposed ground over the proposed system, and invert elevations at both ends of each pipe run. Pipe elevations and grades must be set to avoid hydrostatic surcharge during design conditions. Where hydrostatic surcharge greater than 1-foot of head cannot be avoided, a rubber gasket pipe is to be specified.

I.2.4 Hydraulic Grade Line

The existing grade line and proposed 25- and 100-year hydraulic grade lines (HGL) must be clearly indicated on the system profiles and identified with the initials HGL on the line and identified in the legend key. This grade line must take into consideration pipe and channel friction losses, computing structures losses, tailwater conditions and entrance losses. All pipe systems must be designed so that they will operate without building up a surcharged hydrostatic head under design flow conditions. It is recommended that the HGL be no more than 1 foot above the pipe crown. If pipes have a HGL more than 1 foot above the pipe crown, rubber gaskets are required. The 100-year HGL must not overtop the 6" curb of ingress/egress routes that would isolate interior parcels in the extreme flood event.

If the structural stormwater BMP discharges into a storm sewer, a detailed HGL analysis of the system including the receiving system must be submitted with the final Stormwater Management Plans (SWMPs) for 100-year storm event. Provide documentation supporting safe passage of the 100-yr post-development flow downstream and an analysis of the surrounding neighborhood area to identify any existing capacity shortfalls or drainage blockages based on the 10% rule in Section 3.8.

I.3 Open Channels

- Calculations must be provided for all channels, streams, ditches, swales, etc., including a typical section of each reach and a plan view with reach locations. In the case of existing natural streams/swales, a field survey of the stream (swale) cross sections may be required prior to the final approval.
- The final designed channel must safely pass the 100-yr storm event.
- If the base flow exists for a long period of time or velocities are more than 5 feet per second in earth and sodded channel linings, gabion or riprap protection must be provided at the intersection of the inverts and side slopes of the channels unless it can be demonstrated that the final bank and vegetation are sufficiently erosion-resistant to withstand the designed flows, and the channel will stay within the floodplain easement throughout the project life.

- Channel inverts and tops of bank are to be shown in plan and profile views.
- For a designed channel, a cross section view of each configuration must be shown.
- For proposed channels, a final grading plan must be provided.
- The limits of a recorded 100-year floodplain easement or surface water easement sufficient to convey the 100-year flow must be shown.
- The minimum 25-foot horizontal clearance between a residential structure and 100-year floodplain must be indicated in the plan.
- For designed channels, transition at the entrance and outfall is to be clearly shown on the site

Appendix J: Rainwater Harvesting Treatment and Management Requirements

This Appendix is provided as an example of requirements necessary for approval of use of reclaimed rainwater in non-potable water systems. It is not intended to regulate water retained by another BMP for use in irrigation and to meet stormwater retention volume requirements.

Table of Contents

J.1 Rainwater Harvesting Treatment and Management Requirements

J.1.1 Introduction

The majority of the information and requirements provided herein are excerpted from the 2017 Water Environment and Reuse Foundation Report: Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems (DNWS Report), and much of the text is directly quoted. In some cases, text from this report has been modified to conform to the Stormwater Design Manual and <*local jurisdiction*> review and inspection procedures.

The purpose of this appendix is to provide information and guidance through a risk-based framework to help designers and <*local jurisdiction*> ensure that all rainwater harvesting systems are adequately protective of public health. This appendix identifies pathogen reduction targets that must be met and various treatment systems that can be used to meet the targets, as well as volatile organic compound (VOC) limits that must be achieved storage and distribution management considerations, operation and maintenance as well as long-term monitoring and reporting requirements are also discussed.

J.1.2 Pathogen Reduction Targets

Risk-based pathogen reduction targets have been developed based on analysis of potential human health risks associated with exposure to microbial hazards, and are based on a "10^{-4} Per Person per Year Benchmark." This means that the agreed-upon "tolerable" risk level is a probability of infection of 1 in 10,000 people per year. Pathogen reduction targets are expressed in terms of the 95th percentile Log_{10} Reduction Target (LRT). LRTs were developed for each source water and end use addressed in this appendix based on attaining the "tolerable" infection risk. If a system can maintain this level of treatment performance at all times, then the predicted probability of infection across the population will be less than the 1 in 10,000 benchmark for each pathogen 95% of the time.

The LRT for each non-potable use scenario is presented in Table 1 for healthy adults (values are based on the DNWS Report, although additional uses have been added). A rainwater harvesting system must maintain this level of treatment performance at all times for all three pathogen types: viruses, protozoa, and bacteria. When both general runoff and roof runoff (as defined below in Table 1) are combined, the reduction targets for general runoff shall apply. Similarly, when multiple uses are proposed, the highest reduction targets shall apply.

Table 1. Ninety-fifth percentile log10 pathogen reduction targets (LRT) to meet infection ppy benchmarks for healthy adults.

Water Source and Use	Log_{10} Reduction Targets for 10^{-4} Per Person Per Year Benchmarks		
	Enteric Viruses	**Parasitic Protozoa**	**Enteric Bacteria**
General Runoff[a]			
Cooling Towers[b]	–	–	–
Irrigation	5.0	4.5	4.0
Indoor Use	5.5	5.5	5.0
Roof Runoff[c]			
Cooling Towers[b]	–	–	–
Irrigation	N/A	Limited data available	3.5
Indoor Use	N/A	Limited data available	3.5

a. For the purposes of this appendix, general runoff means precipitation runoff from rain or snowmelt events that flows over land and/or impervious surfaces (e.g., streets, sidewalks, and parking lots). It also includes runoff from roofs or parking garages with frequent public access.

b. The pathogen risks associated with cooling towers and other uses in which there is no public exposure can be controlled by post-treatment management practices rather than initial treatment. The reason is that greater microbial risks from this use is likely to result from not controlling the growth of water-based pathogens (e.g., Legionella pneumophila, Pseudomonas aeruginosa, and non-tuberculous mycobacteria) that may proliferate in stagnant piped water. Management practices are discussed in Section J.1.7 Storage and Distribution Management Practices.

c. Roof runoff means precipitation from a rain event that is collected directly from a roof surface not subject to frequent public access.

The non-potable uses and LRTs included in Table 1 assume that human contact with the harvested water will be infrequent, and ingestion unintentional. Uses where frequent human contact with the harvested water is intended, like fountains or splash pads, will be considered similar to swimming pools, and must meet the standards defined by the *<local jurisdiction>*. The remaining sections in this appendix only cover non-potable uses with infrequent human contact. Treatment and monitoring procedures for frequent contact uses will be reviewed on a case-by-case basis.

Treatment Process

A well-established and accepted concept in modern drinking water and water reuse practices is to attribute the log10 reduction of pathogen groups to specific technologies that are operated within defined limits, coupled with appropriate control points to demonstrate the proper performance of the technology. This is referred to as the log10 reduction value (LRV) and can be compared directly to the LRTs described in Section J.1.2 above. Various treatment processes and treatment trains can be used to obtain the LRT for each pathogen for a given combination of source water and end use. Sections J.1.5 and J.1.6 discuss a range of treatment processes and provide LRVs for each process.

J.1.3 Filtration

The removal of particulate matter, including pathogens, by size exclusion is of interest because filters can serve as a barrier to pathogens in water. Filtration is especially important because pathogens can be shielded by or embedded in particulate matter, reducing the effectiveness of subsequent disinfection processes. Typical values for pathogen group log10 reduction by filtration processes are summarized in Table 2.

Table 2. Typical values for pathogen reduction using filtration processes.

Barrier	Typical Log_{10} Reduction Values		
	Virus	**Protozoa**	**Bacteria**
Slow sand filter	2	4	2
Dual media filter with coagulant	1	2	1
Cartridge/bag filter (5-10 microns)	0	0	0
Cartridge/bag filter (3 microns or less)	0	3	0
Cartridge/bag filter (1 micron)	0	4	0
Diatomaceous earth	1	4	2
Microfilter	1	6	6
Ultrafilter or Nanofilter	6	6	6
Reverse osmosis	6	6	6

J.1.4 Disinfection

Processes for pathogen inactivation include disinfection by chlorine, peracetic acid, ozone, ultraviolet (UV) radiation, advanced oxidation, and pasteurization. Particles in water can inhibit effective disinfection through shading (in the case of UV) and shielding embedded pathogens. Larger particles may require more time for a disinfecting agent to penetrate the particle and reach an embedded pathogen; therefore, for any disinfectant to be effective, particles larger than 10 microns must be removed.

Typical values for the inactivation of pathogens for disinfection processes in filtered water are given in Table *3*, Table 4, and

Table 5. These values serve as a guide to the relative effectiveness of different disinfection technologies and are not for a specific microorganism.

Table 3. Typical values for various levels of the inactivation of enteric virus in filtered secondary effluent with selected disinfection processes.

Disinfectant	Unit[b]	Dose for Corresponding Log_{10} Reduction Value			
		1 Log_{10}	2 Log_{10}	3 Log_{10}	4 Log_{10}
Free chlorine	mg•min/L	–	1.5–1.8	2.2–2.6	3.0–3.5
Chloramine[a]	mg•min/L	–	370–400	550–600	750–800
Peracetic acid	mg•min/L	NA	NA	NA	NA
Ozone	mg•min/L	–	0.25–0.30	0.35–0.45	0.50–0.60
Ultraviolet radiation	mJ/cm^2	50–60	90–110	140–150	180–200
Advanced oxidation	mJ/cm^2	10–20	50–60	70–80	110–130
Pasteurization (60°C)	Second	140	280	420	560
a. Due to interferences with chloro-organic compounds, when chloramine is used as a disinfectant, log10 reductions can only be used if the actual dosage of monochloramine is known, not just the amount of combined chlorine.					
b. mg•min/L = Milligram-minutes per liter					
c. mJ/cm2 = Millijoules per square centimeter.					

Table 4. Typical values for various levels of the inactivation of parasitic protozoa in filtered secondary effluent with selected disinfection processes.

Disinfectant	Unit[b]	Dose for Corresponding Log_{10} Reduction Value			
		1 Log_{10}	2 Log_{10}	3 Log_{10}	4 Log_{10}
Free chlorine	mg•min/L	2,000–2,600	NA	NA	NA
Chloramine[a]	mg•min/L	NA	NA	NA	NA
Peracetic acid	mg•min/L	NA	NA	NA	NA
Ozone	mg•min/L	4.0–4.5	8.0–8.5	12–13	NA
Ultraviolet radiation	mJ/cm^2	2–3	5–6	11–12	20–25
Advanced oxidation	mJ/cm^2	2–3	5–6	10–12	20–25
Pasteurization (60°C)	Second	30	60	90	120
a. Due to interferences with chloro-organic compounds, when chloramine is used as a disinfectant, log10 reductions can only be used if the actual dosage of monochloramine is known, not just the amount of combined chlorine.					
b. mg•min/L = Milligram-minutes per liter.					
c. mJ/cm2 = Millijoules per square centimeter.					

Table 5. Typical values for various levels of the inactivation of enteric bacteria in filtered secondary effluent with selected disinfection processes.

Disinfectant	Unit[b]	Dose for Corresponding Log_{10} Reduction Value			
		1 Log_{10}	2 Log_{10}	3 Log_{10}	4 Log_{10}
Free chlorine	mg•min/L	0.4–0.6	0.8–1.2	1.2–1.8	1.6–2.4
Chloramine[a]	mg•min/L	50–70	95–150	140–220	200–300
Peracetic acid	mg•min/L	10–25	40–60	75–125	150–200
Ozone	mg•min/L	0.005–0.01	0.01–0.02	0.02–0.03	0.03–0.04
Ultraviolet radiation	mJ/cm^2	10–15	20–30	30–45	40–60
Advanced oxidation	mJ/cm^2	4–6	6–8	8–10	10–12
Pasteurization (60°C)	Second	50	100	150	200
a. Due to interferences with chloro-organic compounds, when chloramine is used as a disinfectant, log10 reductions can only be used if the actual dosage of monochloramine is known, not just the amount of combined chlorine.					
b. mg•min/L = Milligram-minutes per liter.					
c. mJ/cm2 = Millijoules per square centimeter.					

J.1.5 Treatment Trains

Most non-potable water systems use a number of unit processes in series to accomplish treatment, known commonly as the “multiple barrier” approach. Multiple barriers are used to improve the reliability of a treatment approach through process redundancy, robustness, and resiliency. When multiple treatment barriers are used to achieve the pathogen LRT, the contribution from each barrier is cumulative; therefore, a reduction in performance by one process is mitigated by other processes in the treatment train.

In addition to these treatment barriers, operational and management barriers are used to ensure that systems are in place to respond to non-routine operation. Treatment barriers can be monitored using sensors and instrumentation for continuous process monitoring. An important ability is to take the treatment train offline automatically in the event of process malfunction.

If each barrier in a treatment train is independent, the LRVs for each process in the treatment train can be added together to obtain the overall treatment train LRV.

J.1.6 Volatile Organic Compounds

For rainwater harvesting systems that use general runoff from vehicular access areas as a source and will have some level of public exposure risk, the treated water must be tested for the presence of volatile organic compounds (VOCs); however, this does not apply when the water will be used for cooling towers or other “no public exposure” uses. The test must be performed by the system operator prior to commissioning of the system (see Commissioning) and prior to subsequent *<local jurisdiction>* maintenance inspections (see Operational Monitoring and Reporting). VOC levels must be below the maximums indicated in Table 6. If any VOC levels exceed these limits, the rainwater harvesting system must not be utilized until the problem is satisfactorily addressed, and a successful test has been performed. VOC limit exceedances may be addressed through source controls or through provision of additional treatment devices.

Table 6. Volatile organic compound maximum concentrations.

VOC	Maximum Concentration (mg/L)[a]
Benzene	0.1
Carbon Tetrachloride	0.5
1,2-Dichlorobenzene	5.4
1,4-Dichlorobenzene	5.4
1,1 Dichloroethane	14.4
1,2 Dichloroethane	0.1
1,1-Dichloroethylene	0.1
cis-1,2-Dichloroethylene	28.4
trans-1,2-Dichloroethylene	28.4
Dichloromethane	3.1
1,2-Dichloropropane	12.6
1,3-Dichloropropene	0.2
Ethylbenzene	15.6
Methyl-tert-butyl ether	5.2
Monochlorobenzene	1.7
Styrene	7.7
1,1,2,2-Tetrachloroethane	0.3
Tetrachloroethylene	6.1
Toluene	6.8
1,2,4-Trichlorobenzene	1.4
1,1,1-Trichloroethane	68.2
1,1,2-Trichloroethane	1.6
Trichloroethylene	4.8
Trichlorofluoromethane	201.1
1,1,2-Trichloro-1,2,2-Trifluoroethane	272.9
Vinyl Chloride	0.1
Xylenes	15.6

a. Values determined by the San Francisco Department of Public Health based on U.S. Occupational Safety and Health Administration Permissible Exposure Limits for 8-hour inhalation exposures to selected VOCs.

J.1.7 Storage and Distribution Management Practices

To achieve the desired objectives of public health protection, treated water must be properly stored and distributed to prevent compromising the quality of water after treatment. For example, opportunistic pathogens like Legionella could grow in the distribution system, sewage could contaminate treated water, or lead and copper (which cause toxicity) could leach from piping. Producing adequate quality non-potable water that meets all the pathogen control criteria set forth in this appendix is the first step in ensuring proper public health protection. The final step in quality control is to manage properly 1) storage and distribution systems and 2) the uses of non-potable water.

In rainwater harvesting systems, neither significant/routine ingestion nor direct contact with the treated water product is typically anticipated due to limited exposures to non-potable water. Nevertheless, the occurrence of aerosol inhalation and indirect contact requires the careful management of DNW system storage and distribution systems to control exposures to non-tuberculous mycobacterial and Legionella pathogens. For example, even clean drinking water may allow biofilm growth of Legionella (aerosol pathogen risk) if the water temperature is between 25°C and 45°C and stagnates, resulting in the presence of minimal residual chlorine.

A number of approaches are available to control microbial regrowth in distribution systems, each with varying benefits and drawbacks that depend on the characteristics and use of the system. Below are some recommended approaches for controlling microbial growth in distribution systems:

- **Producing non-potable water low in carbonaceous material and nutrient content**
  The primary energy source for pathogen regrowth is organic carbon measured as assimilable organic carbon, biodegradable dissolved organic carbon, total organic carbon, and other essential nutrients, including nitrogen (N), phosphorous (P), and iron (Fe); therefore, the primary means to reduce the regrowth potential of pathogens is to provide highly treated water. Reducing the potential for regrowth is more important in large-scale buildings or neighborhood/district-scale projects where there will be more residence time (creating more opportunities for regrowth) in distribution systems that supply non-potable water.

- **Producing highly disinfected non-potable water**
  Low concentrations of microbes resulting from filtration and advanced means of disinfection have a reduced potential for regrowth if organic carbon levels are low. Otherwise, there may be a need for a residual disinfectant to manage growth in larger community systems that produce aerosols. Post-treatment disinfection with UV radiation is a recommended means of disinfection that does not increase levels of assimilable organic carbon or biodegradable dissolved organic carbon.

- **Using non-reactive, biologically stable materials of construction**
  Avoid the use of corrosive materials or organic materials that tend to protect microorganisms from disinfection and enhance the regrowth environment by the adsorption of organic compounds.

- **Maintaining a residual disinfectant**
  Different disinfectants offer advantages and disadvantages to overall water quality and system management. In general, a higher disinfectant residual provides lower regrowth. Many design and operation considerations are available for each specific system. It is recommended that a free chlorine residual of 0.2 milligrams per liter (mg/L) or monochloramine residual of 2 to 3 mg/L be maintained at or near the point of use to control microbial growth. Chloramine provides a better residual duration as compared to chlorine. Various combinations of UV

chlorine, chloramine, ozone, and hydrogen peroxide are beneficial for specific disinfection goals. Periodic shock treatments with disinfectants and continuous disinfection looping of reservoirs help reduce the potential for regrowth and manage issues with biofilms. Stagnation resulting from dead zones or prolonged periods of zero-flow or low flow that create long residence times and allow disinfectants to dissipate and sediments to deposit result in improved conditions for regrowth and should be avoided.

- **Cleaning storage tanks**
  The required frequency of storage tank cleaning varies depending upon the quality of water stored, detention time in storage, temperature of the water, and nature of the tank. Tanks that are open to the atmosphere require more frequent cleaning.
- **Flushing the distribution system**
  The required frequency of distribution system flushing varies depending upon the quality of water transmitted, detention time in the distribution system, temperature of the water, and nature of the distribution system components. Periodic flushing is a good means of both removing sediments and scouring pipe walls. System design must include means for easily flushing pipes as part of routine maintenance.
- **Controlling temperature**
  Avoid the storage and distribution of non-potable water within 20°C to 45°C to reduce the potential for pathogen regrowth. Otherwise, consider a disinfection residual or point-of-use system, particularly if aerosols are generated.

The rainwater harvesting system designer and Person Responsible for Maintenance each should review published guidelines for the management of Legionella in distribution systems and implement as appropriate for each specific system. In particular, ANSI/ASHRAE Standard 188-2015 Legionellosis: Risk Management for Building Water Systems (2015) provides guidance on stormwater best management practices (BMPs) for both potable and non-potable water systems. It addresses management program responsibilities, system design, risk analysis, control mechanisms, monitoring, confirmation, and documentation. Although the ASHRAE Standard targets legionellosis, its rationales and approaches are applicable to all pathogens and health risks identified in this appendix.

J.1.8 Commissioning

In the process of initializing a rainwater harvesting system, the system must be evaluated for leaks in the storage unit and the performance of the components of the treatment and distribution system. A commissioning report of the evaluation is required at the initial startup of the system and anytime the system is brought back online after cleaning, flushing, and/or a hiatus of use (e.g., winter shutdown).

J.1.9 Operational Monitoring and Reporting

The Person Responsible for Maintenance, as identified in the Stormwater Management Plan (SWMP), must maintain the rainwater harvesting system in good working condition and assure adequate treatment of the harvested rainwater. All systems, with the exception of those installed in single-family homes, shall include continuous monitoring systems that are capable of determining if the rainwater harvesting system is operating within the design specification, and if all system components of the rainwater harvesting system are functional.

Data logs from continuous monitoring systems must be kept on file and produced upon request from <*local jurisdiction*>. In addition, annual reports must be generated that identify the following:

- Significant maintenance activities;
- Treatment modifications;
- Outages and malfunctions (including reasons and durations); and
- Steps taken to mitigate or eliminate recurrence of outages and malfunctions.

If there is a change of personnel—Person Responsible for Maintenance—it is the responsibility, within 15 business days, of the owner of the rainwater harvesting system or her/his agent to update the <*local jurisdiction*> with the name and contact information of the new personnel.

An operation and maintenance manual that includes a schematic drawing of the system, standard operating procedures for the system, and maintenance schedule(s), as well as commissioning reports, field verification reports, and annual reports must be on site and produced upon request from <*local jurisdiction*>.

J.1.10 Field Verification

Field verification is a performance confirmation of a rainwater harvesting system. It can be accomplished by physically observing the collection, storage, and distribution system, and the treatment process components. It can also be conducted using challenge testing, including surrogate microorganisms and/or other non-biological surrogates and typically involves manual collection of water samples for microbial analysis to check system performance in achieving LRTs. While not specifically required, <*local jurisdiction*> construction or maintenance inspections may include field verification testing to ensure that the rainwater harvesting system is achieving its LRTs, and that operational monitoring and control systems are functional.

J.1.11 Design Report

A design report must be submitted with each rainwater harvesting system that includes, at a minimum, the following:

- Pathogen $\log_{10}$ reduction target
- Proposed treatment process and associated $\log_{10}$ reduction value
- Proposed storage and distribution management practices
- Identification of the Person Responsible for Maintenance
  - Operation and Maintenance Manual
- Reliability analysis that identifies the following:
  - How the equipment used to monitor treatment, operations, and water quality enables determination of whether the system is working as planned.
  - How the monitoring and controls of the system will enable the operator or automatic controls to intervene in the event of the production of off-specification water.
  - Remedies and provisions for operation disruption (e.g., power failures, vandalism, and excessive source contamination)
  - Unauthorized access limitations for the rainwater harvesting and distribution system.

J.1.12 Treatment Design Examples

Example 1: Rooftop Runoff for Landscape Irrigation

1) **Identify the log_{10} reduction targets for the reference pathogen groups.**
Since the roof will not allow frequent public access, the water source qualifies as roof runoff rather than general runoff. No LRT is provided for enteric bacteria or parasitic protozoa, but an LRT of 3.5 is defined for enteric bacteria.

2) **Select a treatment process to achieve the log_{10} reduction target.**
An ozone system with a CT value (the product of concentration and contact time) of 0.04 mg • min/L can achieve 4-log_{10} reduction of enteric bacteria. However, as all disinfection processes require removal of particles 10 microns or larger, a 10-micron cartridge filter or similar device will also be necessary (see Figure 1).

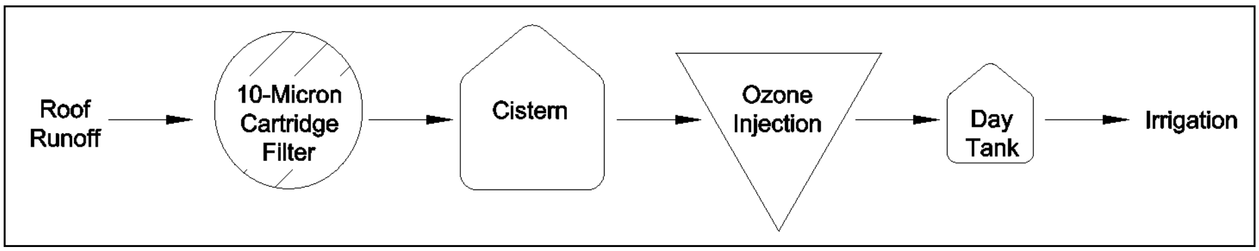


Figure 1. Example 1 treatment schematic.

Alternative treatment trains that also could meet the required LRT include the following:

- Microfiltration (i.e., 6-log_{10} reduction of bacteria).
- Sand filter with an equivalent effluent particle size distribution of 10 microns, followed by UV radiation with a dose of 40 to 60 mJ/cm2 (i.e., 4-log_{10} inactivation of bacteria).
- Cartridge filtration (10 microns), followed by chlorination with free chlorine with a CT value of 1.6 to 2.4 mg•min/L (i.e., 4-log_{10} inactivation of bacteria).

3) **Determine storage and distribution management practices.**
For non-potable water systems, consider the chemical characteristics of roof runoff and storage conditions, as follows:

- Due to its high purity, roof runoff may result in the corrosion of components and fixtures of the metallic distribution system. If any metallic pipe, fittings, solder, or fixtures are used that may be subject to corrosion from contact with aggressive water, then modify the water system or add a corrosion inhibitor to the non-potable water supply.
- If the temperature of water in the non-potable water distribution system exceeds 25°C (which is a condition that could promote the growth of opportunistic pathogens like Legionella), then maintain a free chlorine residual of 0.2 milligrams per liter (mg/L) or chloramine residual of 0.5 mg/L at or near the point of use.

4) **Identify maintenance and monitoring requirements and schedule of activities.**
These will vary based on the specific equipment and devices included in each design.

5) **Submit design report and SWMP.**

Example 2: General Runoff for Indoor Use

1) **Identify the $\log_{10}$ reduction targets for the reference pathogen groups.**
The proposed rainwater harvesting system will capture runoff from two different areas on a rooftop. The first area will have no public access, but the second area includes a patio area that is designed for public access. The combined water from the two areas is therefore considered "general runoff," and will need to be treated accordingly. The LRT for both enteric viruses and protozoa is 5.5, and the LRT for enteric bacteria is 5.0.

2) **Select a treatment process to achieve the $\log_{10}$ reduction target.**
An ultrafiltration system can achieve 6-$\log_{10}$ reduction of viruses, protozoa, and bacteria (see Figure 2).

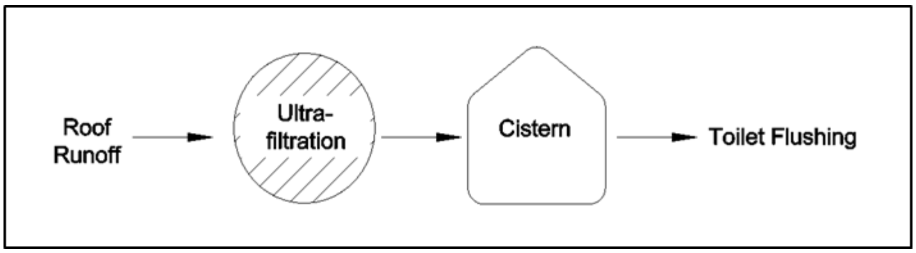


Figure 2. Example 2 treatment schematic.

The only alternative processes that can also meet the required LRTs are nanofiltration and reverse osmosis.

3) **Determine storage and distribution management practices.**
For non-potable water systems, consider the chemical characteristics of roof runoff and storage conditions, as follows:

- Due to its high purity, roof runoff may result in the corrosion of components and fixtures of the metallic distribution system. If any metallic pipe, fittings, solder, or fixtures are used that may be subject to corrosion from contact with aggressive water, then modify the water system or add a corrosion inhibitor to the non-potable water supply.
- If the temperature of water in the non-potable water distribution system exceeds 25°C (which is a condition that could promote the growth of opportunistic pathogens like Legionella), then maintain a free chlorine residual of 0.2 milligrams per liter (mg/L) or chloramine residual of 0.5 mg/L at or near the point of use.

4) **Identify maintenance and monitoring requirements and schedule of activities.**
These will vary based on the specific equipment and devices included in each design.

5) **Submit design report and SWMP.**

Example 3: Roof Runoff for Cooling Towers

1) **Identify the $\log_{10}$ reduction targets for the reference pathogen groups.**
As there is not public exposure to the harvested rainwater, there are not initial treatment requirements. Chlorination may still be required to control the growth of opportunistic pathogens however (see Step 2).

2) **Determine storage and distribution management practices.**
For non-potable water systems, consider the chemical characteristics of roof runoff and storage conditions, as follows:

    - Due to its high purity, roof runoff may result in the corrosion of components and fixtures of the metallic distribution system. If any metallic pipe, fittings, solder, or fixtures are used that may be subject to corrosion from contact with aggressive water, then modify the water system or add a corrosion inhibitor to the non-potable water supply.
    - If the temperature of water in the non-potable water distribution system exceeds 25°C (which is a condition that could promote the growth of opportunistic pathogens like Legionella), then maintain a free chlorine residual of 0.2 milligrams per liter (mg/L) or chloramine residual of 0.5 mg/L at or near the point of use.

3) **Identify maintenance and monitoring requirements and schedule of activities.**
These will vary based on the specific equipment and devices included in each design.

4) **Submit design report and SWMP.**

J.2 Rainwater Harvesting Storage Volume Calculator Instructions

Input Sheet

The cells of the spreadsheet are color coded as follows:

Color Code

	Title/New Category
	Required Entry value
	Alternate Category Entry (if selected, do not enter value into "Required Entry value")
	Final Category Value

Design Storm (inches)

Cell L4	Choose either 1.16 inches or 1.95 inches depending on the Watershed Protection Area in which the project is located.

CONTRIBUTING DRAINAGE AREA (CDA)

Cell L7, L9, L11	Indicate the impervious CDA, the turf cover CDA, and the runoff coefficient (Rv) for the turf cover. The turf cover Rv should range between 0.15 and 0.25. The CDA is assumed to convey 95 percent of the rainfall that lands on its impervious surface and 15 - 25 percent of the rainfall that lands on its turf cover area.

CONTRIBUTING BMPS	
Cell L17	Enter the retention volume as well as the overflow from the Design Storm for any BMPs that drain to the cistern. Both of these values can be found in the SoLoCo Compliance Calculator. The retention volume is in the "Volume Credited" column, and the overflow volume is in the "Remaining Volume" column.
The following instructions identify how the collected rainwater will be used. Only fill in the sections that are applicable to the site.	
IRRIGATION	
Cells L23, L25	Indicate the area to be irrigated in square feet and if the irrigation system as smart controls.
Row A31-L31	The spreadsheet allows for irrigation to be used in certain months. Indicate, for each month, the average weekly irrigation application rate in either inches per week or gallons per month.
	The EPA WaterSense Water Budget Tool can be used to calculate Monthly Landscape Water Requirement (based on the site's peak watering month). The output for this calculation is found on the Part 2-LWA sheet, which can be found at the following link: https://www.epa.gov/watersense/water-budget-tool
INDOOR DEMAND - FLUSHING TOILETS/URINALS	
Cell L35	Indicate the number of people using the building.
Cells L35, L37	The values in **lines 35 and 37** can be altered depending on how much water is used when flushing urinals or toilets. The default values are 0.80 gallons/flush and 1.60 gallons/flush for urinals and toilets, respectively.
Cell L39	If the user knows the daily toilet and urinal demand, that value can be input into **line 39** and the information in the rows above will not be used.
Cells L44, L46, L48	Indicate the first and last day of the week that the building will be in use and the number of hours each day the building will be occupied.
INDOOR DEMAND - LAUNDRY	
Cell L54	Indicate the number of loads of laundry done each day.
Cell L54	The value in **line 54** can be altered depending on how much water is used for each load of laundry. The default value is 42 gallons per load.
Cell L56	If the user knows the daily laundry demand, the value can be input into **line 56** and the information in the rows above will not be used.
Cells L60, L62	Indicate the first and last day of the week when the water will be used.
ADDITIONAL DAILY USE	
Row A71-L71	If there is any other additional daily use not covered in the spreadsheet, **line 69** can accommodate additional demand. Indicate, for each month, the average daily demand in gallons per day.
Cells L73, L75	Indicate the first and last day of the week when the water will be used.

COOLING TOWERS	
Row A79-L79	If the rainwater collected is to be used for cooling towers, indicate in **line 79** the average daily demand in gallons per day for each month the cooling towers use the collected rainwater.
The following section allows for additional contribution to the cistern from sources other than rainwater.	
CONTRIBUTION FROM OTHER SOURCES	
Row A88-L88	If there are other sources of water that contribute to the cistern, indicate the average daily contribution in gallons per day for each month
Cells L90, L92	Indicate the first and last day of the week when the water will be input.
FIRST FLUSH FILTER DIVERSION AND EFFICIENCY	
This section accounts for the filter efficiency of the cistern. It is assumed that, after the first flush diversion and loss of water due to filter inefficiencies, the remainder of the SWRv storm will be successfully captured. These minimum values can be altered if appropriate.	
Cell L98	**Line 98** indicates that for the 1.16-inch storm, a minimum of 95 percent of the runoff should be conveyed into the cistern.
Cell L100	**Line 100** indicates that for the 4.19-inch storm, a minimum of 90 percent of the runoff should be conveyed.

Storage Volume Results Sheets

These sheets give a range of possible cistern sizes and the corresponding storage volume available. Once a cistern size is chosen, the corresponding storage volume may be used in the Stormwater Database.

The table on this sheet has the following information.

- **Cistern Volume** (gallons) – This row gives a range of cistern sizes in gallons based on the CDA size.

- **Daily Average Available Storage Volume** (gallons or cubic feet) – This row shows the average available storage capacity of a given cistern (Sv). Use the Sv that corresponds to the cistern size selected for the site for the General Retention Calculator.

- **Overflow Volume (Sv)** (gallons or cubic feet) – This row shows the average overflow created by a 1.7" storm for various cistern sizes, based on average available storage volumes.

The graph shows a trade-off curve, which allows for a comparison of the retention achieved versus cistern size. While larger cisterns yield more retention, they are more costly. The curve helps the user to choose the appropriate cistern size, based on the design objectives and site needs. The overflow volume is also plotted to illustrate the effects of cistern size on overflow volume.

Southern Low Country -- RAINWATER HARVESTING STORAGE VOLUME CALCULATOR v1.1, August 26, 2020

Input Sheet

The cells of the spreadsheet are color coded as follows:

Color Code

Title/New Category

Required Entry value

Alternate Category Entry (if selected, do not enter value into "Required Entry value")

Final Category Value

Design Storm (inches)

Choose either 1.16 inches or 1.95 inches depending on the Watershed Protection Area in which the project is located.

CONTRIBUTING DRAINAGE AREA (CDA)

Indicate the impervious CDA, the turf cover CDA, and the runoff coefficient (Rv) for the turf cover. The turf cover Rv should range between 0.15 and 0.25. The CDA is assumed to convey 95 percent of the rainfall that lands on its impervious surface and 15 - 25 percent of the rainfall that lands on its turf cover area.

CONTRIBUTING BMPS

Enter the retention volume as well as the overflow from the Design Storm for any BMPs that drain to the cistern. Both of these values can be found in the SoLoCo Compliance Calculator. The retention volume is in the "Volume Credited" column, and the overflow volume is in the "Remaining Volume" column.

The following instructions identify how the collected rainwater will be used. Only fill in the sections that are applicable to the site.

IRRIGATION

Indicate the area to be irrigated in square feet and if the irrigation system as smart controls.

The spreadsheet allows for irrigation to be used in certain months. Indicate, for each month, the average weekely irrigation application rate in either inches per week or gallons per month.

The EPA WaterSense Water Budget Tool can be used to calculate Monthly Landscape Water Requirement (based on the site's peak watering month). The output for this calculation is found on the Part 2-LWA sheet, which can be found at the following link:
https://www.epa.gov/watersense/water-budget-tool

INDOOR DEMAND - FLUSHING TOILETS/URINALS

Indicate the number of people using the building.

The values in **lines 35 and 37** can be altered depending on how much water is used when flushing urinals or toilets. The default values are 0.80 gallons/flush and 1.60 gallons/flush for urinals and toilets, respectively.

If the user knows the daily toilet and urinal demand, that value can be input into **line 39** and the information in the rows above will not be used.
Indicate the first and last day of the week that the building will be in use and the number of hours each day the building will be occupied.

INDOOR DEMAND - LAUNDRY

Indicate the number of loads of laundry done each day.

The value in **line 54** can be altered depending on how much water is used for each load of laundry. The default value is 42 gallons per load. If the user knows the daily laundry demand, the value can be input into **line 56** and the information in the rows above will not be used.
Indicate the first and last day of the week when the water will be used.

ADDITIONAL DAILY USE

If there is any other additional daily use not covered in the spreadsheet, **line 69** can accommodate additional demand. Indicate, for each month, the average daily demand in gallons per day.
Indicate the first and last day of the week when the water will be used.

COOLING TOWERS

If the rainwater collected is to be used for cooling towers, indicate in **line 79** the average daily demand in gallons per day for each month the cooling towers use the collected rainwater.

The following section allows for additional contribution to the cistern from sources other than rainwater.

CONTRIBUTION FROM OTHER SOURCES

If there are other sources of water that contribute to the cistern, indicate the average daily contribution in gallons per day for each month
Indicate the first and last day of the week when the water will be input.

FIRST FLUSH FILTER DIVERSION AND EFFICIENCY

This section accounts for the filter efficiency of the cistern. It is assumed that, after the first flush diversion and loss of water due to filter inefficiencies, the remainder of the SWRv storm will be successfully captured. These minimum values can be altered if appropriate.

Line 96 indicates that for the 1.16-inch storm, a minimum of 95 percent of the runoff should be conveyed into the cistern.
Line 98 indicates that for the 4.19-inch storm, a minimum of 90 percent of the runoff should be conveyed.

Storage Volume Results Sheets

These sheets give a range of possible cistern sizes and the corresponding storage volume available. Once a cistern size is chosen, the corresponding storage volume may be used in the Stormwater Database.

The table on this sheet has the following information.

- **Cistern Volume** (gallons) – This row gives a range of cistern sizes in gallons based on the CDA size.
- **Daily Average Available Storage Volume** (gallons or cubic feet) – This row shows the average available storage capacity of a given cistern (Sv). Use the Sv that corresponds to the cistern size selected for the site for the General Retention Calculator.
- **Overflow Volume (Sv)** (gallons or cubic feet) – This row shows the average overflow created by a 1.7" storm for various cistern sizes, based on average available storage volumes.

The graph shows a trade-off curve, which allows for a comparison of the retention achieved versus cistern size. While larger cisterns yield more retention, they are more costly. The curve helps the user to choose the appropriate cistern size, based on the design objectives and site needs. The overflow volume is also plotted to illustrate the effects of cistern size on overflow volume.

Southern Low Country -- RAINWATER HARVESTING STORAGE VOLUME CALCULATOR v1.1, August 26, 2020

Input

Color Code

- Title/New Category
- Required Entry value
- Alternate Category Entry (if selected, do not enter value into "Required Entry value")
- Final Category Value

Design Storm

Design Storm (inches)	1.16

CONTRIBUTING DRAINAGE AREA (CDA)

What is the area of impervious cover in the CDA (SF)?	
What is the area of compacted cover in the CDA (SF)?	
What is the Runoff Coefficient (Rv) of the compacted cover?	
Total CDA (SF)	0

CONTRIBUTING BMPS

Retention Volume for the Upstream BMP(s) (cubic feet)	
Overflow volume from Design Storm from BMP(s) (cubic feet)	

IRRIGATION

How big is the area to irrigate? (SF)	
Does the irrigation system have smart controls (e.g. soil moisture sensor shutoff)? If no, leave unchecked.	
Enter monthly irrigation needs for site. Select units (Inches/Week or Gallons/Month)	Inches/Week

If using EPA WaterSense Water Budget Tool (link below), select Gallons/Month.

https://www.epa.gov/watersense/water-budget-tool

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00

INDOOR DEMAND - FLUSHING TOILETS/URINALS

Toilet and urinal use (if only toilets are used, set urinals = 0)

How many people will use the building? (# people)	
How much water will each urinal use? (gallons/flush) Set to 0, if no urinal.	0.80
How much water will each toilet use? (gallons/flush)	1.60
Calculated daily toilet and urinal demand. (gallons/day) Use this cell if value has already been calculated, instead of the rows above.	0
Select the first day of the week this water will typically be used (e.g. Monday).	
Select the last day of the week this water will typically be used (e.g. Friday).	
Hours per day the building is used (e.g. 8 for a 9-5 office building; 24 for a shift-work factory).	
Total daily toilet and urinal demand (gallons/day).	0.0

INDOOR DEMAND - LAUNDRY

Laundry use (use either loads per day, pounds per day or calculated demand)

How many loads of laundry are done each day? (# loads/day)	
How much water does each load of laundry use in gallons? (gallons/load)	42
Calculated daily laundry demand. (gallons/day)	0
Select the first day of the week this water will typically be used (e.g. Monday).	
Select the last day of the week this water will typically be used (e.g. Friday).	
Total daily laundry demand. (gallons/day)	0

ADDITIONAL DAILY USE

Additional daily use (bus wash, street sweepers, etc)

This value is user defined and is provided to allow for any other demand value.

Enter the average daily demand for each month throughout the year. (gallons/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

Select the first day of the week this water will typically be used (e.g. Monday).	
Select the last day of the week this water will typically be used (e.g. Friday).	

COOLING TOWERS

If water is to be used for cooling towers (for large scale projects)

Enter the average daily demand for each month throughout the year. (gallons/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

CONTRIBUTION FROM OTHER SOURCES

If any other sources will contribute water to the cistern, add them here (e.g. condensate)

This value is user defined and will be treated as a negative daily demand.

Enter the average daily demand for each month throughout the year. (gallons/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

Select the first day of the week this water will typically be input (e.g. Monday).	
Select the last day of the week this water will typically be input (e.g. Friday).	

FIRST FLUSH FILTER DIVERSION AND EFFICIENCY

Enter Approximate Filter Efficiencies associated with the 1.16" and 4.19" storms below.
Minimum values are 95% and 90%, respectively. See Specification for additional details and guidance.

Filter Efficiency Associated with the 1.16" storm (%)	95
	0.05
Filter Efficiency Associated with the 4.19" storm (%)	90
	0.10

Disclaimer: By using this spreadsheet, the User understands and accepts that the accuracy of results provided herein are not guaranteed. It is the responsibility of the User to verify results and to use professional judgement in its application.

Assigning Numeric Code for Day of Week

Category	Read from input		Numeric Code
Indoor Flushing Toilets			
Start Day Numeric Code	0	9	9
Final Day Numberic Code	0	9	9
			9
			9
Indoor Laundry			
Start Day Numeric Code	0	9	
Final Day Numberic Code	0	9	9
			9
			9
			9
Additional Daily Use			
Start Day Numeric Code	0	9	
Final Day Numberic Code	0	9	
Contribution from other sources			
Start Day Numeric Code	0	9	
Final Day Numberic Code	0	9	

Smart Irrigation?	FALSE
Inches/Week	0

		0
Monday	1	1
Tuesday	2	2
Wednesda	3	3
Thursday	4	4
Friday	5	5
Saturday	6	6
Sunday	7	7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24

1.2 inch rain	1.2
1.7 inch rain	1.7
3.2 inch rain	3.2

Storage Volume Summary

Average Daily Available Storage Volume by Month and Cistern Volume

Month\ Cistern Volume (gallons)	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500
January	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
February	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
March	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
April	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
May	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
June	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
July	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
August	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
September	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
October	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
November	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
December	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Daily Average Available Storage Volume, *Sv* (cubic feet)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Note: Cistern Volume does not include detention for larger storm events.
Detention volume that will be drawn down after each storm event should be modeled separately.

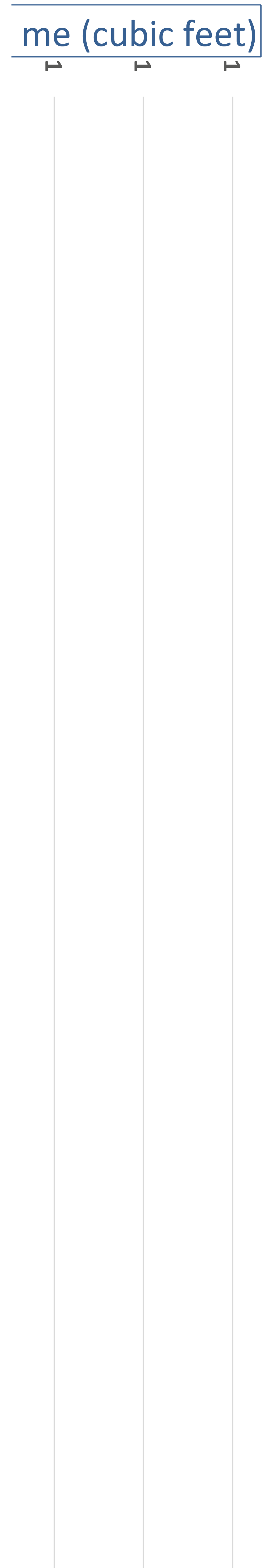
Overflow Volume from a 1.16-Inch Rain Event by Cistern Volume

Cistern Volume (Gallons)	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500
Overflow Volume (cubic feet)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Daily Averages of Available Storage (Sv) and Overflow Volu

1

1


me (cubic feet)

Appendix L: Glossary

A	
Advanced Design (AD)	Detailed design for an area of a project described explicitly in the following: • Stage II planned unit development (PUD) application to the District of Columbia Zoning Commission; • Application for design review under the Capitol Gateway Overlay District to the District Zoning Commission; and • Final design submission to the National Capital Planning Commission (NCPC)
Affordable housing	A single-family or two-family house that is built to be offered for rent or for sale for residential occupancy below market value and is made available to, and affordable to, a household whose income is equal to, or less than, eighty percent (80%) of the Area Median Income calculation provided by the United States Department of Housing and Urban Development
Animal confinement area	An area, including a structure, used to stable, kennel, enclose, or otherwise confine animals, not including confinement of a domestic animal on a residential property
Applicant	A person or their agent who applies for approval pursuant to this chapter
As-built plan	A set of architectural, engineering, or site drawings, sometimes including specifications that certify, describe, delineate, or present details of a completed construction project
Athletic playing fields	Compacted land cover and synthetic surfaces that are constructed primarily for use for athletic activities at public parks and schools. Compacted land cover and synthetic surfaces for which athletic activities are not the primary use are not considered athletic playing fields, unless these areas are necessary to support use of an adjacent area that is primarily used for athletic activities. Synthetic surfaces must have a minimum surface permeability of at least 10 inches per hour, in accordance with ASTM F2898 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
B	
Best management practice (BMP)	Structural or nonstructural practice that minimizes the impact of stormwater runoff on receiving waterbodies and other environmental resources, especially by reducing runoff volume and the pollutant loads carried in that runoff
Buffer	An area along a stream, river, or other natural feature that provides protection for that feature
Building permit	Authorization for construction activity issued by the <*local jurisdiction*>
C	

Clearing	The removal of trees and brush from the land excluding the ordinary mowing of grass, pruning of trees or other forms of long-term landscape maintenance
Combined sewer overflow (CSO)	The discharge of untreated effluent into a water body as a result of the combined volume of stormwater and sanitary water exceeding the capacity of the combined sewer system and wastewater treatment plant
Combined sewer system (CSS)	Sewer system in which stormwater runoff is conveyed together with sanitary wastewater through sewer lines to a wastewater treatment plant
Common plan of development	Multiple, separate, and distinct land-disturbing, substantial improvement, or other construction activities taking place under, or to further, a single, larger plan, although they may be taking place at different times on different schedules
Compacted cover	An area of land that is functionally permeable, but where permeability is impeded by increased soil bulk density as compared to natural cover, such as through grading, construction, or other activity and will require regular human inputs such as periodic planting, irrigation, mowing, or fertilization. Examples include landscaped planting beds, lawns, or managed turf
Conservation area	An area with a natural cover designation set aside to receive stormwater runoff as part of an impervious surface disconnection practice
Construction	Activity conducted for the following: • Building, renovating, modifying, or razing a structure; or • Moving or shaping of earth, sediment, or a natural or built feature
Contributing drainage area (CDA)	Area contributing runoff to a BMP
Control measure	Technique, method, device, or material used to prevent, reduce, or limit discharge
Critical area stabilization	Stabilization of areas highly susceptible to erosion, including down-slopes and side-slopes, through the use of brick bats, straw, erosion control blanket mats, gabions, vegetation, and other control measures
Cut	An act by which soil or rock is dug into, quarried, uncovered, removed, displaced, or relocated and the conditions resulting from those actions
D	
Demolition	The removal of part or all of a building, structure, or built land cover
Detention	Controlling the peak discharge rate of stormwater from a site
Dewatering	Removing water from an area or the environment using an approved technology or method, such as pumping
Director	The local administrator of the stormwater construction permits.
E	

Easement	A right acquired by a person to use another person's land for a special purpose
Electronic media	Means of communication via electronic equipment, including the internet
Energy Grade Line	The energy grade line represents the total energy at any point along the culvert (pipe) barrel.
Erosion	The process by which the ground surface, including soil and deposited material, is worn away by the action of wind, water, ice, or gravity
Excavation	An act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced or relocated and the conditions resulting from those actions
Exposed area	Land that has been disturbed or land over which unstabilized soil or other erodible material is placed
F	
G	
Grading	Causing disturbance of the earth, including excavating, filling, stockpiling of earth materials, grubbing, root mat or topsoil disturbance, or any combination of them
H	
Hydraulic Grade Line	The hydraulic grade line is the depth to which water would rise in vertical tubes connected to the side of the culvert (pipe) barrel.
I	
Impervious cover	A surface area that has been compacted or covered with a layer of material that impedes or prevents the infiltration of water into the ground, examples include conventional streets, parking lots, rooftops, sidewalks, pathways with compacted sub-base, and any concrete, asphalt, or compacted gravel surface and other similar surface
Infiltration	The passage or movement of surface water through the soil profile
J	
K	
L	
Land cover	Surface of land that is impervious, compacted, or natural
Land cover change	Conversion of land cover from one type to another, typically in order to comply with a requirement of this chapter.
Land-disturbing activity	Movement of earth, land, or sediment that disturbs the land surface and the related use of pervious land to support that movement. Land-disturbing activity includes stripping, grading, grubbing, trenching, excavating, transporting, and filling of land, as well as the use of pervious adjacent land for movement and storage of construction vehicles and materials. Land-disturbing activity does not include repaving or re-milling that does not expose the underlying soil

Low impact development (LID)	A land-planning and engineering-design approach to manage stormwater runoff within a development footprint. It emphasizes conservation, the use of on-site natural features, and structural stormwater BMPs to store, infiltrate, evapotranspire, retain, and detain rainfall as close to its source as possible with the goal of mimicking the runoff characteristics of natural cover
M	
Maintenance agreement	See Section 5.5.2 Maintenance Agreement
Maintenance contract	See “maintenance agreement”
Maintenance responsibility	See Section 5.5.1 Maintenance Responsibility
Maintenance plan	Planned scheduled maintenance for the life of the BMP
Maintenance schedule	See “maintenance plan”
Maintenance standards	Detailed maintenance plan laid out in Exhibit C within declaration of covenants
Major land-disturbing activity	A distinct project or a part of a larger common plan of development that involves the creation, addition or replacement of 5000 square feet of impervious surface, or that involves one acre or greater of land disturbing activities. New development regardless of size, that is part of a larger common plan of development, even though multiple, separate and distinct land disturbing activities, may take place at different times and on different schedules. Multiple distinct areas that each disturb one acre of land, that are in separate, non-adjacent sites, and that are not part of a larger common plan of development do not constitute a major land-disturbing activity.
Major Substantial Improvement	a renovation or addition to a structure or existing property that meets both of the following cost and size thresholds: a) construction costs for the building renovation/addition are greater than or equal to 50% of the pre-project assessed value of the structure as developed using current Building Valuation Data of the International Code Council, and b) combined footprint of structure(s) exceeding the cost threshold and any land disturbance are greater than or equal to 5,000 square feet.
N	
Natural cover	Land area that is dominated by vegetation and does not require regular human inputs such as irrigation, mowing, or fertilization to persist in a healthy condition. Examples include forest, meadow, or pasture
Non-structural BMP	A land use, development, or management strategy to minimize the impact of stormwater runoff, including conservation of natural cover or disconnection of impervious surface
O	
Off-site retention	Use of property not within the limits of disturbance of the project to comply with the stormwater retention volumes required by this Manual

Off-site retention volume (Off_V)	A portion of a required stormwater retention volume or required water quality treatment volume that is not retained on site
On-site retention	Retention of a site's stormwater on that site or via conveyance to a shared stormwater BMP on another site
On-site stormwater management	Retention, detention, or treatment of stormwater on site or via conveyance to a shared stormwater BMP
Owner	The person who owns real estate or other property, or that person's agent
P	
Peak discharge	The maximum rate of flow of water at a given point and time resulting from a storm event
Permeable athletic track	A surface, including a surface made of synthetic material, located at a school or public park that is used for athletic purposes including biking, running, and walking, and that allows the infiltration of water into the ground. The track must have a minimum surface permeability of at least 10 inches per hour, in accordance with the ASTM F2898 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
Permeable playground surface	A surface, including a surface made of synthetic material, located under a playground area at a school or public park, that allows the infiltration of water into the ground. The playground surface must have a minimum surface permeability of at least 10 inches per hour, in accordance with ASTM F2898 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
Person	A legal entity, including an individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, cooperative, the <*local authority*> and its agencies, the State of South Carolina and its agencies, and the federal government and its agencies
Pervious area	Area with a compacted cover designation set aside to receive stormwater runoff as part of an impervious surface disconnection practice
Post-development	Describing conditions that may be reasonably expected to exist after completion of land development activity on a site
Practice	A system, device, material, technique, process, or procedure that is used to control, reduce, or eliminate an impact from stormwater; except where the context indicates its more typical use as a term describing a custom, application, or usual way of doing something
Preconstruction meeting	The mandatory meeting occurring prior to any construction, including the owner, the designer, the installer, and the DHEC inspector. This meeting must contain an on-site component to evaluate the SWMP against existing site conditions. This should include, at a minimum, a visual examination of land cover types, the tree preservation plan, boundaries of the CDA(s), the existing inlet elevation(s) to ensure they conform to original design

Predevelopment	Describing conditions of meadow land and its relationship to stormwater before human disturbance of the land
Pre-project	Describing conditions, including land covers, on a site that exist before the construction described in a Stormwater Management Plan has begun
Publicly-owned or publicly-financed project	A project: a. That is municipally-owned or municipality-instrumentality-owned; b. Where at least 15% of the project's total cost is municipally-financed or municipality-instrumentality-financed; or c. That includes a gift, lease, or sale from municipally-owned or municipality-instrumentality-owned property to a private entity
Public right-of-way (PROW)	The surface, the air space above the surface (including air space immediately adjacent to a private structure located on public space or in a public right-of-way), and the area below the surface of any public street, bridge, tunnel, highway, railway track, lane, path, alley, sidewalk, or boulevard
Public space	All the publicly owned property between the property lines on a street, park, or other public property as such property lines are shown on the records of the State. This includes any roadway, tree space, sidewalk, or parking between such property lines, but it excludes adjacent parks and other public property that is not associated with the public right-of-way
Q	
R	
Raze	The complete removal of a building or other structure down to the ground or to its foundation
Responsible person	Construction personnel knowledgeable in the principles and practices of erosion and sediment control and certified by a Department-approved soil erosion and sedimentation control training program to assess conditions at the construction site that would impact the effectiveness of a soil-erosion or sediment-control measure on the site
Retention	Keeping a volume of stormwater runoff on site through infiltration, evapotranspiration, storage for non-potable use, or some combination of these
Retention capacity	The volume of stormwater that can be retained by a stormwater BMP or land cover
Retrofit	A stormwater BMP or land cover installed in a previously developed area to improve stormwater quality or reduce stormwater quantity relative to current conditions
Runoff	The portion of precipitation (including snow-melt) that travels over the land surface, and also from rooftops, either as sheetflow or as channel flow, in small trickles and streams, into the main water courses

S	
Savannah River Watershed Protection Area	
Sediment	Soil, including soil transported or deposited by human activity or the action of wind, water, ice, or gravity
Sedimentation	The deposition or transportation of soil or other surface materials from one place to another as a result of an erosion process
Shared BMP (S-BMP)	A stormwater BMP, or combination of BMPs, providing stormwater management for stormwater conveyed from another site or sites
Single- or two-family house	An individual house, townhouse, or rowhouse designed and used for occupancy by one or two families. An individual house, townhouse, or rowhouse that has been physically altered for use by more than one or two families is not considered a single- or two-family house
Site	A tract, lot or parcel of land, or a combination of tracts, lots, or parcels of land for which development is undertaken as part of a unit, sub-division, or project. The mere divestiture of ownership or control does not remove a property from inclusion in a site
Site drainage area (SDA)	The area that drains stormwater from the site to a single discharge point or sheet flows from a single area off the site
Soil	All earth material of whatever origin that overlies bedrock and may include the decomposed zone of bedrock that can be readily excavated by mechanical equipment
Soil erosion and sediment control plan	A set of drawings, calculations, specifications, details, and supporting documents related to minimizing or eliminating erosion and off-site sedimentation caused by stormwater on a construction site. It includes information on construction, installation, operation, and maintenance
Soils report	A geotechnical report addressing all soil erosion and sediment control-related soil attributes, including but not limited to site soil drainage and stability
Special watershed protection areas	Areas identified by US Geological Survey 12-digit Hydrologic Unit Code (HUC 12) in the Southern Low Country Stormwater Design Manual that require area-specific stormwater standards
Storm sewer	A system of pipes or other conduits that carries or stores intercepted surface runoff, street water, and other wash waters, or drainage, but excludes domestic sewage and industrial wastes
Stormwater	Flow of water that results from runoff, snow melt runoff, and surface runoff and drainage
Stormwater management	A system to control stormwater runoff with structural and non-structural stormwater BMPs, including the following: (a) quantitative control of volume and rate of surface runoff and (b) qualitative control to reduce or eliminate pollutants in runoff
Stormwater Management Plan (SWMP)	A set of drawings, calculations, specifications, details, and supporting documents related to the management of stormwater for a site. A SWMP includes information on construction, installation, operation, and maintenance

Stormwater Pollution Prevention Plan (SWPPP)	A document that identifies potential sources of stormwater pollution at a construction site, describes practices to reduce pollutants in stormwater discharge from the site, and may identify procedures to achieve compliance
Stormwater retention volume (SWRv)	Volume of stormwater from a site for which the site is required to achieve retention
Stripping	An activity that removes or significantly disturbs the vegetative surface cover including clearing, grubbing of stumps and rock mat, and top soil removal
Substantial improvement	A repair, alteration, addition, or improvement of a building or structure, the cost of which equals or exceeds 50% of the market value of the structure before the improvement or repair is started
Structural stormwater BMP	A practice engineered to minimize the impact of stormwater runoff, including a bioretention, green roof, permeable pavement, system to capture stormwater for non-potable uses, etc.
Supplemental review	A review that *<local jurisdiction>* conducts after the review it conducts for a first resubmission of a plan
Swale	A narrow low-lying stretch of land that gathers or carries surface water runoff
T	
Total suspended solids (TSS)	The entire amount of organic and inorganic particles dispersed in water. TSS is measured by several methods, which entail measuring the dry weight of sediment from a known volume of a subsample of the original
U	
V	
W	
Waste material	Construction debris, dredged spoils, solid waste, sewage, garbage, sludge, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial or municipal waste
X	
Y	
Z	

Appendix M: References and Resources

M.1 References

The following documents provide more detailed information on many aspects of BMP design than is found in this Manual. These resources may be useful for those looking to develop greater understanding of individual BMPs or stormwater design in general. Recommendations in these resources may be used to inform BMP designs; however, where conflicts occur between these resources and the Manual, the requirements of the Manual prevail.

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M.2 Resources for Natural Resources Survey

Resource Group	Resource Type	Sources for Information
General Resources	•Topography •Natural Drainage Divides •Natural Drainage Patterns •Natural Drainage Features (e.g., Swales, Basins, Depressional Areas) •Soils •Erodible Soils Comes with soil survey •Steep Slopes (e.g., Areas with Slopes Greater Than 15%) Can determine from DEM or query soil types with steep slopes. Recommend the former for accuracy. •Trees and Other Existing Vegetation – Can use NLCD data to get forest land cover •Impervious surfaces •Protected Lands	LiDAR: https://coast.noaa.gov/dataviewer/index.html#/lidar/search/ Major basin boundaries: https://apps.dhec.sc.gov/GIS/ClearingHouse/ Soils: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx Land Cover (NLCD): https://www.mrlc.gov/data Land Cover (NOAA C-CAP): https://coast.noaa.gov/digitalcoast/data/ccapregional.html County Level LIDAR http://www.dnr.sc.gov/GIS/lidarstatus.html NLCD impervious surface - https://www.mrlc.gov/data/type/urban-imperviousness Protected Lands (PAD-US) - LINK TNC
Freshwater Resources	•Rivers – NHD or state level data	NHD: https://www.usgs.gov/core-science-systems/ngp/national-hydrography

	should be available •Perennial and Intermittent Streams – This distinction might not be available. •Freshwater Wetlands – National Wetland Inventory	Water classifications (view only): https://gis.dhec.sc.gov/watersheds/ NWI: https://www.fws.gov/wetlands/index.html
Estuarine Resources	•Tidal Rivers and Streams I think we can get all of this from NWI. Tidal influence might not be denoted. •Tidal Creeks •Coastal Marshlands •Tidal Flats •Scrub-Shrub Wetlands	NOAA C-CAP classification scheme includes palustrine forested wetland, palustrine scrub/shrub wetland, palustrine emergent wetland, estuarine forested wetland, estuarine scrub/shrub wetland, estuarine emergent wetland, palustrine aquatic bed, and estuarine aquatic bed County Level LIDAR Breaklines (with terrain dataset) http://www.dnr.sc.gov/GIS/lidarstatus.html
Marine Resources	•Near Coastal Waters •Beaches •Shoreline	NOAA C-CAP classification scheme includes unconsolidated shore DHEC OCRM - https://apps.dhec.sc.gov/GIS/ClearingHouse/ ←look under OCRM from drop down "List GIS Layers by DHEC…"
Groundwater Resources	•Groundwater Recharge Areas •Wellhead Protection Areas	https://scdhec.gov/environment/bureau-water/groundwater-use-reporting/groundwater-management-planning/groundwater-2 http://hydrology.dnr.sc.gov/well-database.html DHEC Watershed atlas - https://gis.dhec.sc.gov/watersheds/ Check under Public Water supply tab in layer contents for protection areas

Resource Group	Resource Type	Sources for Information
Terrestrial Resources	•Dunes •Maritime Forests •Marsh Hammocks •Evergreen Hammocks •Canebrakes	• Forest inventory analysis (FIA). The SC Forestry Commission would have that data •Natural Communities of SC https://dc.statelibrary.sc.gov/handle/10827/30179

	•Bottomland Hardwood Forests •Beech-Magnolia Forests •Pine Flatwoods •Longleaf Pine-Wiregrass Savannas •Longleaf Pine-Scrub Oak Woodlands	
Other Resources	• Shellfish Harvesting Areas •Floodplains – FEMA data available nationally •Aquatic Buffers •Other High Priority Habitat Areas as described by South Carolina Department of Natural Resources	•FEMA: https://msc.fema.gov/portal/home •SCDHEC: https://apps.dhec.sc.gov/GIS/ClearingHouse/ •GAP/species richness/habitat/etc. data http://www.dnr.sc.gov/GIS/gap/mapping.html •Intertidal Oyster Reefs - http://www.dnr.sc.gov/GIS/descoysterbed.html •Shellfish harvesting areas - Link

Appendix N: Summary of Federal and State Stormwater Regulations

Table of Contents

N.1 Summary of Federal Regulations

In general, Federal regulations and legislation have been applied at the State level to regulate stormwater runoff quality, whereas for many years local stormwater ordinances and regulations focused on regulating drainage, streets, peak stormwater runoff flow and flooding concerns.

Federal regulations that directly affect stormwater runoff control include the Coastal Zone Management Act and the National Pollutant Discharge Elimination System (NPDES) stormwater regulations of the Clean Water Act, administered by the U.S. Environmental Protection Agency (EPA). The Coastal Zone Management Act was designed to encourage and assist coastal states to develop and implement management programs. The State of South Carolina developed its own Coastal Zone Management Act in 1977, to protect coastal resources and promote responsible development in Beaufort County and seven other coastal counties. This will be discussed further in the following section on State regulations. The EPA NPDES requirements are presented below.

The 1987 amendments to the Federal Clean Water Act define specific stormwater discharges as point source discharges subject to NPDES regulations. These amendments required EPA to promulgate regulations pertaining to stormwater discharges via a phased approach.

The initial phase, promulgated by EPA on November 16, 1990, became known as the Phase I Stormwater NPDES regulations. These final regulations created two broad classes of stormwater discharges under the NPDES program:

1) Municipal Separate Storm Sewer System (MS4) discharges; and
2) Stormwater Discharges Associated with Industrial Activity.

The MS4 Program was divided into three categories (large, medium, and small populations) based on U.S. Census Bureau population estimates, with Phase I regulations including only large and medium MS4 stormwater discharges.

The Stormwater Discharges Associated with Industrial Activity program was divided into 11 categories of industrial activity. These included industrial manufacturing facilities, landfills, transportation facilities, construction (land clearing on 5 or more acres), etc., without consideration given to the type of facility owner or operator such that a publicly owned or operated facility could be included in one of the 11 categories.

On December 8, 1999, EPA adopted the Phase II stormwater regulations, which included small MS4 discharges located in an "Urbanized Area" per U.S. Census Bureau definitions and delineations. In addition, the land disturbance activity regulation with the threshold of 5 or more acres (as per the construction activity regulation) was reduced to 1 or more acres, with a provision that construction sites that disturb less than 1 acre could also be regulated if water quality concerns or problems related to the activity warrant permit coverage under the NPDES Program.

The State of South Carolina has been an EPA NPDES Program delegated authority for a number of years. The State agency that administers the Federal NPDES Program in South Carolina is the Department of Health and Environmental Control (DHEC). As such, DHEC oversees all NPDES Program related permitting, monitoring, and enforcement issues in the State of South Carolina. However, EPA does have authority over DHEC on NPDES Program issues and may, at its discretion, conduct independent audits of a DHEC-issued NPDES permit.

N.1.1 MS4 Program

Phase I of the NPDES Stormwater Program required large MS4s (with populations of 250,000 people or greater) and medium MS4s (with populations of 100,000 people or greater but less than 250,000) to apply for permit coverage in two parts. All permits issued under this phase were individual permits and required the development and implementation of a stormwater management program. At a minimum, this program had to address the following key elements:

1) Structural control maintenance
2) Areas of significant development and redevelopment
3) Roadway runoff management
4) Flood control related to water quality issues
5) Municipally owned operations, including landfills, wastewater treatment facilities, etc.
6) Hazardous waste treatment, storage or disposal sites, etc.
7) Application of pesticides, herbicides, and fertilizers
8) Illicit discharge detection and elimination
9) Regulation of sites classified as associated with industrial activity
10) Construction site and post-construction site runoff control
11) Public education and outreach

As of July 2007, the State of South Carolina has one large MS4 (South Carolina Department of Transportation) and four medium MS4s – the City of Columbia, Greenville County, Lexington County, and Richland County.

As of July 2007, there is a list of 70 regulated small MS4s, which did not specifically include Beaufort County. In 2014 this list was increased, and additional communities were added, including Beaufort County. These small MS4s are required to begin running programs to address stormwater runoff from construction sites and post- construction activities. These activities are two of the six components of a stormwater management program as defined by the NPDES Phase II Final Rule, as listed below:

1) Public education and outreach.

2) Public participation/involvement.
3) Illicit discharge detection and elimination.
4) Construction site runoff control.
5) Post-construction runoff control.
6) Pollution prevention/good housekeeping.

Several of these items are addressed by this document and will fulfill part of the NPDES Phase II requirements.

N.1.2 Industrial Activity Program

The NPDES Phase I stormwater regulations created 11 categories of Stormwater Discharges Associated with Industrial Activity. Categories "i "through "ix" and category "xi" became part of the Industrial Program, while category "x" became part of the Construction Program. Thus, the NPDES stormwater program is made up of three distinct program components: the MS4 Program, the Industrial Program, and the Construction Program. Although the Phase I included a provision for a no-exposure permit exemption to category "xi" (light industry) only, the Phase II regulations extended this no-exposure exemption to categories "i" through "ix."

The no-exposure exemption applied to facilities that had no stormwater runoff exposed to raw materials, byproducts, waste products, intermediate products, final products, etc. Activities within the Industrial Program and the Construction Program can have NPDES stormwater permits issued as either individual permits or general permits; however, due to the nature and number of facilities that must be issued NPDES stormwater permits, general permits are typically utilized. On rare occasions, when water quality concerns become a permit issue, DHEC may require an individual permit in lieu of granting general permit coverage. The general permit under the Industrial Program requires the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) for each covered facility and requires monitoring and/or inspections. Although only certain facilities require both, inspections are required of all facilities.

Under the Construction Program, the construction activity category is divided into two phases, Phase I (for large construction sites) and Phase II (for small construction sites). On a case-by-case basis, a permit may also be required when a construction activity involves the disturbance of less than 1 acre of land. Stormwater discharges from construction activities that disturb less than 5 acres of land are called "small construction activities." A Construction Activity permit can either be issued in the form of a general permit or an individual permit. Typically, the general permit is utilized unless specific water quality issues warrant the use of an individual permit. The general permit requires that a SWPPP be prepared and implemented for each construction site, but sampling of stormwater runoff from the site is not required.

Inspections must be conducted at all construction sites covered under the general permit. In addition, a provision in the MS4 program regulations requires that all regulated MS4s implement a program for controlling construction site runoff. This provision essentially requires that the construction site must receive a permit from the regulated MS4 in addition to having to be covered under an NPDES Stormwater Construction Activity permit.

It is important to note that with the March 10, 2003 initiation of the NPDES Phase II Stormwater Program implementation, considerable overlap exists between the Federal NPDES Stormwater Program and the State of South Carolina's Sediment, Erosion, and Stormwater Management Program as discussed below.

N.2 Summary of State Regulations

In addition to being an EPA NPDES Program delegated authority, the State of South Carolina also has its own relevant regulations. The South Carolina's Sediment, Erosion, and Stormwater Management Program was initiated in 1983, and required construction activities on State-owned and State-managed lands to control sediment and erosion. In 1991, via the South Carolina Stormwater Management and Sediment Reduction Act, the program was expanded to include all construction activities that disturbed more than 2 acres of land. Regulation 72-300, entitled "Standards for Stormwater Management and Sediment Reduction," describes the requirements for preparing a stormwater management and sediment and erosion control plan from land disturbance activities. Exemptions, Waivers, and Variances from the Law are explained in Section 72-302. The Bureau of Water of the Office of Environmental Quality Control (EQC) of DHEC is responsible for administering the Sediment, Erosion, and Stormwater Management Program, and by regulation the Office of Ocean and Coastal Resource management (OCRM) implements the program in the eight coastal county areas. A local government may become a State-delegated authority after submitting a request and receiving approval by the State. However, Federal, State, local government, and public school projects must be submitted to DHEC even if they are located within the jurisdiction of a State-delegated entity.

As indicated previously, the Federal NPDES Stormwater Construction Activity Program requires permit coverage for construction sites that disturb more than 1 acre of land and, on a case-by-case basis, even less than 1 acre of land. Consequently, an overlap exists currently between the State's Sediment, Erosion, and Stormwater Management Program and the NPDES Stormwater Construction Activity Program (that is, when more than 2 acres of land are disturbed due to a construction activity, permits must be secured under both programs). The State coordinates the various aspects of the two programs (i.e., permitting, compliance, monitoring, and enforcement) to minimize the overlapping responsibilities. The two programs are integrated into a comprehensive Stormwater Regulatory Program for the State of South Carolina.

The *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities* (DHEC, 2003) includes all existing South Carolina stormwater management regulations required for individuals to submit a stormwater management and sediment reduction permit application to DHEC. Elements of the Federal NPDES Stormwater Program, Coastal Zone Management Program, and the State's Stormwater Management and Sediment Reduction regulations are included in the handbook.

Table 1 summarizes the State regulatory requirements that are applicable to Southern Lowcountry, including jurisdictions in the State of South Carolina's Coastal Zone Management Program. For land disturbance of 0.5 acre or less that is within 0.5 mile of a receiving waterbody in the coastal zone, Section R.72- 307H of the State Stormwater Management and Sediment Reduction Act of 1991 is applicable. Section R.72-307H is also applicable for land disturbance of less than 1 acre, at locations that are not within 0.5 mile of a coastal zone receiving water If the land disturbance is at least 1 acre, but less than 2 acres, the NPDES General Permit and Section R.72-307H apply. Development is highly impervious or is located directly adjacent to a critical area, the more stringent R.72-307I regulations are applicable; otherwise, the less stringent R.72-307H regulations are appropriate.

Table 1. South Carolina Requirements for Land Development in Southern Lowcountry.

Extent of Land Disturbance (acres)	Applicable Regulatory Requirements
Less than 0.5 acre and within 0.5 acre of receiving waters	R.72-307H
Less than 1 acre and not within 0.5 acre of receiving waters	R.72-307H
At least 1 but less than 2 acres	R.72-307H, SCR100000
More than 2 and less than 5 acres	R.72-307I, SCR100000
5 acres or more	R.72-305, R.72-307, SCR100000

Section R.72-307I regulations are also applicable for developments of more than 2 and less than 5 acres. For developments of 5 acres or more, the applicable regulations include Sections R.72-305 and R.72-307 of the Stormwater Management and Sediment Reduction Act of 1991, plus the NPDES General Permit.

Features of the regulations highlighted in Table 1 are presented in

Table *2*. The regulations under Section R.72-307H provide for a simplified stormwater management and sediment control plan that does not require approval by DHEC and does not require preparation or certification by a registered engineer, landscape architect or Tier B land surveyor (SCDHEC, 1997). However, DHEC staff does have the authority to conduct site inspections to ensure compliance with the submitted plan. Under Section R.72-307I, the stormwater management and sediment control plan must be approved by DHEC, and requires preparation and certification by a registered engineer, landscape architect or Tier B land surveyor. The plan must also include BMPs to control erosion and sediment, and measures to control peak discharge rates and peak velocities of stormwater runoff from the site.

Table 2. South Carolina Sediment, Erosion, and Stormwater Management Program Land Development Regulatory Requirement Details Applicable to Non-Coastal Counties.

Plan Feature	Applicable Regulation(s)		
	R.72-307H	R.72-307I	R.72-305, R.72-307, SCR100000
Plan Approval by Implementing Agency	Not required	Required	Required
Plan Preparation / Certification by Registered Professional Engineers / Landscape Architects / Land Surveyors	Not required	Required	Required
BMPs to Control Erosion and Sediment	Not required	Required	Required
Measures to Control Stormwater Quantity	Not required	Required[1]	Required[1]
Measures to Control Stormwater Quality	Not required	Not required	Required[2]

1. Stormwater quantity control requirements include:
   a. Post-development peak discharge rates shall not exceed pre-development discharge rates for the 2- and 10- year frequency, 24-hour duration storm events. Implementing agencies may utilize a less frequent storm event (e.g., 25-year, 24-hour storm) to address existing or future stormwater quantity or quality problems.
   b. Discharge velocities shall be reduced to provide a non-erosive velocity flow from a structure, channel, or other control measure or the velocity of the 10-year, 24-hour storm runoff in the receiving waterway prior to the land disturbance activity, whichever is greater.
   c. Watersheds other than “designated watersheds” that have well documented water quantity problems may have more stringent, or modified, design criteria determined by the local government that is responsive to the needs of that watershed.
2. See Table A-3 for a summary of stormwater quality requirements.

The State regulation requires that post-development peak flows shall not exceed the pre- development peak flow rate for the 2-year/24-hour and 10-year/24-hour design storms. Developments of 5 acres or more must meet all of the requirements listed above and must provide measures for stormwater quality control.

The current NPDES general permit SCR100000 (effective September 1, 2006) includes requirements for inspections on construction sites. Once construction begins, these inspections must be conducted at least once every 7 calendar days, or at least once every 14 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. The inspections must be conducted by qualified personnel (as defined in the permit) and an inspection report must be completed for each inspection. The report must be retained for at least 3 years from the date that permit coverage expires or is terminated. For construction activities disturbing 10 acres or more, a monthly report must also be submitted to DHEC. Monthly reports may also be required on a case-by- case basis.

Stormwater runoff quality control measures required for developments of 5 acres or more are presented in Table 3. In general, the water quality storage requirements depend upon the type of BMP and, in some cases, the location of the development site.

Table 3. South Carolina Coastal Zone Management Program Stormwater Quality Bmp Requirements Beaufort County.

BMP Facility Type	Water Quality Volume Requirements		
	General	**Within 0.5 Miles of a Receiving Waterbody in the Coastal Zone**	**Within 1,000 Ft of Shellfish Beds**
Water quality facility with permanent pool of water (e.g., wet detention pond)	Permanent pool volume of 0.5 inches of runoff per acre of drainage; storage above permanent pool of 0.5 inches of runoff per acre of drainage, required to bleed down over a 24-hour period	Permanent pool volume of 0.5 inches of runoff per acre of drainage or 1.0 inches of runoff per impervious acre of drainage, whichever is greater; same general storage requirement above permanent pool	Permanent pool volume of 0.5 inches of runoff per acre of drainage or 1.5 inches of runoff per impervious acre of drainage, whichever is greater; same general storage requirement above permanent pool
Water quality facility without permanent pool of water (e.g., extended dry detention pond)	Storage of 1.0 inches of runoff from the entire drainage area, required to bleed down over a 24-hour period	General requirements apply	Not applicable
Infiltration practices	Storage of 1.0 inches of runoff per impervious acre of drainage, required to drain completely in 72 hours	General requirements apply	Storage of 1.5 inches of runoff per impervious acre of drainage, required to drain completely in 72 hours

The basic water quality volume requirements vary based on the type of BMP. A water quality facility with a permanent pool of water (e.g., a wet detention pond) has a required permanent pool volume equivalent to 0.5 inch of runoff per acre of drainage, as well as another 0.5 inch of storage above the permanent pool. The storage above the permanent pool is required to bleed down over a 24-hour period. In contrast, a water quality facility without a permanent pool of water (e.g., an extended dry detention pond) has a required water quality storage volume equivalent to 1.0 inch of runoff per acre of drainage, and this volume is required to bleed down over a 24-hour period. Infiltration facilities, which capture runoff and then release the captured runoff through evapotranspiration and infiltration into the underlying soil, are required to provide water quality storage equivalent to 1.0 inches of runoff per impervious acre of drainage.

Under existing State regulations, water quality control facilities with a permanent pool of water may have more stringent requirements if the development is within 0.5 mile of a receiving waterbody in the coastal zone. In this case, the required permanent pool volume is the greater of: (a) 0.5 inch of runoff from the entire drainage area, or (b) 1.0 inch of runoff per impervious acre of drainage. The latter condition will apply for commercial, industrial and high-density residential land uses with an imperviousness of more than 50 percent. There are no special requirements for infiltration facilities and facilities without a permanent pool of water.

Special considerations also apply when the development is within 1,000 ft of shellfish beds (determined from State mapping or by site inspection). In this case, the regulations require that 1.5 inches of runoff per impervious acre of drainage must be retained. Of the three BMP types discussed above, only infiltration facilities are designed to retain runoff (i.e., captured runoff is depleted by storage through evapotranspiration and infiltration into the underlying soil, rather than released to a drainage channel or waterbody). In contrast, facilities such as ponds are designed to detain runoff (i.e., captured runoff is detained for treatment and is then released to a drainage channel or waterbody).

Table 3 shows how the shellfish bed regulation has been interpreted for this report. The requirement for infiltration facilities is 1.5 inches per impervious acre of drainage, which is 50 percent greater than the general requirements. For facilities with a permanent pool, it was presumed that the requirement would be met by providing a permanent pool volume equivalent to 1.5 inches of runoff per impervious acre. For storms producing runoff of 1.5 inches or less, the runoff will be stored in the permanent pool and an equal volume of water will be displaced from the pool and discharged to a drainage channel or waterbody. The table provides no interpretation of the shellfish bed requirements for other facilities without a permanent pool. Such a facility would actually be operating as an infiltration facility.

As mentioned previously, DHEC administers the Federal NPDES Program on behalf of EPA; therefore, along with having jurisdiction over the NPDES Construction Program, DHEC also has jurisdiction over the NPDES Industrial Program. Under the latter program, the general permit (SCR000000) covers all categories of stormwater discharges associated with industrial activity, except the construction activity, which is covered under the Construction Program. SCR00000 requires the development of a SWPPP, which identifies potential sources of stormwater pollution and describes practices to be implemented for reducing stormwater pollutant discharges. These practices may include structural BMPs (e.g., wet detention ponds), good housekeeping practices, spill prevention procedures, and employee training. Annual or semi-annual monitoring of stormwater discharge from the site is required for certain industrial facilities. The monitoring would include measurement of specific pollutants such as nutrients and metals, and acute whole effluent toxicity tests.

Information on the South Carolina Sediment, Erosion, and Stormwater Management Program can be found at: http://www.scdhec.net/water/html/erfmain.html

Information on NPDES Stormwater Program Implementation in South Carolina can be found at: http://www.scdhec.net/eqc/water/html/swnhistory.html

Appendix O: Maintenance Agreement Template

O.1 Maintenance Agreement Template

E.3 Sample Maintenance Agreement

State of South Carolina	)	**Permanent Stormwater Facility Maintenance**
	)	**and Responsibility Agreement**
County of Beaufort	)	**Tax Map No. ____________________**

This Agreement is entered into this _____ day of ____________________, 20____, by and between ______________________________, (hereinafter referred to as "Landowner") and the County of Beaufort, political subdivision of the State of South Carolina (hereinafter referred to as "County").

It is agreed as follows:

Landowner Responsible for Stormwater Facility:

The South Carolina Stormwater Management and Sediment Reduction Act of 1991 (§48-14-10, et. seq.) and Regulation 72-308 provide that a Landowner shall adequately establish and maintain stormwater management/Best Management Practices (BMP) facilities upon making certain improvements to the Landowner's property. This law applies to any individual, partnership, corporation or other entity, constructing a stormwater facility. It also applies to all subsequent owners of the property. The obligation applies to the maintenance of all pipes, equipment, and channels built to convey stormwater to a retention facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater on the property. (All fixtures and graded or excavated improvements for controlling stormwater are herein the "Facility"). Adequate maintenance is herein defined as keeping the Facility in good working condition so that the Facility is performing all of its design functions in accordance with the purposes for which it is designed.

Maintenance Required:

The Landowner, its successors and assigns, will perform the maintenance, repair, and replacement necessary to keep the Facility in good working order. In the event a maintenance schedule for the Facility (including sediment removal) is outlined on the approved plans, the schedule must be followed.

Inspection Required:

The Landowner, its successors and assigns, shall regularly and periodically inspect the Facility in its entirety. Records shall be kept to identify the dates and maintenance performed and shall be made available to the County at the County's request. The purpose of the inspection is to assure safe and proper functioning of the Facility. The inspection shall cover all parts of the Facility including, but not limited to, berms, outlet structures, pond areas, and access roads. The Landowner's failure to inspect shall be treated as a breach of this Agreement just as much as a failure to repair if repair is needed after inspection.

Access Permitted:

The Landowner grants permission to the County, its authorized employees and agents, to enter upon the Property and to inspect the Facility whenever the County deems necessary. The purpose of inspection is to follow-up on reported or observed deficiencies, to respond to citizen complaints, or to make an inspection if a significant time has passed after the last inspection. The County shall provide the Landowner a copy of the inspection findings and a directive to commence with the repairs if necessary. In the case of multiple Landowners of a single property, notice to one shall suffice as notice to all.

No Duty on the County:

This Agreement creates no affirmative duty on the County to inspect, and it imposes no liability of any kind whatsoever on the County for omissions in inspecting. The Landowner agrees to hold the County harmless from any liability in the event the Facility fails to operate properly due to the Landowner's failure to abide by the terms of this Agreement.

Landowner Covenants:

The Landowner accepts responsibility for ownership and proper maintenance of the stormwater system, the Facility (pond, swales, etc.) on parcel # (R________________________) located at____________________________________, (see attached Site Map) Beaufort, South Carolina, per the approved maintenance plan. The specific BMPs on the property are listed below:

1) ____
2) ____
3) ____
4) ____
5) ____

Landowner will complete any necessary repairs and/or preventive maintenance procedures in a timely manner to ensure proper functioning as a stormwater management device(s).

Landowner understands that the maintenance plan may be amended or revised at any time by the County in order to address changed conditions or to address conditions not being effectively met by the Facility. Following the County's sending notice; Landowner will abide by any prescribed changes.

This covenant to maintain the Facility shall run with the land. Landowner will continue to own and maintain the Facility until the County is notified in writing of a transfer in ownership and maintenance responsibility. The notification will include a date for the transfer of responsibility which will become effective upon the County's receipt of a letter of acceptance from the new owner. Notwithstanding the provision for a letter of acceptance, any new Landowner shall be responsible for all duties and obligations created by this Permanent Stormwater Facility and Maintenance Responsibility Agreement upon it being executed and filed in the Register of Deeds Office for Beaufort County.

Landowner understands that failure to adhere to the signed Maintenance Agreement may result in fines of up to $1,000.00 per day, per violation and /or the institution of a court action, or such other and additional penalties, fines, or assessments as shall be enacted and provided for by the general law of the state or by local regulation lawfully enacted.

(Signatures contained on the next page)

IN WITNESS our hand and seal this_____day of_____________, 20___.

_________________________________ Land Owner Name:____________________
WITNESS 1 (Print)

_________________________________ Land Owner Signature:________________
WITNESS 2

Mailing Address:______________________
____

Phone Number: ________________________

County of Beaufort

____
WITNESS 1

_________________________________ BY: ______________________________
WITNESS 2
_________________________________ ITS: County Administrator

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF BEAUFORT)

The foregoing instrument was acknowledged before me this______day of____________, 20___ by____, (Landowner's name).

____
Notary Public for South Carolina
My Commission Expires: __________

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF BEAUFORT)

The foregoing instrument was acknowledged before me this______day of____________, 20___ by ________________, County Administrator for Beaufort County.

____
Notary Public for South Carolina
My Commission Expires: __________

Appendix R: Land Cover Designation and Maintenance

Table of Contents

R.1 General Notes

The retention standard approach taken in this guidance manual for on-site stormwater management and the run-off reduction methodology recognizes the ability of pervious land covers to manage some, or most, of the rainwater that falls on it. This is termed "land abstraction” in this appendix and is assumed to be based on SCS Hydrologic Soil Group (HSG) or soil type and whether the land cover is best represented as Forest/Open Space (RvN), Managed Turf (RvC) or Impervious Cover (RvI). As noted in Section 3.7, Equation 3.2 Stormwater Retention Volume, the designation of Forest/Open Space with these lands will generate between 2-5% stormwater runoff for a design rain event. The designation of compacted cover assumes these lands will generate 15-25% stormwater runoff for a design rain event. Impervious cover will generate 95% stormwater runoff for the design rain event. The minimum area threshold for the natural cover designation is 1,500 square feet, with a minimum length of 30 feet. Areas not meeting the natural cover threshold will be considered compacted cover RvC. To ensure no loss of land abstraction, all land cover designations must be recorded in the maintenance agreement.

R.1.1 Existing Natural Cover Requirements

A site claiming natural cover based on the preservation of existing conditions must ensure conditions remain undisturbed to preserve hydrologic properties equal to or better than meadow in good condition. No credit will be given for areas that are cut and then replaced with planting. The intention of preserving areas is to allow for natural succession with saplings reaching maturity after a period of time.

Preservation areas for natural cover may include the following:

- Portions of residential yards in forest cover that will not be disturbed during construction;
- Community open space areas that will not be mowed routinely, but left in a natural vegetated state, as defined below (can include areas that will be rotary mowed no more than two times per year);
- Utility rights-of-way that will be left in a natural vegetated state (can include areas that will be rotary mowed no more than two times per year); or

- Other areas of existing forest and/or open space that will be protected during construction and that will remain undisturbed.

R.1.2 Planting Requirements for the Creation of Natural Cover

Every 1,500 square feet of created natural area shall be vegetated according to the following options of plant material quantity:

- 1 native understory tree: 1.5-inch caliper (minimum), and 2 native canopy trees: 2.5 inch caliper (minimum), or
- 6 native shrubs: 5 to 7-gallon container size (minimum), or
- 50 native perennial herbaceous or woody plants or clump-forming grasses: 1-gallon container size (minimum), or
- 1 native canopy tree: 2.5-inch caliper (minimum), and 25 native perennial herbaceous plants: 1-gallon container size (minimum), or
- 3 native shrubs: 5 to 7-gallon container size (minimum), and 25 native perennial herbaceous plants 1-gallon container size (minimum)

Plantings shall be indigenous to the immediate area and shall be arranged in a natural random pattern (e.g. not a formal composition). To ensure a resilient planting composition, diversity must be provided in the planting plan: at least 2 different species of trees, 3 different species of shrubs, and/or 5 different types of perennials/grasses shall be used in each planting.

If planting near marshes, vegetation should be elevated as much as possible to ease establishment from the saline environment and lessen the impacts of inundation from King Tide events.

Steep slopes greater than 6% grade will require additional plantings, soil stabilization, or a terracing system.

Whip and seedling stock may be used (when approved by *<local jurisdiction>*) as a site's natural cover creation if a stream bank stabilization opportunity falls within the site's footprint. In this instance, whips or seedlings must be planted at a minimum density of 700 plants per acre, and at least 55% of these plants must remain at the end of the 2-year management period.

Natural regeneration (i.e., allowing volunteer plants to propagate from surrounding natural cover as a cover creation technique) may be allowed by *<local jurisdiction>*, when 75% of the proposed planting area is located within 25 feet of adjoining forest, and the adjoining forest contains less than 20% cover of invasive exotic species (as documented by the South Carolina Exotic Pest Plant Council 2014 list here: https://www.se-eppc.org/southcarolina/SCEPPC_LIST2014finalOct.pdf). In this case, supplemental planting must ensure a density of 400 seedlings per acre.

All plant materials used must be native to the southeastern region and must be installed in areas suitable for their growth. There are several websites that may be consulted to select the most appropriate plantings for the Southern Lowcountry:

- Low Impact Development in Coastal South Carolina: A Planning and Design Guide; see suggested plant lists for bioretention (4.2), open channels (4.8) and stormwater wetlands (4.12) http://www.northinlet.sc.edu/wp-content/uploads/2019/12/LID-in-Coastal-SC.pdf

- South Carolina Wildlife Federation: http://www.scwf.org/native-plant-list
- South Carolina Native Plant Society: https://scnps.org/wp-content/uploads/2012/04/CoastalNativePlantList.pdf
- Carolina Yards Plant Database: https://www.clemson.edu/extension/carolinayards/plant-database/index.html
- Clemson University Cooperative Extension Services Home & Garden Information Center factsheet for freshwater shoreline landscaping: https://hgic.clemson.edu/factsheet/shorescaping-freshwater-shorelines/

Plant irrigation is recommended until established.

R.2 Stormwater Management Plans and Natural Cover

Sites using preservation of existing areas for the natural cover designation shall include on their Stormwater Management Plan (SWMP) their natural resources inventory, a tree and vegetation survey, identification of location, and extent of preservation areas. Depending on the extent of the preservation area, *<local jurisdiction>* may require the SWMP to include a more detailed schedule for retained trees, noting the tree species, size, canopy, condition, and location.

The SWMP will include the identification of material and equipment staging areas and parking areas. Material and equipment staging areas and parking areas must be sufficiently offset for preservation areas to ensure no adverse impacts.

For areas maintained as meadow in good condition, the SWMP shall document either the preservation of existing conditions or the creation of meadow conditions. A plan submission claiming meadow preservation will note the existing meadow boundaries and include a field survey of the richness and diversity of existing plant species and the existing soil conditions by a qualified individual (see Section 2.1.3). A plan submission claiming meadow creation will note the proposed meadow boundaries, the planting and/or seeding species methods, and provide a soil amendment plan as specified in Appendix C Soil Compost Amendment Requirements.

R.3 Construction Requirements for Natural Cover Designation

The preservation of lands designated as natural cover—such as undisturbed portions of yards, community open space, and any other areas designated on a site's SWMP as preserved natural cover—must be shown outside the limits of disturbance on the site's Soil Erosion and Sediment Control Plan. These areas must be clearly demarcated with signage prior to commencement of construction on the site on the site and with fencing during construction.

The creation of lands designated as natural cover as part of a public right-of-way (PROW) project and on sites where soils were not protected from compaction during construction the soils must be conditioned prior to planting with soil compost amendments as prescribed in Appendix C Soil Compost Amendment Requirements.

For maximum survivability, planting of trees, shrubs, and herbaceous vegetation for the creation of natural cover should occur only during the fall and early spring (i.e., September through November and March through May). The work should be done only under the supervision of someone qualified and skilled in landscape installation (see Section 4.14 Tree Planting and Preservation for details on qualifications). Proper maintenance of the materials after installation will be key in ensuring plants survival. Prior to inspection, all trees and shrubs planted must be alive and in good health, and native grass and wildflower seeds must have been sown at adequate densities and at the right time of year for each species.

Once a natural cover designation has been assigned to a portion of regulated development site, that area will need to be recorded in the declaration of covenants, documented at the site prior to construction activities, protected during construction activities, and permanently protected/maintained for the life of the regulated site.

Root pruning and fertilizing are examples of preconstruction activities. These measures aim to increase the wellbeing of trees and prepare them for higher stress. Prior to beginning construction, temporary devices such as fences or sediment controls are installed and remain throughout the construction phase. Some devices, like retaining walls and root aeration systems may remain permanently. For example, if part of a root system is collapsed by a built road, permanent aeration may be necessary for the tree to remain healthy.

R.4 Maintenance Requirements for Natural Cover Designation

All areas that will be considered natural cover for stormwater purposes must have documentation that prescribes that the area will remain in a natural, vegetated state. Appropriate documentation includes subdivision covenants and restrictions; deeded operation and maintenance agreements and plans; parcels of common ownership with maintenance plans; third-party protective easements within the PROW; or other documentation approved by *<local jurisdiction>*.

While the goal is to have natural cover areas remain undisturbed, some activities may be prescribed in the appropriate documentation, as approved by *<local jurisdiction>*, such as forest management, control of invasive species, replanting and revegetation, passive recreation (e.g., trails), limited bush hogging to maintain desired vegetative community, etc.

R.5 Compacted Cover Designation

The compacted cover designation can apply to all site areas that are disturbed and/or graded for eventual use as managed turf or landscaping. Examples of compacted cover include lawns, portions of residential yards that are graded or disturbed and maintained as turf (including yard areas), residential utility connections, and PROW. Landscaping areas intended to be maintained as vegetation other than turf within residential, commercial, industrial, and institutional settings are also considered compacted cover if regular maintenance practices are employed.

Appendix S: Single Family On-Lot Volume Control

Step 2 On-Lot Volume Control

Beaufort County passed the On-Lot Volume Controls on June 13, 2011. This requires On-Lot Volume Control when constructing new homes in communities that do not meet current community-wide runoff volume control requirements. This section is applicable only for home lots of record platted but not yet developed. Worksheets are available in an online calculator format at http://stormwaterworksheet.createandsolve.com/.

Purpose

The purpose of this worksheet and web-based program is to help a homeowner or builder determine the amount of excess stormwater runoff that will come off the property after construction of the home.

It will also assist in selecting the controls necessary to control this excess runoff so that the County's water resources are not impacted. Scientists have determined that excess freshwater runoff into saltwater tidal waters can impact the area's fishery resources.

The worksheet and program will allow the user to print out a sheet that can be used to document satisfactory controls so a zoning permit can be obtained. This zoning permit is necessary for issuance of a building permit.

Step 1 – Lot Information

This information is used to compute the excess runoff after construction. If a homeowner is planning an irrigation system, (entered in Section 1), storage and reuse of stormwater from rooftop should be considered for a portion of the irrigation needs. Use of drinking water for irrigation is an expensive alternative for homeowners, and reduction of this can save money as well as reducing amount of water running off the parcel after construction. While this is recommended, storage and reuse is optional because of its initial cost.

Step 2 – Post Construction Stormwater Runoff Calculations

The amount of excess runoff in gallons can be computed using this web-based program. It will depend on whether the soil is sandy or clay (entered in Section 1). The rainfall event that is used to determine the amount of runoff to be controlled is a 1.95-inch rainfall (95^{th} percentile of average events in a year) in a 24-hour period. Before construction, on sandy soils, generally no runoff will occur with the 1.95-inch rainfall event. For clay soils, more than 0.5 inch of a 1.95 rainfall will runoff before construction. Taking this into account, the program will determine the runoff to be controlled, in gallons, after construction.

Step 3 – Application of Best Management Practices

This section takes the gallons determined in the Step above and guides the user through three steps that will reduce these gallons until they are all being controlled. The first step is an optional

storage and reuse/infiltration practice. This practice will utilize a holding facility of some size and then the water can be utilized for reuse or infiltrated at a slow rate from the storage facility.

When storage is utilized, it will control a certain amount of rooftop impervious surface. The maximum storage allowed for credit is limited to the rooftop impervious surface (in square feet) times 1.15. Additional storage can be added but credit is limited to 1.15 gallon per square foot of rooftop surface. When storage is used, it decreases the amount of impervious surface that needs to be handled by the other practices. This is called unaddressed impervious surface.

The second practice is **disconnected impervious surface**. It can utilize the natural infiltration capacity of the lot to control water running off unaddressed impervious surfaces. It will require a determination of which way the water sheet flows across the lot. The program allows up to two directions to be selected. The user starts with an estimate of the impervious surfaces and pervious portion of the lot. If the lot flows in one direction, the estimate is easy. It would be the unaddressed impervious surface and the previous surface it flows over to the end of the lot. If the ratio of unaddressed impervious surface to pervious area is greater than 5, there will be no credit, and runoff is better controlledby the next step. Figures 5-1 and 5-2 provide examples of one- and two-direction calculations to help in determining input figures for this practice.

If after the employing the first two practices there is still excess runoff to be handled, **rain gardens and other practices** will be used to control the remaining runoff. This will be computed for the user, who will be given a square foot size of a standard rain garden.

This standard size rain garden is 3 ft deep and can have special soil or sand and rock mixture that will store runoff and allow it to infiltrate. There is some flexibility between storage and reuse and rain gardens. If less rain garden is desired, storage can be increased, and vice-versa.

There is an attached sheet at the end of this help sheet that provides examples of alternative practices under this step.

It should be remembered that impervious surface on the property causes the excess volume that needs to be controlled. The amount of controls can be reduced by decreasing the impervious surface on the property by considering pervious driveways and walks, reducing rooftop size (two story versus one story), and other practices.

Step 4 – Summary of Volume ReductionPractices

This section is computed for the user to show a summary. This program allows the user to print a one-page sheet that summarizes entry and practices being used. This sheet would be attached to zoning and building permits and will be checked at completion of the project.

Definitions:
Impervious surface – hard surface that allows rainfall to run off and not infiltrate the soil.

Rooftop impervious surface – horizontal surface area of rooftops including overhangs and other detached buildings/sheds.
Other impervious – generally hard surfaces on the ground like paved driveways, patios, walkways and sidewalks.
Pervious surface – surface that is not hard, such as grass, garden or forest area.
Irrigated area is area that would be served by an installed irrigation system. **Unaddressed impervious surface** – term used to determine amount of impervious surface or runoff gallons that had not been controlled by a previous practice.
Standard rain garden – rain garden that has 3 ft of fill material and a 6-inch maximum ponding depth. Different sizes can be constructed but then credits must be computed from Beaufort County BMP manual.

Conversions
Rainfall to gallons of runoff
Design storm is 1.95 inches, of which 1.85 inches is available to run off impervious surface. 1.85 inch on 1 sq ft of impervious surface is equivalent to 1.15 gallons of runoff
Preconstruction runoff
Clayey soils – 0.53 inches run off for a 1.95-inch storm. 0.53 inch on 1 sq ft is equivalent to 0.33 gallon of runoff.
Sandy soils – No runoff for a 1.95-inch storm
Storage and reuse – if irrigation is used on parcel then storage must be between 0.3 gallon/sq ft of rooftop impervious surface to maximum credit of 1.15 gallon/ sq ft of rooftop impervious surface. Storage can be larger but maximum credit is 1.15g/sq ft.

Rain garden
Square foot of impervious surface per square foot of standard rain garden
Clayey soils 4 sq ft of impervious surface to 1 sq ft of standard rain garden
Sandy soils 7 sq ft of impervious surface to 1 sq ft of standard rain garden
Disconnected imperviousness – is the practice of running uncontrolled stormwater flow from impervious surfaces over pervious surfaces to take advantage of natural infiltration of the soil. Credit is given in Table 5-8 based on ratio of impervious surface over pervious surface to compute a ratio.

Table 5-8 Credit Table for Disconnected Impervious Area

Disconnected Impervious Ratio	**Runoff reduction (Gal/sq. ft-impervious area)**	**Runoff reduction (Gal/sq. ft-impervious area)**
	Clayey	Sandy
0.1	.40	1.15
0.2	.40	1.12
0.4	.38	1.08
0.8	.33	1.01
1.0	.31	.98
2.0	.24	.84
3.0	.19	.74
4.0	.16	.67
5.0	.14	.60

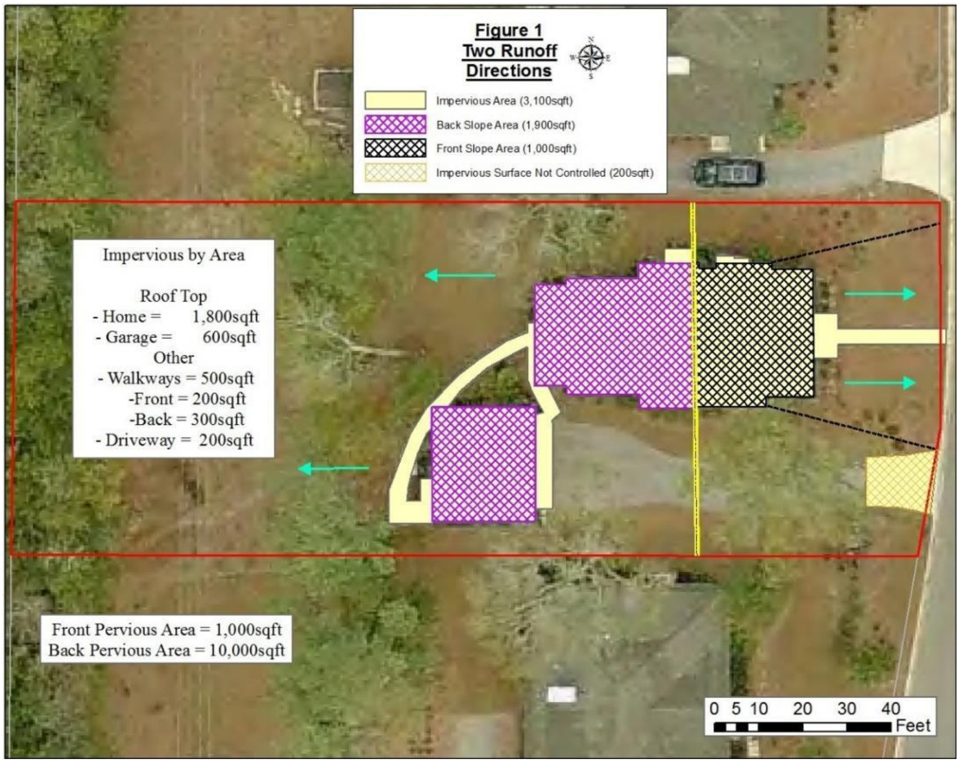


Figure 5-1
Example of a One-Direction Calculation for Disconnected Impervious Surface

This is a home on a 16,000 sq ft lot with about 2,500 sq ft of living space.

In this example, runoff from 1,000 sq ft of impervious surface flows towards the front of the house. It can be made to sheet flow over 1,000 sq ft of lawn (pervious surface). Therefore, on the worksheet or web program, enter 1,000 in impervious area and 1,000 in pervious area of the first direction.

The second direction is to the back of the home, and this 1,900 sq ft of rooftop and other impervious surface flow over 10,000 sq ft of lawn and forest area.

Therefore, enter in the second direction 1,900 sq ft in impervious area and 10,000 in pervious area.

In this example, there is 200 sq ft (paved portion of driveway) that cannot sheet flow over enough pervious area to receive a credit and would not be included in calculations

If storage and reuse/infiltration was used in the first step (say two 500 cisterns/tanks in front of house) then the unaddressed impervious surface would be computed by reducing the first direction impervious surface.

Therefore, the in first direction, enter 130 in impervious surface (reduced by 870 sq ft = 1000 gal/1.15 gal/sq ft) and still 1,000 in pervious surface. See program printout for this example (with storage) in Appendix E.3

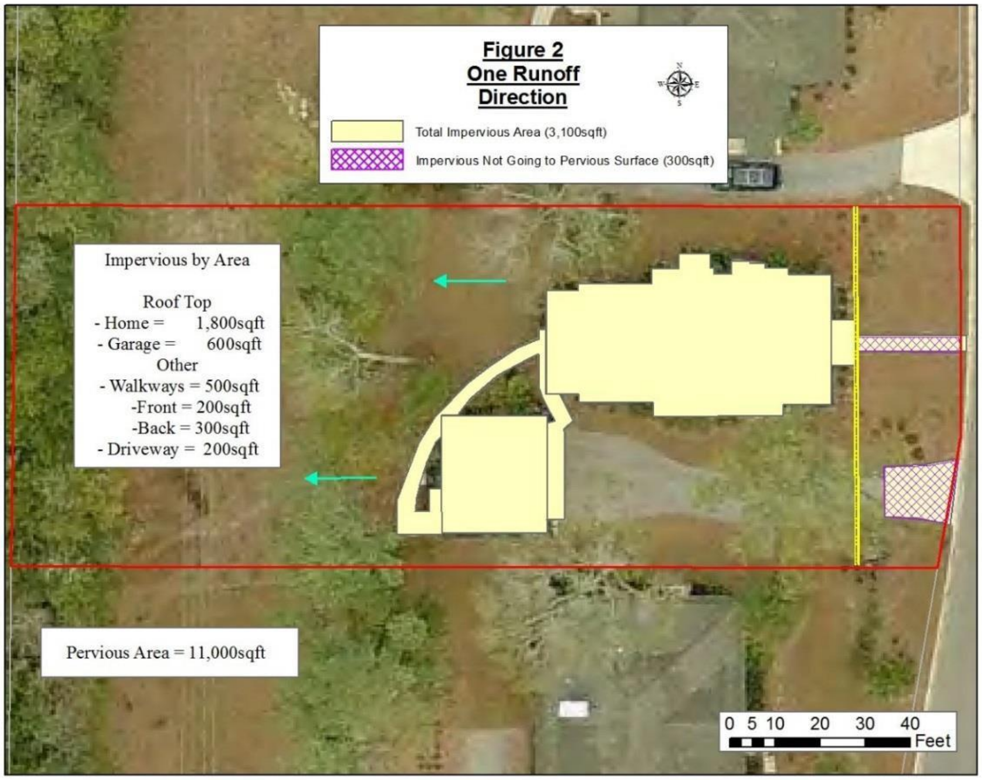


Figure 5-2
Example of a Two-Direction Calculation for Disconnected Impervious Surface

In this example, there would be 2,800 (3,100 to 300) sq ft of impervious surface sheet flowing over 11,000 sq ft of pervious surface out the back yard.

Therefore, enter 2,800 in the first impervious area and 11,000 in the pervious area. The second direction would have zero entered in both categories.

Again, if storage and reuse/infiltration was used, the impervious surface that included in the worksheet or web program would need to be reduced.

If, for example, two 500-gallon storage devices were used, the impervious surface needs to be reduced by 870 sq ft (1000 gal/1.15 gal/sq ft).

Therefore, enter 1,930 in first impervious area and 11,000 in pervious area. The second direction would have zero in bothcategories.

BEAUFORT COUNTY

-STORMWATER PERMIT APPLICATION-

DATE ACCEPTED	RECEIVED BY	FILING FEE	RECEIPT#	PERMIT#	PIN#

PROJECT NAME:	PROJECT TYPE:
PROJECT LOCATION:	
APPLICANT/DEVELOPER NAME, ADDRESS, PHONE#	PROPERTY OWNER NAME, ADDRESS, PHONE#
EMAIL	EMAIL
SWPPP PREPARER NAME, ADDRESS, PHONE#	CONTRACTOR NAME, ADDRESS, PHONE#
EMAIL	EMAIL
QUALIFIED INSPECTOR NAME, ADDRESS, PHONE#	ADDITIONAL INFORMATION:
EMAIL	

SW01 (Single Family Home)

- ☐ COPY OF TIER I STORMWATER POLLUTION PREVENTION PLAN (SWPPP) – (See Appendix D)
- ☐ PLOT PLAN SHOWING, VICINITY MAP, NORTH ARROW, GRAPHIC SCALE, PROPOSED IMPROVEMENTS
- ☐ SITE PLAN SHOWING EXISTING GRADES/CONTOURS/ELEVATIONS AND PROPOSED GRADES/CONTOURS/ELEVATIONS, WITH OFFSITE DISCHARGE POINTS IDENTIFIED
- ☐ NATURAL RESOURCE INVENTORY SHOWING TREES, WETLANDS, DRAINAGE COURSES, AND BUFFERS
- ☐ GRADING AND DRAINAGE CERTIFICATION
- ☐ STEP II VOLUME CONTROL (See Section 5.3) (http://stormwaterworksheet.createandsolve.com)
- ☐ APPLICATION FEE

SW02 (Non Residential and Attached Residential)

- ☐ COPY OF TIER II STORMWATER POLLUTION PREVENTION PLAN (SWPPP)
- ☐ POST CONSTRUCTION STORMWATER PLAN CHECKLIST WITH LOCATION OF ALL ITEMS INDICATED.
- ☐ SITE PLAN: VICINITY MAP, PROJECT LOCATION, NORTH ARROW, GRAPHIC SCALE, PROPOSED IMPROVEMENTS
- ☐ CONSTRUCTION PLANS
- ☐ DRAINAGE CALCULATIONS (See Section 5.3)
- ☐ APPLICATION FEE

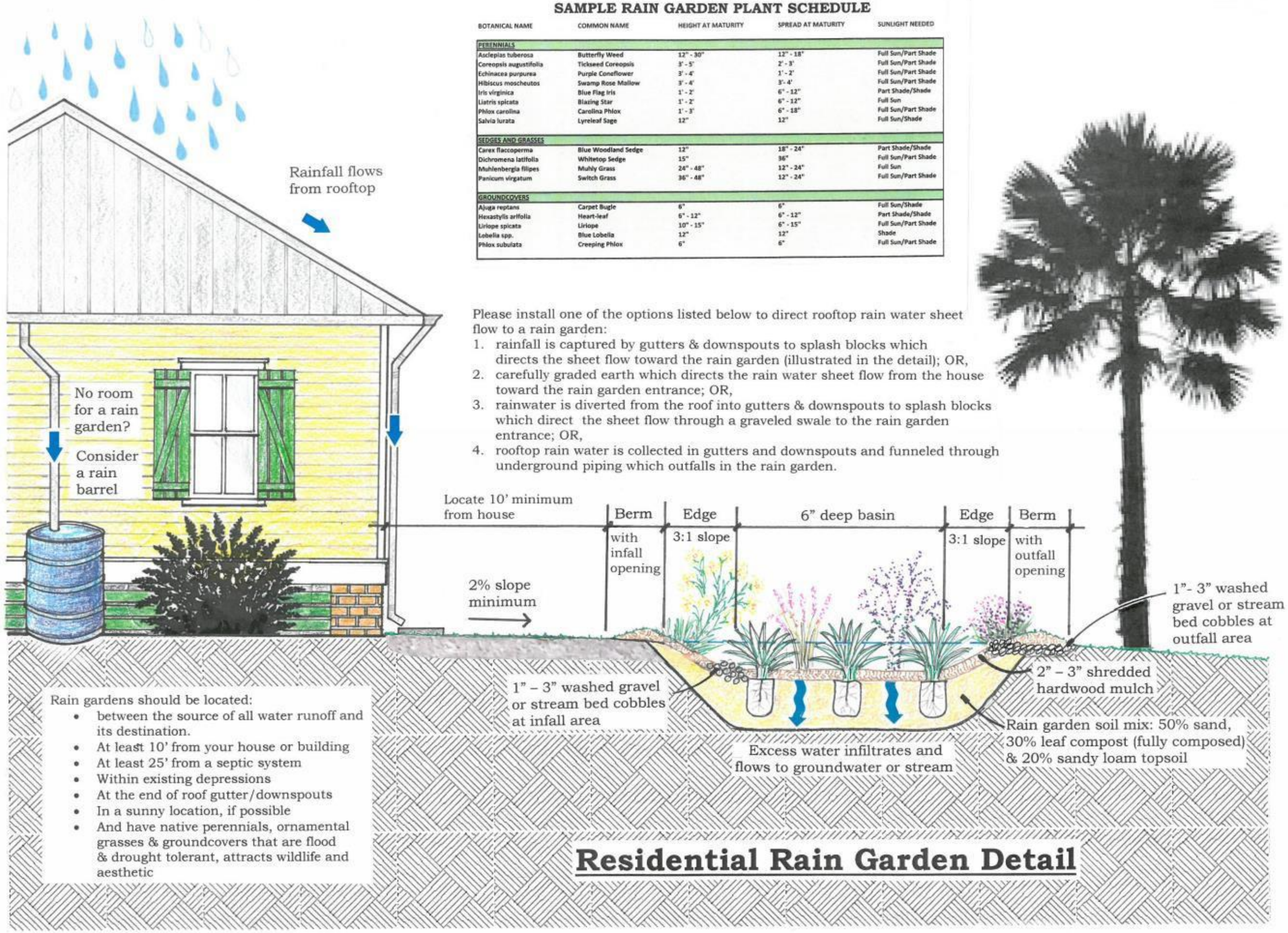
Application Affidavit
The applicant acknowledges that application and issuance of the local Beaufort County Stormwater Permit does not preclude the need to obtain a NPDES permit from SC-DHEC per the South Carolina Erosion and Sediment Reduction act of 1983 as promulgated via 72-300, Standards for Stormwater Management and Sediment Reduction. Any change to the SWPPP associated with this permit as a result of permitting by DHEC renders this permit void until revised by the applicant to match the DHEC approved plan. The applicant further acknowledges the County may refuse to conduct inspections and may issue Notices of Violation, Stop Work Orders, and/or Civil Penalties for failure to comply with DHEC requirements.
Signature__________________________________ Date___________________

SAMPLE RAIN GARDEN PLANT SCHEDULE

BOTANICAL NAME	COMMON NAME	HEIGHT AT MATURITY	SPREAD AT MATURITY	SUNLIGHT NEEDED
PERENNIALS				
Asclepias tuberosa	Butterfly Weed	12" - 30"	12" - 18"	Full Sun/Part Shade
Coreopsis augustifolia	Tickseed Coreopsis	3' - 5'	2' - 3'	Full Sun/Part Shade
Echinacea purpurea	Purple Coneflower	3' - 4'	1' - 2'	Full Sun/Part Shade
Hibiscus moscheutos	Swamp Rose Mallow	3' - 4'	3'- 4'	Full Sun/Part Shade
Iris virginica	Blue Flag Iris	1' - 2'	6" - 12"	Part Shade/Shade
Liatris spicata	Blazing Star	1' - 2'	6" - 12"	Full Sun
Phlox carolina	Carolina Phlox	1' - 3'	6" - 18"	Full Sun/Part Shade
Salvia lurata	Lyreleaf Sage	12"	12"	Full Sun/Shade
SEDGES AND GRASSES				
Carex flaccoperma	Blue Woodland Sedge	12"	18" - 24"	Part Shade/Shade
Dichromena latifolia	Whitetop Sedge	15"	36"	Full Sun/Part Shade
Muhlenbergia filipes	Muhly Grass	24" - 48"	12" - 24"	Full Sun
Panicum virgatum	Switch Grass	36" - 48"	12" - 24"	Full Sun/Part Shade
GROUNDCOVERS				
Ajuga reptans	Carpet Bugle	6"	6"	Full Sun/Shade
Hexastylis arifolia	Heart-leaf	6" - 12"	6" - 12"	Part Shade/Shade
Liriope spicata	Liriope	10" - 15"	6" - 15"	Full Sun/Part Shade
Lobelia spp.	Blue Lobelia	12"	12"	Shade
Phlox subulata	Creeping Phlox	6"	6"	Full Sun/Part Shade

Please install one of the options listed below to direct rooftop rain water sheet flow to a rain garden:

1. rainfall is captured by gutters & downspouts to splash blocks which directs the sheet flow toward the rain garden (illustrated in the detail); OR,
2. carefully graded earth which directs the rain water sheet flow from the house toward the rain garden entrance; OR,
3. rainwater is diverted from the roof into gutters & downspouts to splash blocks which direct the sheet flow through a graveled swale to the rain garden entrance; OR,
4. rooftop rain water is collected in gutters and downspouts and funneled through underground piping which outfalls in the rain garden.



Rain gardens should be located:

- between the source of all water runoff and its destination.
- At least 10' from your house or building
- At least 25' from a septic system
- Within existing depressions
- At the end of roof gutter/downspouts
- In a sunny location, if possible
- And have native perennials, ornamental grasses & groundcovers that are flood & drought tolerant, attracts wildlife and aesthetic

Residential Rain Garden Detail

BEAUFORT COUNTY SOUTH CAROLINA 1769

Residential Rain Garden Detail

DATE: 10/01/18
SCALE: Not to Scale
DRAWN BY: NRM
REVISIONS: 10/10/18
11/08/18
11/26/18

RAIN GARDEN DETAIL

Illicit Discharge Detection and Elimination

1.1 Purpose

The purpose of this section is to provide for the health, safety, and general welfare of the citizens of Beaufort County, South Carolina, through regulation of non-storm-water discharges to the storm drainage system to the maximum extent practicable as required by Federal and State law. This ordinance establishes methods for controlling the introduction of pollutants into the MS4 in order to comply with requirements of the NPDES permit process. The objectives of this ordinance are:

1. To regulate the contribution of pollutants to the MS4 by stormwater discharges by any user.

2. To prohibit illicit connections and discharges to the MS4.

3. To establish legal authority to carry out all inspection, surveillance and monitoring procedures necessary to ensure compliance with this ordinance.

1.2 Program

The basic organization of this program is outlined below. The plan is developed around eight key components that are recommended by the U.S. Environmental Protection Agency (EPA) and the Center for Watershed Protection (CWP) for effective Illicit Discharge Detection and Elimination (IDDE) programs. These eight components are intended to help:

- Conduct an audit to understand community needs and capabilities
- Establish adequate legal authority
- Develop a tracking system to map outfalls and document reported illicit discharges
- Conduct desktop analyses to prioritize targets for illicit discharge control
- Conduct rapid reconnaissance of the stream corridor to find problem outfalls
- Apply new analytical and field methods to find and fix illicit discharges
- Educate municipal employees and the public to prevent discharges
- Estimate costs to run a program and conduct specific investigations

Technical information that addresses various aspects of the plan and references cited can be found in the following EPA sponsored publication produced by the CWP (http://www.cwp.org/index.html) and Robert Pitt from the University of Alabama:

Illicit Discharge Detection and Elimination:
A Guidance Manual for Program Development and Technical Assessments
October 2004

1.2.1 Ordinance

In 2016, the County adopted a revised stormwater ordinance that will prohibit illicit discharges along with the necessary enforcement capability. The County will review other potential codes and ordinances that may have potential links to IDDE and make necessary cross-references and statements of supersede as needed to establish consistency.

1.2.2 Reporting and Education

The County has a web application that will allow a person to report a suspecting IDDE to the County staff via the app. The app will allow the individual to provide the GPS location where the suspected discharge has occurred. Records are kept on each report, including the reporting mode (telephone, email, walk-in, etc.), location and nature of the problem, and any actions taken. Citizens can also call the stormwater department at 843.255.2805.

1.2.3 Monitoring

The County has established a dry weather screening program to proactively detect illicit discharge and eliminate them through sampling, testing and enforcement. The County has a separate monitoring plan document that can be found in Appendix C. Inspection protocol and enforcement actions are in the stormwater ordinance found in Appendix G.

1.3 Definition of Illicit Discharge

Illicit discharge is defined in Article V. of Chapter 99: Stormwater Ordinance. A copy of this ordinance is found in Appendix A.

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

AN ORDINANCE ADOPTING THE REQUIRED CHAPTER 99 STORMWATER ORDINANCE CHANGES FOR UPDATES TO THE SOUTHERN LOWCOUNTRY DESIGN MANUAL ($0.00)

MEETING NAME AND DATE:

Natural Resources Committee – November 1, 2021

PRESENTER INFORMATION:

Jared Fralix, ACE – Engineering

Neil Desai, P.E - Public Works Director *(Alternate)*

(5 min)

ITEM BACKGROUND:

January 11th, 2021 – County Council Approved adoption of Southern Lowcountry Design Manual Ordinance
October 13th, 2021 – Stormwater Utility Board approved proposed updates to the Southern Lowcountry Design Manual.

PROJECT / ITEM NARRATIVE:

As Beaufort County has implemented the Southern Lowcountry Design Manual, staff has recognized the need for updates to be made to stay current as knowledge in our field improves. Updates to this manual also include process improvements for the development community in Beaufort County. The manual updates are consistent with the regional standards for those who have adopted the Southern Lowcountry Design Manual. To implement the updates to the Design Manual, Beaufort County needs to update Chapter 99 of the Beaufort County Code of Ordinances.

FISCAL IMPACT:

There are no fiscal impacts associated with the text amendment to Chapter 99 of the Beaufort County Code of Ordinances.

STAFF RECOMMENDATIONS TO COUNCIL:

Staff recommends approval of the text amendment to Chapter 99 of the Beaufort County Code of Ordinances.

OPTIONS FOR COUNCIL MOTION:

Motion to approve/deny the text amendment to Chapter 99 of the Beaufort County Code of Ordinances.

(Next Step – Upon approval, send to County Council for First Reading)

Chapter 99 STORMWATER MANAGEMENT[1]

ARTICLE I. IN GENERAL

Secs. 99-1—99-100. Reserved.

ARTICLE II. STORMWATER MANAGEMENT UTILITY

Sec. 99-101. Findings of fact.

The county council of Beaufort County, South Carolina, makes the following findings of fact:

(a) The professional engineering and financial analyses conducted on behalf of and submitted to the county properly assesses and defines the stormwater management problems, needs, goals, program priorities, costs of service, need for interlocal cooperation, and funding opportunities of the county.

(b) Given the problems, needs, goals, program priorities, costs of service, needs for interlocal cooperation, and funding opportunities identified in the professional engineering and financial analyses submitted to the county, it is appropriate to authorize the establishment of a separate enterprise accounting unit which shall be dedicated specifically to the management, construction, maintenance, protection, control, regulation, use, and enhancement of stormwater systems and programs in Beaufort County in concert with other water resource management programs.

(c) Stormwater management is applicable and needed throughout the unincorporated portions of Beaufort County, but interlocal cooperation between the county and the incorporated cities and towns within the county is also essential to the efficient provision of stormwater programs, services, systems, and facilities. Intense urban development in some portions of the county has radically altered the natural hydrology of the area and the hydraulics of stormwater systems, with many natural elements having been replaced or augmented by manmade facilities. Other areas of the county remain very rural in character, with natural stormwater systems predominating except along roads where ditches and culverts have been installed. As a result, the specific program, service, system, and facility demands differ from area to area in the county. While the county manages, operates, and improves stormwater programs, services, systems and facilities in the rural as well as urban areas, the need for improved stormwater management is greatest in the urban areas and nearby, including areas within incorporated cities and towns. Therefore, a stormwater utility service area subject to stormwater service fees should encompass, in so far as possible through interlocal agreements, the entirety of Beaufort County and the stormwater management utility service fee rate structure should reflect the amount of impervious area on individual properties and the runoff impact from water quantity and water quality.

[1]Editor's note(s)—Ord. No. 2015/24 , adopted Sept. 28, 2015, amended and replaced ch. 99 to read as herein set out. Former ch. 99 pertained to the same subject matter, and derived from Ord. No. 2005/33 , adopted Sept. 22, 2005; and Ord. No. 2009/21 , adopted May 26, 2009.

(d) The stormwater needs in Beaufort County include, but are not limited to, protecting the public health, safety, and welfare. Provision of stormwater management programs, services, systems, and facilities therefore renders and/or results in both service and benefit to individual properties, property owners, citizens, and residents of the county and to properties, property owners, citizens, and residents of the county concurrently in a variety of ways as identified in the professional engineering and financial analyses.

(e) The service and benefit rendered or resulting from the provision of stormwater management programs, services, systems, and facilities may differ over time depending on many factors and considerations, including, but not limited to, location, demands and impacts imposed on the stormwater programs, systems, and facilities, and risk exposure. It is not practical to allocate the cost of the county's stormwater management programs, services, systems, and facilities in direct and precise relationship to the services or benefits rendered to or received by individual properties or persons over a brief span of time, but it is both practical and equitable to allocate the cost of stormwater management among properties and persons in proportion to the long-term demands they impose on the county's stormwater programs, services, systems, and facilities which render or result in services and benefits.

(f) Beaufort County presently owns and operates stormwater management systems and facilities that have been developed, installed, and acquired through various mechanisms over many years. The future usefulness and value of the existing stormwater systems and facilities owned and operated by Beaufort County, and of future additions and improvements thereto, rests on the ability of the county to effectively manage, construct, protect, operate, maintain, control, regulate, use, and enhance the stormwater systems and facilities in the county, in concert with the management of other water resources in the county and in cooperation with the incorporated cities and towns. In order to do so, the county must have adequate and stable funding for its stormwater management program operating and capital investment needs.

(g) The county council finds, concludes, and determines that a stormwater management utility provides the most practical and appropriate means of properly delivering stormwater management services and benefits throughout the county, and the most equitable means to fund stormwater services in the county through stormwater service fees and other mechanisms as described in the professional engineering and financial analyses prepared for the county.

(h) The county council finds, concludes, and determines that a schedule of stormwater utility service fees be levied upon and collected from the owners of all lots, parcels of real estate, and buildings that discharge stormwater or subsurface waters, directly or indirectly, to the county stormwater management system and that the proceeds of such charges so derived be used for the stormwater management system.

(i) The county council finds that adjustments and credits against stormwater utility service fees are an appropriate means to grant properties providing stormwater management program services that would otherwise be provided by the county and will afford Beaufort County cost savings. These reductions will be developed by the public works director and will be reviewed on an annual basis to allow for any modifications to practices required by Beaufort County.

The county council finds that both the total gross area and impervious area on each property are the most important factors influencing the cost of stormwater management in Beaufort County and, the runoff impact from water quantity and water quality.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-102. Establishment of a stormwater management utility and a utility enterprise fund.

There is hereby established within the environmental engineering division of Beaufort County a stormwater management utility for the purpose of conducting the county's stormwater management program. The county administrator shall establish and maintain a stormwater management utility enterprise fund in the county budget and accounting system, which shall be and remain separate from other funds. All revenues of the utility shall be placed into the stormwater management utility enterprise fund and all expenses of the utility shall be paid from the fund, except that other revenues, receipts, and resources not accounted for in the stormwater management utility enterprise fund may be applied to stormwater management programs, services, systems, and facilities as deemed appropriate by the Beaufort County Council. The county administrator may designate within the stormwater management utility enterprise fund such sub-units as necessary for the purpose of accounting for the geographical generation of revenues and allocation of expenditures pursuant to interlocal governmental agreements with the cities and towns of Beaufort County.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2020/18, 5-26-2020 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-103. Purpose and responsibility of the utility.

The Beaufort County Stormwater Management Utility is established for the purpose of managing, acquiring, constructing, protecting, operating, maintaining, enhancing, controlling, and regulating the use of stormwater drainage systems in the county. The utility shall, on behalf of the county and the citizens of the county: administer the stormwater management program; perform studies and analyses as required; collect service fees; system development fees, in-lieu of construction fees and other funding as allowed by law, and obtain and administer grants and loans as authorized by the county council; prepare capital improvement plans and designs; perform routine maintenance and remedial repair of the stormwater systems; acquire, construct, and improve stormwater systems; acquire necessary lands, easements, rights-of-way, rights-of-entry and use, and other means of access to properties to perform its duties; regulate the on-site control, conveyance, and discharge of stormwater from properties; obtain federal and state permits required to carry out its purpose; enter into operating agreements with other agencies; allocate funds pursuant to interlocal governmental agreements; educate and inform the public about stormwater management; and perform, without limitation except by law, any stormwater management functions and activities necessary to ensure the public safety, protect private and public properties and habitat, and enhance the natural environment and waters of the county.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-104. Limitation of scope of responsibility.

The purpose and responsibility of the stormwater management utility shall be limited by the following legal and practical considerations:

(a) Beaufort County owns or has legal access for purposes of operation, maintenance and improvement only to those stormwater systems and facilities which:

  (1) Are located within public streets, other rights-of-way, and easements;

  (2) Are subject to easements, rights-of-entry, rights-of-access, rights-of-use, or other permanent provisions for adequate access for operation, maintenance, monitoring, and/or improvement of systems and facilities; or

  (3) Are located on public lands to which the county has adequate access for operation, maintenance, and/or improvement of systems and facilities.

(b) Operation, maintenance, and/or improvement of stormwater systems and facilities which are located on private property or public property not owned by Beaufort County and for which there has been no public dedication of such systems and facilities for operation, maintenance, monitoring, and/or improvement of the systems and facilities shall be and remain the legal responsibility of the property owner, except as that responsibility may be otherwise affected by the laws of the State of South Carolina and the United States of America.

(c) It is the express intent of this article to protect the public health, safety, and welfare of all properties and persons in general, but not to create any special duty or relationship with any individual person or to any specific property within or outside the boundaries of the county. Beaufort County expressly reserves the right to assert all available immunities and defenses in any action seeking to impose monetary damages upon the county, its officers, employees and agents arising out of any alleged failure or breach of duty or relationship as may now exist or hereafter be created.

(d) To the extent any permit, plan approval, inspection or similar act is required by the county as a condition precedent to any activity or change upon property not owned by the county, pursuant to this or any other regulatory ordinance, regulation, or rule of the county or under federal or state law, the issuance of such permit, plan approval, or inspection shall not be deemed to constitute a warranty, express or implied, nor shall it afford the basis for any action, including any action based on failure to permit or negligent issuance of a permit, seeking the imposition of money damages against the county, its officers, employees, or agents.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-105. Boundaries and jurisdiction.

The boundaries and jurisdiction of the stormwater management utility shall encompass all those portions of unincorporated Beaufort County, as they may exist from time to time and such additional areas lying inside the corporate limits of those cities and towns in Beaufort County as shall be subject to interlocal agreements for stormwater management as approved by county council and participating municipal councils.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-106. Definitions.

Unless the context specifically indicates otherwise, the meaning of words and terms used in this article shall be as set forth in S.C. Code § 48-14-20, and 26 S.C. Code Regulation 72-301, mutatis mutandis.

Abatement. Any action deemed necessary by the county or its officers or agents to remedy, correct, control, or eliminate a condition within, associated with, or impacting a stormwater drainage system or the water quality of receiving waters shall be deemed an abatement action.

Adjustments. Adjustments shall mean a change in the amount of a stormwater service fee predicated upon the determination reached by the public works director and referenced to the adjustments and credit manual.

Bill class. Every property falls into one of several bill classes. The bill class determines the fee calculation of that property.

Condominiums. Properties with individual ownership of a particular dwelling unit in a building and the common right to share, with other co-owners, in the general and limited common elements of the real property.

Countywide infrastructure operation and maintenance and capital projects. The county maintains some typically larger infrastructure within each of the four municipalities in addition to within the unincorporated area.

The rate structure will allocate the costs for the county to maintain just the countywide drainage infrastructure across the entire rate base in all jurisdictions based on infrastructure linear feet per jurisdiction.

Customers of the stormwater management utility. Customers of the stormwater management utility shall be broadly defined to include all persons, properties, and entities served by and/or benefiting, directly and indirectly, from the utility's acquisition, management, construction, improvement, operation, maintenance, extension, and enhancement of the stormwater management programs, services, systems, and facilities in the county, and by its control and regulation of public and private stormwater systems, facilities, and activities related thereto.

Developed land. Developed land shall mean property altered from its natural state by construction or installation of improvements such as buildings, structures, or other impervious surfaces, or by other alteration of the property that results in a meaningful change in the hydrology of the property during and following rainfall events. Existing county maintained dirt roads which are improved and/or paved as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 and existing private dirt roads which are improved or paved and where the project is not related to a pending or proposed development of adjacent land are deemed not to constitute "developed land".

Exemption. Exemption shall mean not applying to or removing the application of the stormwater management utility service fee from a property. No permanent exemption shall be granted based on taxable or non-taxable status or economic status of the property owner.

Fixed costs. Costs associated with the public service provided equally to each property owner. These costs include, but are not limited to, the following: billing and collections, data management and updating, programming, and customer support.

Gross area. Gross area is the acreage of a parcel as identified by the Beaufort County Assessor records.

Hydrologic response. The hydrologic response of a property is the manner whereby stormwater collects, remains, infiltrates, and is conveyed from a property. It is dependent on several factors including, but not limited to, the size and overall intensity of development of each property, its impervious area, shape, topographic, vegetative, and geologic conditions, antecedent moisture conditions, and groundwater conditions and the nature of precipitation events. Extremely large undeveloped properties naturally attenuate but do not eliminate entirely the discharge of stormwater during and following rainfall events.

Jurisdictional infrastructure operations, maintenance and capital projects. Each of the five jurisdictions maintains its own stormwater drainage infrastructure and funds those costs from utility revenue. Revenue from this fee component will be returned to the service provider, the individual jurisdiction.

Impervious surfaces. Impervious surfaces shall be a consideration in the determination of the development intensity factor. Impervious surfaces are those areas that prevent or impede the infiltration of stormwater into the soil as it entered in natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, sidewalks, walkways, patio areas, driveways, parking lots, storage areas, compacted gravel and soil surfaces, awnings and other fabric or plastic coverings, and other surfaces that prevent or impede the natural infiltration of stormwater runoff that existed prior to development.

Minimum charge. A charge that reflects the minimum amount of demand a property will place on the service provider.

MS4 permit. Each jurisdiction within Beaufort County will be subject to the federally mandated MS4 permit requirements. Compliance requirements include, but are not limited to, monitoring, plan review, inspections, outreach and public education.

Nonresidential properties. Properties developed for uses other than permanent residential dwelling units and designated by the assigned land use code in the Beaufort County tax data system.

Other developed lands. Other developed lands shall mean, but not be limited to, mobile home parks, commercial and office buildings, public buildings and structures, industrial and manufacturing buildings, storage

buildings and storage areas covered with impervious surfaces, parking lots, parks, recreation properties, public and private schools and universities, research facilities and stations, hospitals and convalescent centers, airports, agricultural uses covered by impervious surfaces, water and wastewater treatment plants, and lands in other uses which alter the hydrology of the property from that which would exist in a natural state. Properties that are used for other than single-family residential use shall be deemed other developed lands for the purpose of calculating stormwater service fees.

Residential dwelling classifications. The following categories will identify the appropriate dwelling unit classifications to be utilized in applying the stormwater utility fee structure to the designations contained in the Beaufort County tax data system:

Single-family

Apartments

Townhouses

Condominiums

Mobile home

Salt water marsh. Those parcels, typically contiguous to water, identified as inundated daily due to tidal action and unbuildable. These properties are 100 percent below mean high tide and/or beyond established critical line as defined by the South Carolina Department of Health and Environmental Control's Office of Coastal Resource Management (DHEC-OCRM). The county tax assessor's office shall make this determination based on best available data.

Stormwater management programs, services, systems and facilities. Stormwater management programs, services, systems and facilities are those administrative, engineering, operational, regulatory, and capital improvement activities and functions performed in the course of managing the stormwater systems of the county, plus all other activities and functions necessary to support the provision of such programs and services. Stormwater management systems and facilities are those natural and manmade channels, swales, ditches, swamps, rivers, streams, creeks, branches, reservoirs, ponds, drainage ways, inlets, catch basins, pipes, head walls, storm sewers, lakes, and other physical works, properties, and improvements which transfer, control, convey or otherwise influence the movement of stormwater runoff and its discharge to and impact upon receiving waters.

Stormwater service fees. Stormwater service fees shall mean the service fee imposed pursuant to this article for the purpose of funding costs related to stormwater programs, services, systems, and facilities. These fees will be calculated based upon the impervious and gross area at an 80/20 allocation; stormwater service fee categories; any state agricultural exemptions or caps; an account administrative fee, countywide jurisdiction operation maintenance and capital project fees; and jurisdictional operation, maintenance and capital project fee.

Single-family unit (SFU). The single-family unit shall be defined as the impervious area measurements obtained from a statistically representative sample of all detached single-family structures within Beaufort County. The representative value will be 4,906 square feet.

Stormwater service fee categories. The appropriate categories for determining SFUs will be as follows:

	SFU Calculation (SFUs equal)
Tier 1: Single-family unit (≤2,521 square feet)	Dwelling units x 0.5
Tier 2: Single-family unit (2,522 to 7,265 square feet)	Dwelling units x 1
Tier 3: Single-family unit (≥7,266 square feet)	Dwelling units x 1.5
Mobile home	Dwelling units x 0.36
Apartments	Dwelling units x 0.39
Townhouses	Dwelling units x 0.60

Condominiums	Dwelling units x 0.27
Commercial	Impervious area * 4,906 sq. ft.*

* Commercial billed at a rate of one SFU per 4,906 square feet or a portion thereof.

Submerged property. Those parcels, typically contiguous to water, identified as eroded due to tidal action and unbuildable. These properties are 100 percent below mean low tide and/or beyond established critical line as defined by South Carolina Department of Health and Environment Control's Office of Coastal Resource Management (DHEC-OCRM). The county tax assessor's office shall make this determination based on best available data.

Townhomes. See Condominiums.

Variable costs. An impervious and gross area rate structure that allocates some cost to each of the two variables based on the amount of impervious surface and gross area.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2018/6, 3-12-2018 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-107. Reserved.

Editor's note(s)—Ord. No. 2016/38 , adopted Oct. 24, 2016, deleted § 99-107, which pertained to requirements for on-site stormwater systems; enforcement, methods, and inspections, and derived from Ord. No. 2015/24 , adopted Sept. 28, 2015.

Sec. 99-108. General funding policy.

(a) It shall be the policy of Beaufort County that funding for the stormwater management utility program, services, systems, and facilities shall be equitably derived through methods which have a demonstrable relationship to the varied demands and impacts imposed on the stormwater program, services, systems, and facilities by individual properties or persons and/or the level of service rendered by or resulting from the provision of stormwater programs, systems and facilities. Stormwater service fee rates shall be structured so as to be fair and reasonable, and the resultant service fees shall bear a substantial relationship to the cost of providing services and facilities throughout the county. Similarly situated properties shall be charged similar rentals, rates, fees, or licenses. Service fee rates shall be structured to be consistent in their application and shall be coordinated with the use of any other funding methods employed for stormwater management within the county, whether wholly or partially within the unincorporated portions of the county or within the cities and towns. Plan review and inspection fees, special fees for services, fees in-lieu of regulatory requirements, impact fees, system development fees, special assessments, general obligation and revenue bonding, and other funding methods and mechanisms available to the county may be used in concert with stormwater service fees and shall be coordinated with such fees in their application to ensure a fair and reasonable service fee rate structure and overall allocation of the cost of services and facilities.

(b) The cost of stormwater management programs, systems, and facilities subject to stormwater service fees may include operating, capital investment, and non-operating expenses, prudent operational and emergency reserve expenses, and stormwater quality as well as stormwater quantity management programs, needs, and requirements.

(c) To the extent practicable, adjustments to the stormwater service fees will be calculated by the Beaufort County Public Works Director or his/her designee in accordance with the standards and procedures adopted by the public works director's office.

(d) The stormwater service fee rate may be determined and modified from time to time by the Beaufort County Council so that the total revenue generated by said fees and any other sources of revenues or other resources allocated to stormwater management by the county council to the stormwater management utility shall be sufficient to meet the cost of stormwater management services, systems, and facilities, including, but not limited to, the payment of principle and interest on debt obligations. operating expense, capital outlays, nonoperating expense, provisions for prudent reserves, and other costs as deemed appropriate by the county council.

Beaufort County service fee rate will be based on impervious and gross area at an 80/20 allocation; stormwater service fee categories; any state agricultural exemptions or caps; an account administrative fee, countywide jurisdiction operation maintenance and jurisdictional operation, maintenance and capital project fee. The rates are set by the Beaufort County Stormwater Rate Study adopted August 24, 2015.

The gross area charge for all parcels, except master account properties for condominiums, is calculated in equivalent units as follows:

First 2 acres	$X
For every acre above 2 acres and up to 10 acres	0.5 x $X
For every acre above 10 acres, and up to 100 acres	0.4 x $X
For every acre above 100 acres	0.3 x $X

Condominium accounts will receive a minimum gross area charge of 0.2 x $X. The master account associated with the condominium subdivision will not receive a gross area charge.

Each municipal jurisdiction may have a different fee predicated upon the municipal jurisdiction's revenue needs. The stormwater service fee rates shall be adopted by the municipal jurisdictions and may be amended from time to time by the individual governing body.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-109. Exemptions and credits applicable to stormwater service fees.

Except as provided in this section, no public or private property shall be exempt from stormwater utility service fees. No exemption, credit, offset, or other reduction in stormwater service fees shall be granted based on the age, tax, or economic status, race, or religion of the customer, or other condition unrelated to the stormwater management utility's cost of providing stormwater programs, services, systems, and facilities. A stormwater management utility service fee credit manual shall be prepared by the public works director specifying the design and performance standards of on-site stormwater services, systems, facilities, and activities that qualify for application of a service fee credit, and how such credits shall be calculated.

(a) *Credits.* The following types of credits against stormwater service fees shall be available:

(1) Freshwater wetlands. All properties except those classified as detached single-family dwelling units may receive a credit against the stormwater service fee applicable to the property based on granting and dedicating a perpetual conservation easement on those portions of the property that are classified as freshwater wetlands and as detailed in the stormwater management utility service fee credit manual. The conservation easement shall remove that portion of the subject property from any future development.

(2) Salt water marsh. All properties except those classified as detached single-family dwelling units may receive a credit against the stormwater service fee applicable to the property based on those portions of the property that are classified as salt water marsh and as detailed in the stormwater management utility service fee credit manual.

(3) Submerged properties. All properties may receive a credit against the stormwater service fee applicable to the property based on those portions of the property that are classified as submerged and as detailed in the stormwater management utility service fee credit manual.

(4) Those properties that apply for consideration of an adjustment shall satisfy the requirements established by the Beaufort County Public Works Director or his/her designee and approved reduced stormwater service fee.

(b) *Exemptions.* The following exemptions from the stormwater service fees shall be allowed:

(1) Improved public road rights-of-way that have been conveyed to and accepted for maintenance by the state department of transportation and are available for use in common for vehicular transportation by the general public.

(2) Improved public road rights-of-way that have been conveyed to and accepted for maintenance by Beaufort County and are available for use in common for vehicular transportation by the general public.

(3) Improved private roadways that are shown as a separate parcel of land on the most current Beaufort County tax maps and are used by more than one property owner to access their property.

(4) Improved private roadways that are not shown as a separate parcel of land on the most current Beaufort County tax maps but are used by more than one property owner to access their property.

(5) Railroad tracks shall be exempt from stormwater service fees. However, railroad stations, maintenance buildings, or other developed land used for railroad purposes shall not be exempt from stormwater service fees.

(6) Condominium boat slips shall be exempt from stormwater service fees.

(7) Properties determined by the assessor having 100 percent of the gross area of the property submerged, salt water marsh, or freshwater wetland will not receive an administrative charge, if applicable in the utility rate structure, after the applicable credit defined in paragraph (a) above has been applied to the account.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2016/26, 9-26-2016 ; Ord. No. 2020/18, 5-26-2020 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-110. Stormwater service fee billing, delinquencies and collections.

(a) *Method of billing.* A stormwater service fee bill may be attached as a separate line item to the county's property tax billing or may be sent through the United States mail or by alternative means, notifying the customer of the amount of the bill, the date the fee is due (January 15), and the date when past due (March 17 - see Title 12, Section 45-180 of the South Carolina State Code). The stormwater service fee bill may be billed and collected along with other fees, including, but not limited to, the Beaufort County property tax billing, other Beaufort County utility bills, or assessments as deemed most effective and efficient by the Beaufort County Council. Failure to receive a bill is not justification for non-payment. Regardless of the party to whom the bill is initially directed, the owner of each parcel of land shall be ultimately obligated to pay such fees and any associated fines or penalties, including, but not limited to, interest on delinquent service fees. If a customer is under-billed or if no bill is sent for a particular property, Beaufort County may retroactively bill for a period of up to one-year, but shall not assess penalties for any delinquency during that previous unbilled period.

(b) *Declaration of delinquency.* A stormwater service fee shall be declared delinquent if not paid within 60 days of the date of billing or upon the date (March 17) of delinquency of the annual property tax billing if the stormwater service fee is placed upon the annual property tax billing or enclosed with or attached to the annual property tax billing.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-111. Appeals.

Any customer who believes the provisions of this article have been applied in error may appeal in the following manner and sequence:

(a) An appeal of a stormwater service fee must be filed in writing with the Beaufort County Public Works Director, or his/her designee within 30 days of the fee being mailed or delivered to the property owner and stating the reasons for the appeal. In the case of stormwater service fee appeals, the appeal shall include a survey prepared by a registered land surveyor or professional engineer containing information on the impervious surface area and any other feature or conditions that influence the development of the property and its hydrologic response to rainfall events.

(b) Using information provided by the appellant, the county public works director or his/her designee shall conduct a technical review of the conditions on the property and respond to the appeal in writing within 30 days after receipt of the appeal. In response to an appeal, the county public works director or his/her designee may adjust the stormwater service fee applicable to the property in conformance with the general purposes and intent of this article.

(c) A decision of the public works director or his/her designee that is adverse to an appellant may be further appealed to the county administrator or his/her designee within 30 days of the adverse decision. The appellant, stating the grounds for further appeal, shall deliver notice of the appeal to the county administrator or his designee. The county administrator or his designee shall issue a written decision on the appeal within 30 days. All decisions by the county administrator or his designee shall be served on the customer personally or by registered or certified mail, sent to the billing address of the customer. All decisions of the county administrator or his designee shall be final.

(d) The appeal process contained in this section shall be a condition precedent to an aggrieved customer seeking judicial relief. Any decisions of the county administrator or his designee may be reviewed upon application for writ of certiorari before a court of competent jurisdiction, filed within 30 days of the date of the service of the decision.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-112. No suspension of due date.

No provision of this article allowing for an administrative appeal shall be deemed to suspend the due date of the service fee with payment in full. Any adjustment in the service fee for the person pursuing an appeal shall be made by refund of the amount due.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-113. Enforcement and penalties.

Any person who violates any provision of this article may be subject to a civil penalty of not more than $1,000.00, or such additional maximum amount as may become authorized by state law, provided the owner or

other person deemed to be in violation has been notified of a violation. Notice shall be deemed achieved when sent by regular United States mail to the last known address reflected on the county tax records, or such other address as has been provided by the person to the county. Each day of a continuing violation may be deemed a separate violation. If payment is not received or equitable settlement reached within 30 days after demand for payment is made, a civil action may be filed on behalf of the county in the circuit court to recover the full amount of the penalty. This provision on penalties shall be in addition to and not in lieu of other provisions on penalties, civil or criminal, remedies and enforcement that may otherwise apply.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-114. Investment and reinvestment of funds and borrowing.

Funds generated for the stormwater management utility from service fees, fees, rentals, rates, bond issues, other borrowing, grants, loans, and other sources shall be utilized only for those purposes for which the utility has been established as specified in this article, including, but not limited to: regulation; planning; acquisition of interests in land, including easements; design and construction of facilities; maintenance of the stormwater system; billing and administration; water quantity and water quality management, including monitoring, surveillance, private maintenance inspection, construction inspection; public information and education, and other activities which are reasonably required. Such funds shall be invested and reinvested pursuant to the same procedures and practices established by Title 12, Section 45-70 of the South Carolina State Code for investment and reinvestment of funds. County council may use any form of borrowing authorized by the laws of the State of South Carolina to fund capital acquisitions or expenditures for the stormwater management utility. County council, in its discretion and pursuant to standard budgetary procedures, may supplement such funds with amounts from the general fund.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-115. Responsibilities of the stormwater management utility.

The county stormwater management utility shall perform adequate studies throughout the area served by the utility to determine the following:

(1) Baseline study of water quality in the receiving waters;

(2) Identification of pollutants carried by stormwater runoff into the receiving waters;

(3) Recommended mitigation efforts to address pollutants carried by stormwater runoff into the receiving waters;

(4) Inventory of the existing drainage system;

(5) Recommended maintenance practices and standards of the existing drainage system;

(6) Identification of capital improvements to the system to include construction or installation of appropriate BMPs;

(7) A five-year spending plan;

(8) Ensure compliance with the federally mandated MS4 permit requirements;

(9) Efficient utility administration including, but not limited to, billing, collection, defining rate structures, data management and customer support.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Sec. 99-116. Stormwater management utility board.

(1) *Purpose.* In compliance with and under authority of Beaufort County Ordinance 2001/23, the Beaufort County Council hereby establishes the stormwater management utility board (hereinafter referred to as the "SWU board") to advise the council as follows:

(a) To determine appropriate levels of public stormwater management services for residential, commercial, industrial and governmental entities within Beaufort County;

(b) To recommend appropriate funding levels for provision of services in the aforementioned sectors;

(c) To advise the staff of the stormwater management utility on master planning efforts and cost of service/rate studies; and

(d) To support and promote sound stormwater management practices that mitigates non-point source pollution and enhances area drainage within Beaufort County.

Municipal councils are encouraged to organize similar boards to advise them on stormwater management programs and priorities within their boundaries.

In keeping with discussions held during the formation of the stormwater utility, it is anticipated that the municipalities will appoint staff professionals as their representative on the advisory board.

(2) *Stormwater districts.* Stormwater districts are hereby established as follows:

District 1 - City of Beaufort

District 2 - Town of Port Royal

District 3 - Town of Hilton Head Island

District 4 - Town of Bluffton

District 5 - Unincorporated Sheldon Township

District 6 - Unincorporated Port Royal Island

District 7 - Unincorporated Lady's Island

District 8 - Unincorporated St. Helena Island Islands East

District 9 - Unincorporated Bluffton Township and Daufuskie Island

(3) *Membership.*

(a) The SWU board is formed in accordance with Beaufort County Ordinance 92-28 and shall consist of a total of seven voting representatives from each of the following districts as noted below:

No. of Reps.	Stormwater District	Area
1	5	Unincorporated Sheldon Township
1	6	Unincorporated Port Royal Island
1	7	Unincorporated Lady's Island
1	8	Unincorporated St. Helena Island Islands East
2	9	Unincorporated Bluffton Township and Daufuskie Island
1	—	"At large"

All members of the SWU board will be appointed by county council and shall be residents of those districts or "at large" members from unincorporated Beaufort County.

(b) The SWU board shall also consist of one nonvoting (ex officio) representative from the following districts:

Stormwater District	Municipality
1	City of Beaufort
2	Town of Port Royal
3	Town of Hilton Head Island
4	Town of Bluffton

All ex officio members from municipalities shall be appointed by their respective municipal councils for four-year terms.

(c) All citizen members shall be appointed for a term of four years. The terms shall be staggered with one or two members appointed each year.

(d) While no other eligibility criteria is established, it is recommended that members possess experience in one or more of the following areas: Stormwater management (drainage and water quality) issues, strategic planning, budget and finance issues or established professional qualifications in engineering, construction, civil engineering, architectural experience, commercial contractor or similar professions.

(4) *Officers.*

(a) *Officers.* Selection of officers and their duties as follows:

1. *Chairperson and vice-chair.* At an annual organizational meeting, the members of the SWU board shall elect a chairperson and vice-chairperson from among its members. The chair's and vice-chair's terms shall be for one year with eligibility for reelection. The chair shall be in charge of all procedures before the SWU board, may administer oaths, may compel the attendance of witnesses, and shall take such action as shall be necessary to preserve order and the integrity of all proceedings before the SWU board. In the absence of the chair, the vice-chair shall act as chairperson.

2. *Secretary.* The county professional staff member shall appoint a secretary for the SWU board. The secretary shall keep minutes of all proceedings. The minutes shall contain a summary of all proceedings before the SWU board, which include the vote of all members upon every question, and its recommendations, resolutions, findings and determinations, and shall be attested to by the secretary. The minutes shall be approved by a majority of the SWU board members voting. In addition, the secretary shall maintain a public record of SWU board meetings, hearings, proceedings, and correspondence.

3. *Staff.* The public works director shall be the SWU board's professional staff.

(b) *Quorum and voting.* Four SWU board members shall constitute a quorum of the SWU board necessary to take action and transact business. All actions shall require a simple majority of the number of SWU board members present.

(c) *Removal from office.* The county council, by a simple majority vote, shall terminate the appointment of any member of the SWU board and appoint a new member for the following reasons:

1. Absent from more than one-third of the SWU board meetings per annum, whether excused or unexcused;

2. Is no longer a resident of the county;

3. Is convicted of a felony; or

4. Violated conflict of interest rules.

Moreover, a member shall be removed automatically for failing to attend any three consecutive regular meetings.

(d) *Vacancy.* Whenever a vacancy occurs on the SWU board, the county council shall appoint a new member within 60 days of the vacancy, subject to the provisions of this section. A new member shall serve out the former member's term.

(e) *Compensation.* The SWU board members shall serve without compensation, but may be reimbursed for such travel, mileage and/or per diem expenses as may be authorized by the county council-approved budget.

(5) *Responsibilities and duties.*

(a) Review and recommend to the county council for approval, a comprehensive Beaufort County Stormwater Management Master Plan and appropriate utility rate study which is in accordance with the South Carolina Stormwater Management and Sediment Reduction Act; and

(b) Review and comment to the county administrator on the annual stormwater management utility enterprise fund budget; and

(c) Cooperate with the South Carolina Department of Health and Environmental Control (DHEC), Office of Coastal Resource Management (OCRM), the Oversight Committee of the Special Area Management Plan (SAMP), the Beaufort County Clean Water Task Force as well as other public and private agencies having programs directed toward stormwater management programs; and

(d) Review and make recommendations concerning development of a multiyear stormwater management capital improvement project (CIP) plan; and

(e) Review and advise on proposed stormwater management plans and procurement procedures; and

(f) Provide review and recommendations on studies conducted and/or funded by the utility; and

(g) Review and advise on actions and programs to comply with regulatory requirements, including permits issued under the State of South Carolina National Pollutant Discharge Elimination System (NPDES) general permit for stormwater discharges from regulated small municipal separate storm sewer systems (MS4).

(6) *Meetings.* Meetings of the SWU board shall be held as established by the SWU board and county staff on a quarterly and an as needed basis and a calendar will be prepared giving the date, time and location of such meetings. Additionally, meetings may be called by the chairperson or at the request of county staff. The location of all SWU board meetings shall be held in a public building in a place accessible to the public. The following shall apply to the conduct of all meetings:

(a) *Meeting records.* The SWU board shall keep a record of meetings, resolutions, findings, and determinations. The SWU board may provide for transcription of such hearings and proceedings, or portions of hearings and proceedings, as may be deemed necessary.

(b) *Open to public.* All meetings and public hearings of the SWU board shall be open to the public.

(c) *Recommendations or decisions.* All recommendations shall be by show of hands of all members present. A tie vote or failure to take action shall constitute a denial recommendation. All recommendations shall be accompanied by a written summary of the action and recommendations.

(d) *Notice and agenda.* The SWU board must give written public notice of regular meetings at the beginning of each calendar year. The SWU board must post regular meeting agendas at the meeting place 24 hours before any meeting. Notices and agenda for call, special or rescheduled meetings must

be posted at least 24 hours before such meetings. The SWU board must notify any persons, organizations and news media that request such notification of meetings.

(Ord. No. 2015/24, 9-28-2015 ; Ord. No. 2021/04, 1-11-2021)

Secs. 99-117—99-199. Reserved.

ARTICLE III. REGULATORY GENERAL PROVISIONS

Sec. 99-200. Authority.

This article is adopted pursuant to the authority conferred upon the Beaufort County (county) by the South Carolina Constitution, the South Carolina General Assembly and in accordance with Federal Clean Water Act, the South Carolina Pollution Control Act, and regulations promulgated there under.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-201. Findings.

The county council makes the following findings:

(a) Beaufort County's waters contain some of the few remaining pristine shellfish harvesting areas in the southern coastal counties of South Carolina. Many of its waters have been designated by the State of South Carolina as Outstanding Resource Waters. This use has historical and traditional significance to the area. It is in the public interest that the condition of these areas be maintained and preserved for future generations. Uncontrolled stormwater runoff may have significant, adverse impact on the health, safety and general welfare of the county and the quality of life of its citizens by transporting pollutants into receiving waters and by causing erosion and/or flooding. Development and redevelopment may alter the hydrologic response of local watersheds and increases stormwater runoff rates and volumes, flooding, soil erosion, stream channel erosion, non-point pollution, and sediment transport and deposition, as well as reducing groundwater recharge. These changes in stormwater runoff may contribute to increased quantities of water-borne pollutants and alterations in hydrology which are harmful to public health, safety, and welfare, as well as to the natural environment.

(b) Point source pollution may have significant, adverse impact on the health, safety and general welfare of the county and the quality of life of its citizens by transporting pollutants into receiving waters. The allowance of discharge pipes and outfalls for non-stormwater discharges, illegal dumping, and improper handling of accidental spills and intentional disposals increase the quantities of water-borne pollutants which are harmful to public health, safety, and welfare, as well as to the natural environment.

(c) The effects of point and non-point source pollution, such as uncontrolled runoff, have shown evidence of degradation of the county's receiving waters; thereby adversely affecting the unique qualities of the county's receiving waters, its recreational opportunities and commercial, oystering, boating and fishing, the ecosystem's ability to naturally reproduce and thrive, and the general ability of the area to sustain its natural estuarine resources.

(d) These deleterious effects can be managed and minimized by applying proper design and well-planned controls to manage stormwater runoff from development and redevelopment sites, manage existing natural features that maintain hydrology and provide water quality control, and eliminate potential sources of pollution to receiving waters. Public education regarding the cause and effect of these types

of pollutions and the implementation of the controls and management policies is key to fundamentally changing public behavior.

(e) This article is not in conflict with any development agreements to which the county is a party and does not prevent the development set forth in any development agreement unless impairments to the county's receiving waters is linked to this development.

(f) This article is essential to the public health, safety or welfare and shall apply to any development that is subject to a development agreement.

(g) Laws of general application throughout the county necessary to protect health, safety and welfare are anticipated and are provided for in development agreements.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-202. Purpose.

(a) It is the purpose of this article to guide development in Beaufort County to protect, maintain, and enhance the environment of the county and the short- and long-term public health, safety, and general welfare of the citizens of the county by establishing requirements and procedures to control the potential adverse effects of increased stormwater runoff associated with both future development, re-development, and existing developed land. Proper management of stormwater runoff will minimize damage to public and private property, ensure a functional drainage system, reduce the effects of development on land and stream channel erosion, attain and maintain water quality standards, enhance the local environment associated with the drainage system, reduce local flooding, reduce pollutant loading to the maximum extent practicable and maintain to the extent practicable the pre-developed runoff characteristics of the area, and facilitate economic development while minimizing associated pollutant, flooding, and drainage impacts.

(b) This article specifically authorizes and enables the county to:

(1) Prohibit illicit discharges to the stormwater system and receiving waters.

(2) Define procedures for site plan design, review, inspection, and enforcement relative to stormwater management. Establish decision-making processes surrounding land development or redevelopment activities that protect the integrity of local aquatic resources.

(3) Control the discharge of spills, dumping or disposal of materials other than stormwater to the stormwater system and receiving waters.

(4) Address specific categories of non-stormwater discharges and similar other incidental non-stormwater discharges.

(5) Control importation of water that adversely impacts our receiving waters.

(6) Require temporary erosion and sediment controls to protect water quality to the maximum extent practicable during construction activities, in accordance with current state regulations.

(7) Define procedures for receipt and consideration of information submitted by the public.

(8) Address runoff, particularly volume, rate, and quality through the control and treatment of stormwater with stormwater management facilities and/or best management practices (BMPs).

(9) Develop post-construction stormwater quality performance standards, through enforcement of minimum design standards for BMPs.

(10) Ensure effective long-term operation and maintenance of BMPs.

(11) Carry out all inspection, surveillance, monitoring, and enforcement procedures necessary to determine compliance and noncompliance with this article and stormwater permit conditions including the prohibition of illicit discharges to the county's stormwater system and the protection of water quality of the receiving waters.

(12) Development, implement, and enforce regulations any and all other programs or policies to comply with the Municipal Separate Stormsewer System (MS4) permit issued by South Carolina Department of Health and Environmental Control (DHEC).

(13) Establish design criteria in the most current version of the Southern Lowcountry Stormwater Design Manual for structural and nonstructural stormwater management practices that can be used to meet the minimum post-development stormwater management standards and design criteria;

(14) Establish that Better Site Design (BSD) and site planning has been incorporated, documented, and presented in the development/redevelopment design process.

(15) Maintain structural and nonstructural stormwater management practices to ensure that they continue to function as designed and pose no threat to public safety.

(16) Streamline administrative procedures for the submission, review, approval and disapproval of stormwater management plans and for the inspection of approved land development projects.

(17) If any of the stormwater management standards, as defined in this chapter and in the most current version of the Southern Lowcountry Stormwater Design Manual cannot be attained on the site (due to impractical site characteristics or constraints), a maximum extent practicable analysis shall be prepared and submitted by the applicant for review, discussion, and ultimate approval or rejection of the jurisdiction. Any uncontrolled post-development stormwater quantity or quality volume shall be intercepted and treated in one or more off-site stormwater management practices or a fee-in-lieu shall be required.

(18) The stormwater management practices of approved plans shall provide volume control and at least an 80 percent reduction in total suspended solids loads, 30 percent reduction of total nitrogen load, and 60 percent reduction in bacteria load.

(c) The article requires prudent site planning, including special considerations for the purposes of preserving natural drainage ways incorporating on-site stormwater detention and infiltration to minimize runoff from individual sites to receiving waters by use of effective runoff management, structural and non-structural BMPs, drainage structures, and stormwater facilities. Establish that better site design (BSD) and site planning has been incorporated, documented, and presented in the development/redevelopment design process.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-203. Definitions.

The following definitions shall apply in articles III, IV, V, and VI this chapter. Any term not herein defined shall be given the definition, if any, as is found elsewhere in the Code of Ordinances of Beaufort County, including the community development code (CDC) ordinance.

Administrators. The public works director, the stormwater manager and other individuals designated by the county administrator, from time to time, to administer interpret and enforce this article.

Best management practices ("BMP"). Stormwater management practices, either structural, non-structural or natural that has been demonstrated to effectively control movement of stormwater, pollutants, prevent degradation of soil and water resources, and that are compatible with the planned land use.

Clean Water Act. The Federal Water Pollution Control Act, as amended, codified at 33 U.S.C § 1251 et seq.

Community development code ("CDC"). A form based code to regulate zoning and development in Beaufort County.

County. The Beaufort County, South Carolina.

County council. The publicly elected official of Beaufort County, South Carolina.

Department. The stormwater department, or any duly authorized representatives thereof as designated by the county administrator.

Development. All project construction, modification, or use of any lot, parcel, building, or structure on land and on water. Existing dirt roads which are improved and/or paved as part of Beaufort County's Dirt Road Paving Program as set forth in Beaufort County Policy Statement 15 and Policy Statement 17 and existing private dirt roads which are improved or paved and where the project is not related to a pending or proposed development of adjacent land are deemed not to constitute "development".

Disconnected impervious areas or disconnected impervious surfaces. Those non-contiguous impervious areas or impervious surfaces which produce stormwater runoff that discharges through or across a pervious area or surface (i.e. vegetated cover), of sufficient width to reduce or eliminate pollutants associated with stormwater runoff, prior to discharge to the stormwater system.

Environment. The complex of physical, chemical, and biotic factors that act upon an ecological community and ultimately determine its form and survival.

Evapotranspiration. The sum of evaporation and plant transpiration from the earth's land surface to atmosphere.

Excess stormwater volume. The additional volume of stormwater runoff leaving the site over and above the runoff volume which existed pre-development.

Illicit connection. A connection to the county's stormwater system or receiving water which results in a discharge that is not composed entirely of stormwater runoff and has a detrimental effect on the stormwater system or receiving water except, those granted coverage by an active NPDES permit.

Illicit discharge. Any activity, which results in a discharge to the county's stormwater system or receiving waters that is not composed entirely of stormwater except:

(a) Discharge pursuant to an NPDES permit; and

(b) Other allowable discharges as defined and exempted in this article.

Impervious surface. As defined in the county's best management practices (BMP) manual.

Improper disposal. Any disposal through an illicit discharge, including, but not limited to, the disposal of used oil and toxic materials resulting from the improper management of such substances.

Land disturbance or *land disturbing activity.* The use of land by any person that results in a change in the natural vegetated cover or topography, including clearing that may contribute to or alters the quantity and/or quality of stormwater runoff.

Maintenance. Any action necessary to preserve stormwater management facilities in proper working condition, in order to serve the intended purposes set forth in this article and to prevent structural failure of such facilities.

MS4. Municipal separate storm sewer system.

NPDES. National Pollutant Discharge Elimination System (see "Clean Water Act.")

Natural resources. Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources.

Outfall. The point where county's stormwater system discharges to waters of the United States or the State of South Carolina.

Person. Any and all persons, natural or artificial and includes any individual, association, firm, corporation, business trust, estate, trust, partnership, two or more persons having a joint or common interest, or an agent or employee thereof, or any other legal entity.

Pollutant. Those manmade or naturally occurring constituents that when introduced to a specific environment creates a deleterious effect. Typical pollutants found in stormwater include, but are not limited to, sediment (suspended and dissolved), nutrients (nitrogen and phosphorus, etc.), oxygen demanding organic matter, heavy metals (iron, lead, manganese, etc.), bacteria and other pathogens, oil and grease, household hazardous waste (insecticide, pesticide, solvents, paints, etc.) and polycyclic aromatic hydrocarbons (PAHs).

Property owner or *owner.* The legal or equitable owner of land.

Receiving waters. All natural water bodies, including oceans, salt and freshwater marsh areas, lakes, rivers, streams, ponds, wetlands, and groundwater which are located within the jurisdictional boundaries of the county. Stormwater management ponds, manmade wetlands, ditches, and swales constructed for the sole purpose of controlling and treating stormwater are not considered receiving waters.

Record drawings. A set of drawings prepared by and certified by a South Carolina registered professional engineer or landscape architect that accurately represents the actual final configuration of the stormwater and other related infrastructure constructed in a development.

Redevelopment. As defined in the county's best management practices (BMP) manual.

Regulation. Any regulation, rule or requirement and promulgated by the county pursuant to this article.

Southern Lowcountry Stormwater Design Manual. "The Manual for Stormwater Best Management and Design Practices (BMP)" establishes technical standards as referenced and incorporated into the community development code (CDC).

Stormwater. Stormwater runoff, precipitation runoff, and surface runoff.

Stormwater management. The collection, conveyance, storage, treatment and disposal of stormwater in a manner to meet the objectives of this article and its terms, including, but not limited to, measures that control the increased volume and rate of stormwater runoff and water quality impacts caused by manmade changes to the land.

Stormwater management program, services, systems facilities. Those administrative, engineering, operational, regulatory, and capital improvement activities and functions performed in the course of managing the stormwater systems of the county, plus all services. Stormwater management systems and facilities are those natural and manmade channels, swales, ditches, swamps, rivers, streams, creeks, branches, reservoirs, ponds, drainage ways, inlets, catch basins, pipes, head walls, storm sewers, lakes, and other physical works, properties, and improvements which transfer, control, convey or otherwise influence the movement of stormwater runoff and its discharge to and impact upon receiving waters.

Stormwater management plan or *SWMP.* The set of drawings and other documents that comprise all of the information and specifications for the programs, drainage systems, structures, BMPs, concepts, and techniques for the control of stormwater.

Stormwater pollution prevention plan or *SWPPP.* Erosion prevention and sediment control (EPSC). Also see "stormwater management plan".

Stormwater system. The conveyance or system of conveyances (including roads with drainage systems, highways, right-of-way, private streets, catch basins, curbs, gutters, ditches, manmade channels, storm drains, detention ponds, and other stormwater facilities) which is designed or used for collecting or conveying stormwater.

Structural best management practices ("BMP"). A device designed and constructed to trap and filter pollutants from runoff.

Total impervious surface. All impervious surfaces on a site regardless if they are directly connected to another and that is not constructed using permeable pavement technology.

Utility. Beaufort County Stormwater Utility as established by county article chapter 99, article II.

Waiver. The modification of the minimum stormwater management requirements contained in these articles and the most current version of the Southern Lowcountry Stormwater Design Manual for specific circumstances where strict adherence of the requirements would result in unnecessary hardship and not fulfill the intent of this article.

Water quality. Those characteristics of stormwater runoff that relate to the physical, chemical, biological, or radiological integrity of water.

Water quantity. Those characteristics of stormwater runoff that relate to the rate and volume of the stormwater runoff.

Wetlands. As defined by the Army Corps of Engineers and generally means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar type areas.

Working day. Monday through Friday, excluding all county-observed holidays.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2018/6 , 3-12-2018; Ord. No. 2020/18 , 5-26-2020; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-204. Applicability.

Beginning with and subsequent to its effective date, this article shall be applicable to:

(a) All development and redevelopment.

(b) Any illicit discharges.

(c) The provisions of this article shall apply throughout the unincorporated areas of the county.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-205. Regulations.

The county council, may, in its discretion, amend or change this article, or adopt additional regulations to implement this article in order to comply with the state regulations, administer the stormwater management department, or to otherwise further the goal of protecting the quality of the receiving waters into which the stormwater system discharges.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-206. County stormwater management administration.

Stormwater management will be administered by the public works department and the stormwater department to administer and implement the regulations of this article as set forth in the most current version of the Southern Lowcountry Stormwater Design Manual. The manual may include design standards, procedures and

criteria for conducting hydrologic, hydraulic, pollutant load evaluations, and downstream impact for all components of the stormwater management system. It is the intention of the manual to establish uniform design practices; however, it neither replaces the need for engineering judgment nor precludes the use of information not submitted. Other accepted engineering procedures may be used to conduct hydrologic, hydraulic and pollutant load studies if approved by the public works director.

The manual will contain at a minimum the following components:

(a) Construction activity application contents and approval procedures;

(b) Construction completion and closeout processes;

(c) Hydrologic, hydraulic, and water quality design criteria (i.e., design standards) for the purposes of controlling the runoff rate, volume, and pollutant load. Suggested reference material shall be included for guidance in computations needed to meet the design standards;

(d) Information and requirements for new and re-development projects in special protection areas necessary to address TMDLs, known problem areas and other areas necessary to protect, maintain, and enhance water quality and the environment of Beaufort County and the public health, safety, and general welfare of the citizens of Beaufort County.

(e) Construction document requirements;

(f) Long-term maintenance and maintenance plan;

(g) Minimum easement requirements;

(h) Required and recommended inspection schedules and activities for all components of the stormwater management system, including construction related BMPs.

The manual will be updated periodically to reflect the advances in technology and experience.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2020/18 , 5-26-2020; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-207. Administrators of operations, power and duties.

(a) The administrators, or designee, shall administer, implement, and enforce provisions of this article on behalf of the county.

(b) In addition to the powers and duties that may be conferred by other provisions of the county and other laws, the administrators shall have the following powers and duties under this article:

(1) To create the Southern Lowcountry Stormwater Design Manual. The manual may be used to convey design and engineering standards, construction management processes and procedures, and other aspects necessary for compliance with this chapter;

(2) To review and approve, approve with conditions, or disapprove applications for approval of a stormwater management plan pursuant to this article;

(3) To make determinations and render interpretations of this article;

(4) To establish application requirements, schedules and fees for submittal and review of applications, receipt of appeals, in accordance with the standards for county development permits and stormwater permits under the county's CDC ordinance and this article;

(5) To review and make recommendations to the applications for development or redevelopment approvals;

(6) To enforce the provisions of this article in accordance with its enforcement provisions;

(7) To maintain records, maps, and official materials related enforcement, or administration of this article;

(8) To provide expertise and technical assistance;

(9) To take any other action necessary to administer the provisions of this article.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-208. Coordination with other agencies.

The administrators will coordinate the county's activities with other federal, state, and local agencies, which manage and perform functions relating to the protection of receiving waters.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-209. Cooperation with other governments.

The county may enter into agreements with other governmental and private entities to carry out the purposes of this article. These agreements may include, but are not limited to, enforcement, resolution of disputes, cooperative monitoring, and cooperative management of stormwater systems and cooperative implementation of stormwater management programs.

Nothing in this article or in this section shall be construed as limitation or repeal of any ordinances of these local governments or of the powers granted to these local governments by the South Carolina Constitution or statues, including, without limitation, the power to require additional or more stringent stormwater management requirements within their jurisdictional boundaries.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-210. Stormwater management standards.

(a) Reference to best management practices can be found in the most current version of the Southern Lowcountry Stormwater Design Manual. The administrators shall use the policy, criteria, and information, including technical specifications and standards, in the most current version of the Southern Lowcountry Stormwater Design Manual as the basis for decisions about stormwater plans and about the design, implementation and performance of structural and non-structural stormwater systems. The stormwater management standards shall describe in detail how post-development stormwater runoff will be controlled and managed, the design of all stormwater facilities and practices, and how the proposed project will meet the requirements of this article. The most current version of the Southern Lowcountry Stormwater Design Manual includes a list of acceptable stormwater treatment practices, including the specific design criteria for each stormwater practice. These standards will be updated as technology improves.

(b) Relationship of stormwater management standards to other laws and regulations. If the specifications or guidelines of the standards are more restrictive or apply a higher standard than other laws or regulations, that fact shall not prevent application of the specifications or guidelines in the standards.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-211. Review of stormwater management plans.

Stormwater management plans shall be reviewed as a component of the development plan review process by the administrators. They will be reviewed for compliance with standards in this article and requirements in the

CDC and the most current version of the Southern Lowcountry Stormwater Design Manual Procedures are outlined in the most current version of the Southern Lowcountry Stormwater Design Manual. Requests for meetings and submission of plans will be submitted to stormwater department. The expected process will be in accordance with the standard procedures for applications described in the community development code.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-212. Approvals.

(a) *Effect of approval.* Approval authorizes the applicant to go forward with only the specific plans and activity authorized in the plan. The approval shall not be construed to exempt the applicant from obtaining other applicable approvals from local, state, and federal authorities.

(b) *Time limit/expiration.* Time limit, expiration and extensions shall be in accordance with the county's community development code.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-213. Appeals.

(a) *Scope of appeal.* Any person aggrieved by a decision of the administrators may appeal the same by filing an interim written notice of appeal, with the administrators within 30 days of the issuance of said decision or notice of violation. The interim notice of appeal must specify with reasonable practicality the grounds of the appeal and relief sought. The stormwater management utility board (SWUB) will review and provide a decision within 15 days after the next scheduled board meeting following the appeal. The decision of the SWUB shall be final. Appeals to SWUB's decision shall be processed in accordance with state law.

(b) *Standards.*

(1) The SWUB is limited to the following determinations for an administrative appeal:

a. The administrators made an error in reviewing whether a standard was met. The record must indicate that an error in judgment occurred or facts, plans, or regulations were misread in determining whether the particular standard was met.

b. Where conflicting evidence exists, the appeal is limited to determining what evidence or testimony bears the greatest credibility in terms of documentation and qualifications of those making the determination.

c. The administrators made the decision on standards not contained in this chapter or other county ordinances, regulations, or state law, or a standard more strict or broad was applied. This chapter does not permit administrators to consider or create standards not officially adopted.

d. An error in applying a standard or measuring a standard was made.

(2) The board, on an appeal, shall not hear any evidence or make any decision based on financial hardships.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-214—99-299. Reserved.

ARTICLE IV. STORMWATER MANAGEMENT STANDARDS TO BE APPLIED

Sec. 99-300. General requirements.

(a) All development and redevelopment, including highways, shall use site planning, design, construction. and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume and duration of flow.

(b) All development shall connect impervious surfaces to vegetative surfaces to the maximum extent practicable.

(c) Stormwater runoff shall be controlled in a manner that:

(1) Promotes positive drainage from structures resulting from development.

(2) Includes the use of vegetated conveyances, such as swales and existing natural channels to promote infiltration and evapotranspiration.

(3) Reduces runoff velocities and maintains sheet flow condition to prevent erosion and promote infiltration.

(4) Limits its interaction with potential pollutant sources that may become water-borne and create non-point source pollution.

(5) Promotes reuse of excess stormwater volume to increase evapotranspiration.

(d) Natural vegetative buffers play an integral part in minimizing the volume of stormwater runoff by promoting infiltration and increasing evaportranspiration to reduce stormwater volume to receiving waters and acting as a first line of treatment of water quality pollution. Development shall observe the buffer requirements of the county's CDC ordinance or if applicable the relevant development agreement, concept plan, and/or approved master plan.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-301. Stormwater design requirements for development.

Developments which incorporates engineered stormwater collection, conveyance, and storage systems shall be designed to the criteria established in the ~~latest~~ most current version of county's Southern Lowcountry Stormwater Design Manual.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-302. BMP requirements.

(a) Effectiveness of infiltration practices is dependent on the site conditions. The most current version of the Southern Lowcountry Stormwater Design Manual outlines guidance for properly siting infiltration practices and shall be reviewed prior to the design phase.

(b) The owners of all new developments that receive a stormwater permit from the county shall be required to perform stormwater quantity monitoring at their expense to ensure compliance with the provisions of this article and ensure that volume reduction plans are operated as intended.

(c) All construction and implementation of erosion and sediment control BMPs shall comply with the requirements of the South Carolina Stormwater Management and Sediment Reduction Act and submit reports in accordance with the most current version of the Southern Lowcountry Stormwater Design Manual.

(d) The county reserves the right to perform other monitoring as it deems appropriate to determine compliance with the State Sediment and Erosion Control Act.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-303. Reserved.

(Ord. No. 2016/38 , 10-24-2016)

Sec. 99-304. Waiver.

Individuals seeking a waiver in connection with a stormwater plan may submit to the public works director a request for a waiver from the requirements of this article if exceptional circumstances applicable to a site exist, such that the applicant can provide rational documentation and justification to support a waiver.

Waivers may be granted for water quantity control only and best management practices to achieve water quality goals will still be required.

(a) *Request of waiver at staff level.* A written request for a waiver is required and shall state the specific waiver sought and the reasons, with supporting data, a waiver should be granted. The request shall include all information necessary to evaluate the proposed waiver. Requests must outline the need for such a waiver, such as site constraints, soil characteristics, or similar engineering limitations. Cost shall not be considered cause for a waiver. The applicant will address the four areas of consideration for waiver approval as follows:

(1) What exceptional circumstances to the site are evident?

(2) What unnecessary hardship is being caused?

(3) How will denial of the waiver be inconsistent with the intent of the ordinance?

(4) How will granting waiver comply with intent of ordinance?

(b) *Review of waivers.* The administrators will conduct a review of the request and will issue a decision within 15 working days of receiving the request.

(c) *Appeal of decision.* Any person aggrieved by the decision of the administrators concerning a waiver request may appeal such decision in accordance with section 99-213 above.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-305. Maintenance; general requirements.

(a) *Function of BMPs as intended.* The owner of each structural BMP installed pursuant to this article shall maintain and operate it to preserve and continue its function in controlling stormwater quality and quantity at the degree or amount of function for which the structural BMP was designed.

(b) *Right of county to inspection.* Every structural BMP installed pursuant to this article shall be made accessible for adequate inspection by the county.

(c) *Annual maintenance inspection and report.* The person responsible for maintenance of any structural BMP installed pursuant to this article shall submit to the administrator(s) an inspection report from a CSPR certified inspector, Post-construction BMP certified inspector, an E.I.T. or registered South Carolina Professional Engineer. The inspection report, at a minimum, shall contain all of the following:

(1) The name and address of the land owner;

(2) The recorded book and page number of the lot of each structural BMP or a digital representation of the geographic location of each structural BMP;

(3) A statement that an inspection was made of all structural BMPs;

(4) The date the inspection was made;

(5) A statement that all inspected structural BMPs are performing properly and comply with the terms and conditions of the approved maintenance agreement required by this article;

(6) The original signature and seal of the engineer inspecting the structural BMPs; and

(7) Digital photographs of the structural BMPs and pertinent components integral to its operation, including, but not limited to, inlet/outlet control structures, downstream receiving channel/area, embankments and spillways, safety features, and vegetation.

An original inspection report shall be provided to the administrators beginning one year from the date of final inspection of the completed structural BMP and each year thereafter on or before the date of the record drawings certification.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-306. Operation and maintenance agreement.

(a) Prior to the conveyance or transfer of any lot or building site requiring a structural BMP pursuant to this article, the applicant or owner of the site must execute an operation and maintenance agreement (see the most current version of the Southern Lowcountry Stormwater Design Manual for form) that shall be binding on all subsequent owners of the site, portions of the site, and lots or parcels served by the structural BMP. Until the transference of all property, sites, or lots served by the structural BMP, the original owner or applicant shall have primary responsibility for carrying out the provisions of the maintenance agreement.

(b) The operation and maintenance agreement must be approved by the administrators prior to plan approval, and it shall be referenced on the final plat and shall be recorded with the county register of deeds upon final plat approval. If no subdivision plat is recorded for the site, then the operations and maintenance agreement shall be recorded upon the approval of a certificate of completion with the county register of deeds to appear in the chain of title of all subsequent purchasers under generally accepted searching principles. A copy of the recorded maintenance agreement shall be given to the administrators within 14 days following its recordation.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-307. Deed recordation and indications on plat.

The applicable operations and maintenance agreement pertaining to every structural BMP shall be referenced on the final plat and in covenants and shall be recorded with the county register of deeds upon final plat approval.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-308. Records of installation and maintenance activities.

The owner of each structural BMP shall keep records of inspections, maintenance, and repairs for at least five years from the date of the record and shall submit the same upon reasonable request to the administrator(s).

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-309. Nuisance.

The owner of each stormwater BMP shall maintain it so as not to create or result in a nuisance condition, such as, but not limited to, flooding, erosion, excessive algal growth, overgrown vegetation, mosquito breeding habitat, existence of unsightly debris, or impairments to public safety and health. Maintenance practices must not lead to discharges of harmful pollutants.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-310—99-399. Reserved.

ARTICLE V. ILLICIT DISCHARGES AND CONNECTIONS TO THE STORMWATER SYSTEM

Sec. 99-400. Illicit discharges.

No person shall cause or allow the discharge, emission, disposal, pouring, or pumping directly or indirectly to any stormwater conveyance, receiving water, or upon the land in manner and amount that the substance is likely to reach a stormwater conveyance or the receiving waters, any liquid, solid, gas, or other substance (including animal waste), other than stormwater.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-401. Non-stormwater discharges.

(a) Non-stormwater discharges associated with the following activities are allowed provided that acceptable BMPs are followed:

  (1) Water line and hydrant flushing;

  (2) Landscape irrigation, unless it leads to excess SW volume discharge;

  (3) Diverted stream flows;

  (4) Rising ground waters;

  (5) Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));

  (6) Uncontaminated pumped ground water;

  (7) Discharges from potable water sources (with dechlorination BMP utilized);

  (8) Foundation drains;

  (9) Air conditioning condensation;

(10) Reuse water;

(11) Springs;

(12) Water from crawl space pumps;

(13) Footing drains;

(14) Individual residential car washing;

(15) Flows from riparian habitats and wetlands;

(16) Dechlorinated swimming pool discharges: typically less than one part per million;

(17) Street wash water;

(18) Other non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under EPA authority, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the storm drain system;

(19) Discharges specified in writing by the authorized agency/entity, as being necessary to protect public health and safety;

(20) Dye testing is an allowable discharge, but requires a verbal notification to the authorized enforcement agency prior to the test; and

(21) Firefighting.

(22) The public works director may develop procedures for allowing other non-stormwater discharges.

(b) Prohibited substances include, but are not limited to: Oil, anti-freeze, chemicals, animal waste, paints, garbage, and litter.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-402. Illicit connections.

(a) Connections to a receiving water and/or stormwater conveyance system that allow the discharge of non-stormwater, other than the exclusions described in subsection 99-401(a) above are unlawful. Prohibited connections include, but are not limited to, floor drains, waste water from washing machines or sanitary sewers, wash water from commercial vehicle washing or steam cleaning, and waste water from septic systems.

(b) Where such connections exist in violation of this section and said connections were made prior to the adoption of this article or any other article prohibiting such connections, the property owner or the person using said connection shall remove or correct the connection immediately upon notice.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-403. Spills.

(a) Spills or leaks of polluting substances released, discharged to, or having the potential to released or discharged to a receiving water or the stormwater conveyance system, shall be immediately contained, controlled, collected, and properly disposed. All affected areas shall be restored to their preexisting condition.

(b) Persons in control of the polluting substances shall immediately report the release or discharge to persons owning the property on which the substances were released or discharged, shall within two hours of such an event notify the nearest fire department (which will also notify the administrators), and all required federal and state agencies of the release or discharge. Notification shall not relieve any person of any expenses related to the restoration, loss, damage, or any other liability which may be incurred as a result of said spill or leak, nor shall such notification relieve any person from other liability which may be imposed by state or other law.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-404. Nuisance.

Illicit discharges and illicit connections which exist within the unincorporated county are hereby found, deemed, and declared to be dangerous and prejudicial to the public health, and welfare, and are found, deemed, and declared to be public nuisances. Such public nuisances shall be abated in accordance with the procedures set forth in subsection 99-503(c) and (d).

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-405. Suspension of a MS4 discharge due to an illicit discharge.

(a) Any person discharging to the MS4 in violation of this article may have their MS4 access terminated if such termination would abate or reduce an illicit discharge. The authorized administrators notify a violator of the proposed termination of its MS4 access. The violator may petition the authorized enforcement agency for a reconsideration and hearing.

(b) A person commits a violation if the person reinstates MS4 access to premises terminated pursuant to this section, without the prior approval of the authorized administrators.

(c) The Beaufort County, South Carolina administrators may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge that presents or may present imminent and substantial danger to the environment, or to the health or welfare of persons, or to the MS4 or waters of the United States. If the violator fails to comply with a suspension order issued in an emergency, the authorized enforcement agency may take such steps as deemed necessary to prevent or minimize damage to the MS4 or waters of the United States, or to minimize danger to persons.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Secs. 99-406—99-499. Reserved.

ARTICLE VI. INSPECTION, ENFORCEMENT, AND CORRECTION

Sec. 99-500. Inspections.

The county administrators will maintain the right to inspect any and all stormwater systems within its jurisdiction as outlined below:

(a) An inspector designated by the administrators, bearing proper credentials and identification, may enter and inspect all properties for regular inspections, periodic investigations, monitoring, observation

measurement, enforcement, sampling and testing, to ensure compliance with the provisions of this article.

(b) Upon refusal by any property owner to permit an inspector to enter or continue an inspection, the inspector may terminate the inspection or confine the inspection to areas concerning which no objection is raised. The inspector shall immediately report the refusal and the grounds to the administrators. The administrators will promptly seek the appropriate compulsory process.

(c) In the event that the administrators or inspector reasonably believes that discharges from the property into the county's stormwater system or receiving waters may cause an imminent and substantial threat to human health or the environment, the inspection may take place at any time after an initial attempt to notify the owner of the property or a representative on site. The inspector shall present proper credentials upon reasonable request by the owner or representative.

(d) The Beaufort County, South Carolina, administrators shall have the right to set up on any permitted facility such devices as are necessary in the opinion of the authorized enforcement agency to conduct monitoring and/or sampling of the facility's stormwater discharge.

(e) The Beaufort County, South Carolina, administrators have the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure stormwater flow and quality shall be calibrated to ensure their accuracy.

(f) Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the authorized administrators and shall not be replaced. The costs of clearing such access shall be borne by the operator.

(g) Unreasonable delays in allowing the Beaufort County, South Carolina, administrators access to a permitted facility is a violation of a stormwater discharge permit and of this article. A person who is the operator of a facility with a NPDES permit to discharge stormwater associated with industrial activity commits an offense if the person denies the authorized enforcement agency reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this article.

(h) Inspection reports will be maintained in a permanent file at the offices of the administrators.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-501. Notice and warning.

(a) Upon the county's attention to a violation of this article, the administrators shall investigate the violation and prepare a report concerning the violation. If a violation exists, a notice of violation shall be delivered within five working days to any person occupying the property or linked to a discharge, whether the person is the owner, renter, or lessee. If the nature of the violation is not correctable, a stop work order shall be issued immediately. If no one is present or refuses to accept the notice, the administrators shall post the notice of violation on the residence or building entrance.

(b) The notice of violation shall contain the following:

(1) The address and tax ID number of the property.

(2) The section of this chapter being violated.

(3) The nature and location of the violation and the date by which such violation shall be removed or abated.

(4) A notice of the penalty for failing to remove or abate the violation, stating that if the nuisance recurs by the same apparent occupant, owner, or person in charge, a notice of violation, stop work order, or notice to appear will be issued without further notice.

(5) The notice shall specify the number of days in which the violation shall be removed or abated, which time shall be not less than three days nor more than ten days, except in emergency cases.

(c) If the violation occurs where the residence or building is unoccupied, the property may be posted as provided in this section. If the property is unimproved, the notice may be placed on a tree, a stake, or other such object as available.

(d) A written notice containing the same information as the notice of violation shall be sent to the owner or any other person having control of the property at the last known address of the owner, or at the address of the person having control, by U.S. mail or email.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-502. Recurring violations.

Once a notice has been delivered pursuant to this article and the same violation recurs on the same lot or tract of land by the same person previously responsible, no further notice of violation need be given. Each day a violation continues after the expiration of the warning period to abate such a violation shall constitute a separate offence. Thereafter, the county may issue a stop work order, or such person deemed responsible may be notified to appear in court to answer to the charge against such person.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-503. Failure to act upon notice of violation.

Upon neglect or failure to act upon the notice of violation, and/or stop work order given as provided in sections 99-501 and 99-502, the county shall issue a notice to appear and shall follow the procedures as follows:

(a) *Service of notice to appear.* If a stop work order is given and, after the time for removal or abatement has lapsed, the property is reinspected and the administrator or designee finds and determines the violation has not been removed or abated, the administrator or designee shall fill out and sign, as the complainant, a complaint and information form or a notice to appear. The notice to appear shall include the following:

(1) Name of the occupant, owner, or person in charge of the property.

(2) The address or tax ID number of the property on which the violation is occurring.

(3) This chapter section or other reference the action or condition violates.

(4) The date on which the case will be on the court docket for hearing.

(5) Any other information deemed pertinent by the county official.

The original copy of the notice to appear shall be forwarded to the clerk of the court for inclusion on the court's docket for the date indicated on the notice to appear.

(b) *Notice to appear; delivery by mail.* If no one is found at the property to accept a notice to appear for failure to remove or abate a violation, the administrator or designee shall fill out and sign the notice to appear as the complainant and deliver the original plus one copy to the clerk of the court. The clerk shall verify or insert the date the case has been set for hearing before the court. The clerk shall mail the copy by certified mail to the person named in the notice to appear at that person's last known address.

(c) *Abatement by county; costs assessed to person responsible.* If the occupant, owner, or person in charge of the property for which a warning notice has been given fails to remove or abate the violation in the time specified in the notice, whether on public or private property, the administrator or designee may, if severe conditions exist that affect health, welfare, safety or severe environmental degradation, remove the violation and thereby abate the violation. If such conditions exist, the administrator or designee may lawfully enter upon the property on which the violation remains unabated to remove or abate such violation at the cost of the person responsible for creating or maintaining the violation. The violation will be subject to civil fines reflecting the cost to the county, as prosecuted by the county attorney.

(d) *Payment of costs; special tax bill or judgment.* All costs and expenses incurred by the county in removing or abating any violation on any private property may be assessed against the property as a lien on the property. Alternatively, the cost of removing or abating the violation may be made part of the judgment by the judge, in addition to any other penalties and costs imposed if the person charged either pleads or is found guilty of causing, creating, or maintaining a violation.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-504. Penalty for violation.

(a) Enforcement of this article shall fall under the jurisdiction of both the Beaufort County Public Works Department and Beaufort County Codes Enforcement. Officers and inspectors shall have the authority to exercise full discretion in deciding whether to issue a notice of violation, stop work order, or fine when investigating complains that arise under this article.

(b) Any person, group, firm, association, or corporation violating any section of this chapter, or the requirements of an approved Beaufort County Stormwater Permit, shall be guilty of a misdemeanor and, upon conviction thereof, shall pay such penalties as the court may decide, as prescribed by state law, not to exceed $1000.00 or 30 days' imprisonment for each violation. Each day during which such conduct shall continue shall subject the offender to the liability prescribed in this article.

(c) In addition to the penalties established and authorized in subsection (a) of this section, the county attorney may take other actions at law or in equity as may be required to halt, terminate, remove, or otherwise eliminate any violations of this chapter.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-505. Interpretation.

(a) *Meaning and intent.* All provisions, terms, phrases, and expressions contained in this article shall be construed according to the general and specific purposes set forth in section 99-202, purpose. If a different or more specific meaning is given for a term defined elsewhere in county's Code of Ordinances or in an existing development agreement, the meaning and application of the term in this article shall control for purposes of application of this article.

(b) *Text controls in event of conflict.* In the event of a conflict or inconsistency between the text of this article and any heading, caption, figure, illustration, table, or map, the text shall control.

(c) *Authority for interpretation.* The administrators have, after consultation with county attorney, authority to determine the interpretation of this article. Any person may request an interpretation by submitting a written request to the administrators who shall respond in writing within 30 days. The administrators shall keep on file a record of all written interpretations of this article.

(d) *References to statutes, regulations, and documents.* Whenever reference is made to a resolution, article, statute, regulation, manual (including the most current version of the Southern Lowcountry Stormwater Design Manual), or document, it shall be construed as a reference to the most recent edition of such that has been finalized and published with due provision for notice and comment, unless otherwise specifically stated.

(e) *Delegation of authority.* Any act authorized by this article to be carried out by the county administrator may be carried out by his or her designee.

(f) *Usage.*

(1) *Mandatory and discretionary terms.* The words "shall," "must," and "will" are mandatory in nature, establishing an obligation or duty to comply with the particular provision. The words "may" and "should" are permissive in nature.

(2) *Conjunctions.* Unless the context clearly indicates the contrary, conjunctions shall be interpreted as follows: The word "and" indicates that all connected items, conditions, provisions or events apply. The word "or" indicates that one or more of the connected items, conditions, provisions or events apply.

(3) *Tense, plurals, and gender words used in the present tense include the future tense.* Words used in the singular number include the plural number and the plural number includes the singular number, unless the context of the particular usage clearly indicates otherwise. Words used in the masculine gender include the feminine gender, and vice versa.

(g) *Measurement and computation.* Lot area refers to the amount of horizontal land area contained inside the lot lines of a lot or site.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-506. Conflict of laws.

This article is not intended to modify or repeal any other ordinance, rule, regulation or other provision of law. The requirements of this article are in addition to the requirements of any other ordinance, rule, regulation or other provision of law, and where any provision of this article imposes restrictions different from those imposed by any other ordinance, rule, regulation or other provision of law, whichever provision is more restrictive or imposes higher protective standards for human or environmental health, safety, and welfare, shall control.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

Sec. 99-507. Severability.

If the provisions of any section, subsection, paragraph, subdivision or clause of this article shall be adjudged invalid by a court of competent jurisdiction, such judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision or clause of this article.

(Ord. No. 2016/38 , 10-24-2016; Ord. No. 2021/04 , 1-11-2021)

ORDINANCE 2021/

TEXT AMENDMENT TO THE STORMWATER MANAGEMENT UTILITY ORDINANCE AS ADOPTED SEPTEMBER 26TH, 2016 TO ADDRESS THE ADOPTION OF THE SOUTHERN LOWCOUNTRY DESIGN MANUAL

WHEREAS, pursuant to the requirements mandated by the Municipal Separate Stormsewer System (MS4) permit issued by the South Carolina Department of Health and Environmental Control (DHEC) on December 1, 2015, Beaufort County is required to adopt standards related to Stormwater management and create a regulatory framework to enforce the same; and

WHEREAS, the Beaufort County Utility Board has approved the Southern Lowcountry Design Manual as the source of the technical stormwater standards used in the development of Stormwater Plans; and

WHEREAS, added text is underlined and deleted text is struck through.

ADOPTED, this ___ day of __________, 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

BY: ________________________________
Joseph Passiment, Chairman

ATTEST:

____

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

Text Amendment to the Community Development Code (CDC): Section A.3.40 (Permitted Activities) to revise the Lady's Island Expanded Home Business district to include short-term rentals as a special use.

MEETING NAME AND DATE:

Natural Resources Committee Meeting, November 1, 2021

PRESENTER INFORMATION:

Juliana Smith, Long Range Planner, Beaufort County Planning and Zoning

(10 minutes need for item discussion)

ITEM BACKGROUND:

This text amendment was considered by the Lady's Island Community Preservation Committee at their September 20, 2021 meeting. At that time, the Committee was not opposed to the amendment.

The Beaufort County Planning Commission considered this text amendment at their October 4, 2021 meeting. At that time, the Commission voted unanimously to recommend approval of the amendment.

PROJECT / ITEM NARRATIVE:

The applicant seeks to revise the Lady's Island Expanded Home Business district (LIEHB), a Community Preservation district, to include short-term rentals as an allowable special use. The applicant owns 160 Sam's Point Road, located in the LIEHB, and wishes to establish a short-term rental on the property. The property is currently residential.

FISCAL IMPACT:

Not applicable

STAFF RECOMMENDATIONS TO COUNCIL:

Staff recommends approval.

OPTIONS FOR COUNCIL MOTION:

To approve or deny the proposed amendment to the Community Development Code (CDC): Section A.3.40 (Permitted Activities) to revise the Lady's Island Expanded Home Business district to include short-term rentals as a special use.

ORDINANCE 2021 / __

TEXT AMENDMENT TO THE COMMUNITY DEVELOPMENT CODE (CDC): SECTION A.3.40 (PERMITTED ACTIVITIES) TO REVISE THE LADY'S ISLAND EXPANDED HOME BUSINESS DISTRICT TO INCLUDE SHORT-TERM RENTALS AS A SPECIAL USE.

WHEREAS, added text is highlighted in yellow and underlined.

Adopted this ___ day of __________ 2021.

COUNTY COUNCIL OF BEAUFORT COUNTY

By: ______________________________________
Joseph Passiment, Chairman

ATTEST:

____
Sarah W. Brock, JD, Clerk to Council

A.3.40 Permitted Activities

A.3.40 - Permitted Activities

The permitted, conditional, and special uses are listed in Table A.3.40.A. A use not listed in Table A.3.40.A may be permitted by the Director provided it is determined to be substantially similar to a listed use and complies with the purpose established for the LIEHB District. All other uses are prohibited.

Table A.3.40.A: Lady's Island Expanded Home Business Land Uses		
Land Use	**Use Definition**	**Use Permission**
Residential		
Single-family detached	Detached dwelling unit intended for only one family. Includes any one-family dwelling unit, which complies with the codes used by the Beaufort County Building Codes office.	C
Single-family cluster	Two or more single-family detached residential uses in a subdivision, or on an individual lot that include, as part of the subdivision or lot design, significant common open space that meets the standards in Article 2, Division 2.8.	C
Traditional Community Plan	See Article 2, Division 2.3 (Traditional Community Plans)	C
Multifamily	A building containing two or more dwelling units, specifically permitting duplexes, mansion apartments, and apartment houses.	C
Accessory dwelling unit	A second dwelling unit, clearly subordinate to the principal unit, either in or added to an existing single-family detached dwelling, or in a separate accessory structure on the same lot as the main dwelling, for use as a complete, independent living facility. Maximum building size shall not exceed 50 percent of the principal unit's floor area.	P
Family compound	Form of traditional rural development which provides affordable housing for family members allowing additional family dwelling units on, and/or subdivisions of, a single lot owned by the same family for at least 50 years (see Article 2, Section 2.7.40).	C
Group home	Residential facility for nine or fewer mentally or physically handicapped persons providing care on a 24-hour basis and licensed by a state agency or department,	P

	or is under contract with a state agency or department, for that purpose.	
Home-based business	A business, profession, or trade operated out of a single-family residence and/or accessory structures. The employment of up to three unrelated individuals including independent contractors operating from the facility, but not including farm workers is permitted.	C
Retail and Restaurants		
Gas-convenience marts with no repair bays or facilities	There is no towing, vehicle body and engine repair, painting, or exterior overnight vehicle storage permitted with this use. Single-bay car washes associated with a gas convenience mart are permitted (NAICS 811191, 811192).	S
Offices and Services		
Administrative support services	Activities that provide supporting services for businesses located in another location. No outside storage or vehicle parking is permitted with the exception of parking for office staff and clients.	P
Ambulatory health care services	Provide health care services directly or indirectly to ambulatory and do not usually provide inpatient services. Facilities and equipment are not usually the most significant part of the services. Offices of doctors, dentists, chiropractors, optometrists, and mental health practitioners (NAICS 621).	P
Day care, family	A facility in a private home that is operated by one or more persons duly licensed or qualified to be licensed by the state for the purpose of providing child day care for one to not more than eight children at any one time, who are not relatives of the day care provider (NAICS 62441).	P
Day care, commercial	All day care facilities not classified as "day care, family" and including more than eight children (NAICS 62441).	C
Lodging: Short-Term Housing Rental (STHR)	A property with a residential dwelling where lodging is offered, advertised, or provided to Short-Term Rental Tenants (excluding family members) for a fee or any form of compensation with individual rental terms not exceeding 29 consecutive days. See specific use regulations in Article 4.1.360	S
Personal and professional services	This category includes broker and investment services (NAICS 523), caterers (NAICS 72232), commercial day care (NAICS 6244), educational services (NAICS 611),	P

	electronic and computer repair (NAICS 8112), insurance agents and brokers (NAICS 524, 525), internet service providers (NAICS 518), personal and household goods repair (NAICS 8114), personal care (NAICS 812111, 812112, and 812113), professional and technical services (NAICS 5417), real estate services (NAICS 5312).	
Recreation, Education, Safety, Public Assembly		
Civic and social organizations	Establishments primarily engaged in promoting social welfare activities such as educational, scientific, cultural and health (NAICS 8132-34).	P
Religious establishments (small)	Establishments engaged in operating religious organizations, such as churches, religious temples and /or establishments primarily engaged in administering an organized religion or promoting religious activities with no schools (except Sunday schools occupying no more than 50 percent of the floor area) as part of the complex and having less than 15,000 square feet of floor area.	P
Religious establishments (large)	Establishments engaged in operating religious organizations, such as churches, religious temples and /or establishments primarily engaged in administering an organized religion or promoting religious activities with or without schools (except Sunday schools occupying no more than 50 percent of the floor area) as part of the complex and having 15,000 or greater square feet of floor area (NAICS 813110).	S
Schools, neighborhood (elementary and middle schools) and community (high schools)	Institutions of learning or instruction primarily catering to minors, whether public or private, which are licensed by either the county or the State of South Carolina. The definition includes nursery schools, kindergarten, elementary schools, middle schools, senior high schools or any special institution of learning under the jurisdiction of the state department of education catering to those age groups. This does not include charm schools, dancing schools, music schools or similar limited schools (NAICS 6111).	S
Infrastructure, Transportation, Communications		
Local utility	Utility substations or transmission and local distribution facilities, including telephone, and all government-owned utilities. Not included are generation facilities, storage of combustibles, regional facilities, and landfills or mining operations. (NAICS 221122, 22121)	S

Temporary Uses		
Construction staging or plant	A concrete or asphalt batch plant, or metal forming and cutting facility assembled on the site or located no more than one mile from the site where the construction of a particular road, infrastructure or building is to take place. Such facilities shall be removed within one year.	S
Contractor's office	Security guard buildings and structures, construction equipment sheds, contractor's trailers and similar uses incidental to a construction project.	P
Model homes sales office	A dwelling unit or modular unit in a subdivision used as a sales office for that subdivision.	P
Traditional Community Plan Uses		
General Retail 3,500 SF or less	Stores and shops that sell and/or rent goods and merchandise to the general public. This category does not include "Open Air Retail," "Vehicle Sales and Rental," or "Gas Stations/Fuel Sales."	TCP
Animal Services: Clinic/Hospital	An establishment used by a veterinarian where animals are treated. This use may include boarding and grooming as accessory uses.	TCP
Lodging: Bed & Breakfast (5 rooms or less)	The use of a single residential structure for commercial lodging purposes, with up to 5 guest rooms used for the purpose of lodging transient guests and in which meals may be prepared for them, provided that no meals may be sold to persons other than such guests, and where the owner resides on the property as his/her principal place of residence.	TCP
Lodging: Inn (up to 24 rooms)	A building or group of buildings used as a commercial lodging establishment having up to 24 guest rooms providing lodging accommodations to the general public. This includes the use of any dwelling unit for lodging accommodations on a daily or weekly rate to the general public.	TCP
Restaurant, Café, Coffee Shop	A retail business selling ready-to-eat food and/or beverages for on- or off-premise consumption. These include eating establishments where customers are served from a walk-up ordering counter for either on- or off-premise consumption ("counter service"); and establishments where customers are served food at their tables for on-premise consumption ("table service"), that may also provide food for take-out, but does not include drive-through services, which are separately defined and regulated. This use includes all mobile kitchens.	TCP

Community Oriented Cultural Facility (less than 15,000 SF)	Public or non-profit facilities that provide educational and cultural experiences for the general public, examples of which include: aquariums, arboretums, art galleries, botanical gardens, libraries, museums, planetariums, civic centers and theaters predominantly used for live performances, and zoos. May also include accessory retail uses such as a gift/book shop, restaurant, etc.	TCP
Single-Family attached	A structure containing one dwelling unit on a single lot and connected along a property line to another dwelling unit on an adjoining lot by a common wall or other integral part of the principal building such as a breezeway or carport.	TCP
Live/Work	An integrated housing unit and working space, occupies by a single household. Commercial activities are limited to those listed in this table.	TCP
Community Residence (dorms, convents, assisted living, temporary shelters)	See definition in Article 8, Table 3.1.70	TCP
"P" indicates a Use that is Permitted By Right. "C" indicates a Use that is Permitted with Conditions. "S" indicates a Use that is Permitted as a Special Use. "TCP" indicates a Use that is permitted only as part of a Traditional Community Plan under the requirements in Division 2.3		

To:	Beaufort County Natural Resources Committee
From:	Juliana Smith, Long Range Planner, Department of Planning and Zoning
Subject:	Text Amendment to the Community Development Code (CDC): Section A.3.40 (Permitted Activities) to revise the Lady's Island Expanded Home Business district to include short-term rentals as a special use.
Date:	November 1, 2021

STAFF REPORT:

Case No.	ZTA 2021-03
Owner/Applicant:	Mary E. Moyd
Proposed Text Change:	Text Amendment to the Community Development Code (CDC): Section A.3.40 (Permitted Activities) to revise the Lady's Island Expanded Home Business district to include short-term rentals as a special use.

A. SUMMARY OF REQUEST: The applicant seeks to revise the Lady's Island Expanded Home Business district (LIEHB), a Community Preservation district, to include short-term rentals as an allowable special use. The applicant owns 160 Sam's Point Road, located in the LIEHB, and wishes to establish a short-term rental on the property. The property is currently residential.

B. SUMMARY OF PROPOSED AMENDMENT: The amendment currently under consideration would permit short-term rentals as a special use in the LIEHB. The purpose of the LIEHB, a mixed-use district, is to provide areas that are conducive to the establishment and convenience of small-scale office, service, and civic uses, in addition to a variety of residential land uses. Nonresidential uses in the LIEHB are required to blend into the residential character of the area. Currently, two lodging uses are allowed within Traditional Community Plans in the LIEHB: Bed and Breakfast (5 rooms or less) and Inn (up to 24 rooms).

The LIEHB flanks the Sam's Point Road corridor from Miller Drive to the traffic circle on Lady's Island (see attached map). Current conditions on this portion of the corridor are primarily commercial, except for two PUDs that front the corridor: Oyster Bluff and Newpoint.

Per Ordinance 2020-32, robust short-term rental standards were established in the Community Development Code. At the time of adoption, the short-term rental use was added as a special use to all transect and conventional zones except for T1 Natural Preserve and S1 Industrial. The special use was not added to any of the Community Preservation districts; however, LIEHB is consistent with transect zone districts that allow short-term rentals.

Considering the current conditions of the corridor, the current conditions on the Applicant's property, and the intent of the LIEHB and its consistency with transect zones that allow short-term rentals, the addition of short-term rentals as a special use to this district is appropriate.

During their September 20, 2021 meeting, the Lady's Island Community Preservation Committee reviewed the proposed amendment to the LIEHB to include short-term rentals as a special use and were not opposed to the amendment. If adopted, any property owner in the LIEHB seeking to use the short-term rental use will have to apply to the Zoning Board of Appeals for approval.

C. TEXT AMENDMENT REVIEW STANDARDS: In determining whether to adopt or deny a proposed Text Amendment, the County Council shall weigh the relevance of and consider whether, and the extent to which, the proposed amendment:

1. **Is consistent with the goals, objectives, and policies of the Comprehensive Plan;**
The proposed text amendment is consistent with the Comprehensive Plan, which envisions this area to be Neighborhood Mixed Use.

2. **Is not in conflict with any provision of this Development Code, or the Code of Ordinances;**
In the LIEHB, the permitted office, service and civic activities tend to produce relatively low volume traffic and may maintain compatibility with nearby residential uses. Compatibility is further accomplished by limiting building size and scale; strict architectural and land use controls; excluding commercial retail uses; beneficent buffer and setback standards; encouraging home uses; and establishing development standards that reflect present patterns. The short-term rental use is not in conflict with this Development Code or the Code of Ordinances.

3. **Is required by changed conditions;**
Per Ordinance 2020-32, short-term rental standards were established as a special use in the Community Development Code within transect and conventional zones. These standards were not added to Community Preservation Districts.

4. **Addresses a demonstrated community need;**
N/A

5. **Is consistent with the purpose and intent of the zones in this Development Code, or would improve compatibility among uses and ensure efficient development within the County;**

See 2 above.

6. **Would result in logical and orderly development pattern;**
As a special use, each applicant seeking to establish a short-term rental property in the LIEHB will be required to apply to the Zoning Board of Appeals for approval. In addition to typical considerations, the Zoning Board of Appeals (ZBOA) may also establish an appropriate rental limit as a condition of approval after conducting the public hearing and finding that conditions exist making such a limitation necessary for short-term rental applications.

7. **Would not result in adverse impacts on the natural environment, including but not limited to water, air, noise, stormwater management, wildlife, vegetation, wetlands, and the natural functioning of the environment;**
See 6 above.

D. STAFF RECOMMENDATION: Staff recommends approval.

E. BEAUFORT COUNTY PLANNING COMMISSION RECOMMENDATION: At the October 4, 2021 meeting of the Beaufort County Planning Commission, the Commission voted unanimously to recommend approval of the proposed text amendment.

F. ATTACHMENTS:

- Revised LIEHB district use table.
- Map of LIEHB district.

A.3.40 Permitted Activities

A.3.40 - Permitted Activities

The permitted, conditional, and special uses are listed in Table A.3.40.A. A use not listed in Table A.3.40.A may be permitted by the Director provided it is determined to be substantially similar to a listed use and complies with the purpose established for the LIEHB District. All other uses are prohibited.

Table A.3.40.A: Lady's Island Expanded Home Business Land Uses		
Land Use	**Use Definition**	**Use Permission**
Residential		
Single-family detached	Detached dwelling unit intended for only one family. Includes any one-family dwelling unit, which complies with the codes used by the Beaufort County Building Codes office.	C
Single-family cluster	Two or more single-family detached residential uses in a subdivision, or on an individual lot that include, as part of the subdivision or lot design, significant common open space that meets the standards in Article 2, Division 2.8.	C
Traditional Community Plan	See Article 2, Division 2.3 (Traditional Community Plans)	C
Multifamily	A building containing two or more dwelling units, specifically permitting duplexes, mansion apartments, and apartment houses.	C
Accessory dwelling unit	A second dwelling unit, clearly subordinate to the principal unit, either in or added to an existing single-family detached dwelling, or in a separate accessory structure on the same lot as the main dwelling, for use as a complete, independent living facility. Maximum building size shall not exceed 50 percent of the principal unit's floor area.	P
Family compound	Form of traditional rural development which provides affordable housing for family members allowing additional family dwelling units on, and/or subdivisions of, a single lot owned by the same family for at least 50 years (see Article 2, Section 2.7.40).	C
Group home	Residential facility for nine or fewer mentally or physically handicapped persons providing care on a 24-hour basis and licensed by a state agency or department, or is under contract with a state agency or department, for that purpose.	P

Home-based business	A business, profession, or trade operated out of a single-family residence and/or accessory structures. The employment of up to three unrelated individuals including independent contractors operating from the facility, but not including farm workers is permitted.	C
Retail and Restaurants		
Gas-convenience marts with no repair bays or facilities	There is no towing, vehicle body and engine repair, painting, or exterior overnight vehicle storage permitted with this use. Single-bay car washes associated with a gas convenience mart are permitted (NAICS 811191, 811192).	S
Offices and Services		
Administrative support services	Activities that provide supporting services for businesses located in another location. No outside storage or vehicle parking is permitted with the exception of parking for office staff and clients.	P
Ambulatory health care services	Provide health care services directly or indirectly to ambulatory and do not usually provide inpatient services. Facilities and equipment are not usually the most significant part of the services. Offices of doctors, dentists, chiropractors, optometrists, and mental health practitioners (NAICS 621).	P
Day care, family	A facility in a private home that is operated by one or more persons duly licensed or qualified to be licensed by the state for the purpose of providing child day care for one to not more than eight children at any one time, who are not relatives of the day care provider (NAICS 62441).	P
Day care, commercial	All day care facilities not classified as "day care, family" and including more than eight children (NAICS 62441).	C
Lodging: Short-Term Housing Rental (STHR)	A property with a residential dwelling where lodging is offered, advertised, or provided to Short-Term Rental Tenants (excluding family members) for a fee or any form of compensation with individual rental terms not exceeding 29 consecutive days. See specific use regulations in Article 4.1.360	S
Personal and professional services	This category includes broker and investment services (NAICS 523), caterers (NAICS 72232), commercial day care (NAICS 6244), educational services (NAICS 611), electronic and computer repair (NAICS 8112), insurance agents and brokers (NAICS 524, 525), internet service providers (NAICS 518), personal and	P

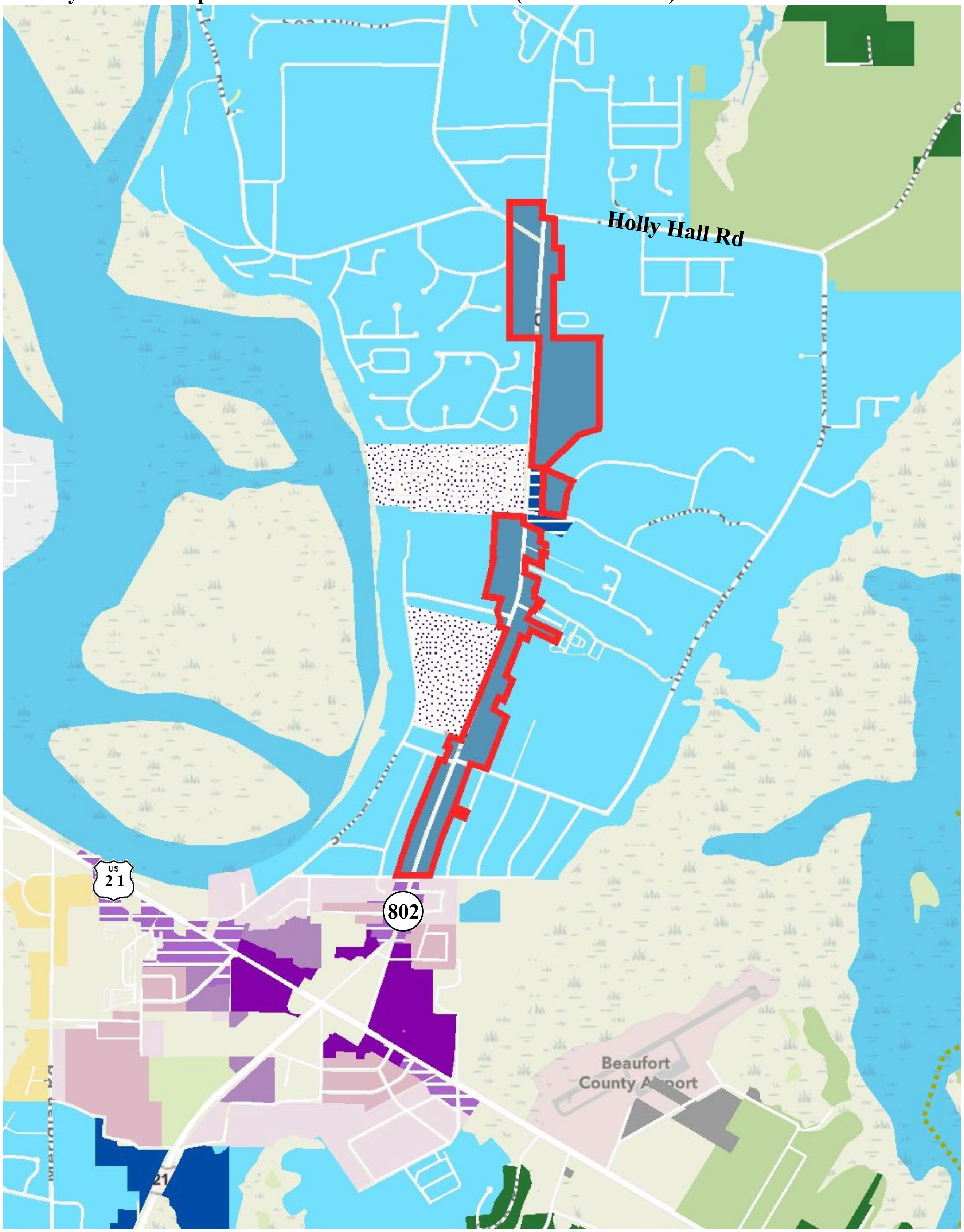
	household goods repair (NAICS 8114), personal care (NAICS 812111, 812112, and 812113), professional and technical services (NAICS 5417), real estate services (NAICS 5312).	
Recreation, Education, Safety, Public Assembly		
Civic and social organizations	Establishments primarily engaged in promoting social welfare activities such as educational, scientific, cultural and health (NAICS 8132-34).	P
Religious establishments (small)	Establishments engaged in operating religious organizations, such as churches, religious temples and /or establishments primarily engaged in administering an organized religion or promoting religious activities with no schools (except Sunday schools occupying no more than 50 percent of the floor area) as part of the complex and having less than 15,000 square feet of floor area.	P
Religious establishments (large)	Establishments engaged in operating religious organizations, such as churches, religious temples and /or establishments primarily engaged in administering an organized religion or promoting religious activities with or without schools (except Sunday schools occupying no more than 50 percent of the floor area) as part of the complex and having 15,000 or greater square feet of floor area (NAICS 813110).	S
Schools, neighborhood (elementary and middle schools) and community (high schools)	Institutions of learning or instruction primarily catering to minors, whether public or private, which are licensed by either the county or the State of South Carolina. The definition includes nursery schools, kindergarten, elementary schools, middle schools, senior high schools or any special institution of learning under the jurisdiction of the state department of education catering to those age groups. This does not include charm schools, dancing schools, music schools or similar limited schools (NAICS 6111).	S
Infrastructure, Transportation, Communications		
Local utility	Utility substations or transmission and local distribution facilities, including telephone, and all government-owned utilities. Not included are generation facilities, storage of combustibles, regional facilities, and landfills or mining operations. (NAICS 221122, 22121)	S
Temporary Uses		
Construction staging or plant	A concrete or asphalt batch plant, or metal forming and cutting facility assembled on the site or located no more	S

	than one mile from the site where the construction of a particular road, infrastructure or building is to take place. Such facilities shall be removed within one year.	
Contractor's office	Security guard buildings and structures, construction equipment sheds, contractor's trailers and similar uses incidental to a construction project.	P
Model homes sales office	A dwelling unit or modular unit in a subdivision used as a sales office for that subdivision.	P
Traditional Community Plan Uses		
General Retail 3,500 SF or less	Stores and shops that sell and/or rent goods and merchandise to the general public. This category does not include "Open Air Retail," "Vehicle Sales and Rental," or "Gas Stations/Fuel Sales."	TCP
Animal Services: Clinic/Hospital	An establishment used by a veterinarian where animals are treated. This use may include boarding and grooming as accessory uses.	TCP
Lodging: Bed & Breakfast (5 rooms or less)	The use of a single residential structure for commercial lodging purposes, with up to 5 guest rooms used for the purpose of lodging transient guests and in which meals may be prepared for them, provided that no meals may be sold to persons other than such guests, and where the owner resides on the property as his/her principal place of residence.	TCP
Lodging: Inn (up to 24 rooms)	A building or group of buildings used as a commercial lodging establishment having up to 24 guest rooms providing lodging accommodations to the general public. This includes the use of any dwelling unit for lodging accommodations on a daily or weekly rate to the general public.	TCP
Restaurant, Café, Coffee Shop	A retail business selling ready-to-eat food and/or beverages for on- or off-premise consumption. These include eating establishments where customers are served from a walk-up ordering counter for either on- or off-premise consumption ("counter service"); and establishments where customers are served food at their tables for on-premise consumption ("table service"), that may also provide food for take-out, but does not include drive-through services, which are separately defined and regulated. This use includes all mobile kitchens.	TCP
Community Oriented Cultural Facility (less than 15,000 SF)	Public or non-profit facilities that provide educational and cultural experiences for the general public, examples of which include: aquariums, arboretums, art galleries, botanical gardens, libraries, museums,	TCP

	planetariums, civic centers and theaters predominantly used for live performances, and zoos. May also include accessory retail uses such as a gift/book shop, restaurant, etc.	
Single-Family attached	A structure containing one dwelling unit on a single lot and connected along a property line to another dwelling unit on an adjoining lot by a common wall or other integral part of the principal building such as a breezeway or carport.	TCP
Live/Work	An integrated housing unit and working space, occupies by a single household. Commercial activities are limited to those listed in this table.	TCP
Community Residence (dorms, convents, assisted living, temporary shelters)	See definition in Article 8, Table 3.1.70	TCP
"P" indicates a Use that is Permitted By Right. "C" indicates a Use that is Permitted with Conditions. "S" indicates a Use that is Permitted as a Special Use. "TCP" indicates a Use that is permitted only as part of a Traditional Community Plan under the requirements in Division 2.3		

Division A.3 – Lady's Island Expanded Home Business District (LIEHB)

Lady's Island Expanded Home Business District (outlined in red)



BEAUFORT COUNTY RESOLUTION No. 21-____

A RESOLUTION ESTABLISHING THE CRITERIA TO BE USED FOR THE REAPPORTIONMENT OF ALL COUNTY COUNCIL DISTRICTS AS TO POPULATION FOLLOWING THE ADOPTION BY THE STATE OF THE FEDERAL DECENNIAL CENSUS AS REQUIRED BY S.C. CODE ANN. SEC. 4-9-90

WHEREAS, S.C. Code Ann. Sec. 4-9-90 requires that all County Council districts be reapportioned as to population by County Council within a reasonable time prior to the next scheduled general election which follows the adoption by the State of each federal decennial census; and,

WHEREAS, the State has adopted the federal decennial census conducted in 2020; and,

WHEREAS, Beaufort County Council is desirous of establishing the criteria which should be used during the process of reapportionment to ensure that each County Council district be of equal population, or as nearly as practical, to comply with the constitutional principles and requirements of "one person, one vote".

NOW, THEREFORE, BE IT RESOLVED by Beaufort County Council, duly assembled, that the following criteria are hereby established to be used during the process of reapportionment of all County Council districts as required by S.C. Code Ann. Sec. 4-9-90:

1. County Council districts shall be of equal population, or as nearly as practical, to comply and adhere to the Constitutional requirement of one person, one vote.
2. The population variance between County Council districts shall not exceed 5% as required by S.C. Code Ann. Sec. 4-9-90.
3. County Council districts must comply with the Federal Voting Rights Act to ensure that minorities have an equal opportunity to elect representatives of their choice.
4. County Council districts must be contiguous.
5. County Council districts should be drawn to minimize the division of voting precincts, and, when feasible, with respect to existing districts and communities of interest.

6. County Council districts should be geographically compact to the extent practicable, so that nearby areas of population are not bypassed for a more distant population.
7. County Council districts must comply with all other applicable court decisions and federal and state laws.
8. Public input should be solicited throughout the process.

Adopted this _____ day of _________________, 2021.

BEAUFORT COUNTY COUNCIL

____
Joseph Passiment, Jr. Chairman

____
Attest: Sarah Brock, Clerk to Council

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

Consideration of approval of Monday, December 27, 2021, as an additional Christmas Holiday for the Beaufort County Employees.

MEETING NAME AND DATE:

Executive Committee November 1, 2021

PRESENTER INFORMATION:

Eric Greenway, County Administrator

5-10 minutes

ITEM BACKGROUND:

N/A

PROJECT / ITEM NARRATIVE:

County Administration recommends that Council consider approving Monday, December 27, 2021, as a 3rd paid Christmas holiday for the employees.

FISCAL IMPACT:

Any fiscal impact is negligible.

STAFF RECOMMENDATIONS TO COUNCIL:

Staff recommends that Council approve Monday, December 27, 2021, as a 3rd paid Christmas holiday for the employees.

OPTIONS FOR COUNCIL MOTION:

Motion to approve Monday, December 27, 2021, as an additional Christmas Holiday for the Beaufort County Employees.

Motion to deny Monday, December 27, 2021, as an additional Christmas Holiday for the Beaufort County Employees.

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

Resolution to accept Operation Mariposa Grant in the amount of $260,311

MEETING NAME AND DATE:

Executive Committee Meeting

November 1, 2021

PRESENTER INFORMATION:

Steve Donaldson

5-10 minutes

ITEM BACKGROUND:

The department wrote a three-year Prevention Capacity Expansion Grant in August 2021.

PROJECT / ITEM NARRATIVE:

Given the Hispanic population in Beaufort County, and the higher per capita arrest and car crashes within that demographic, the BCADAD wrote a Prevention grant to target the #1, #4, and #5 per capita cities in SC (All in Beaufort) to work within the schools and the community and with police departments to raise awareness of the risks to them, SC Code of Laws, and to the services available through BCADAD.

FISCAL IMPACT:

The grant is 100% funded with no county match for $260,311.

STAFF RECOMMENDATIONS TO COUNCIL:

Approve acceptance of Operation Mariposa Grant.

OPTIONS FOR COUNCIL MOTION:

Motion to approve acceptance of Operation Mariposa Grant or Motion to disapprove the acceptance of Operation Mariposa Grant.

BEAUFORT COUNTY CADAD
ALCOHOL & DRUG ABUSE DEPARTMENT

Application Package for Submission

Beaufort County Alcohol and Drug abuse Department

Primary Prevention Enhancement for County Alcohol and Drug Abuse Authorities

Operation Mariposa

BEAUFORT COUNTY BCADAD ALCOHOL & DRUG ABUSE DEPARTMENT

Steve Donaldson
Beaufort Alcohol and Drug Abuse Director
PO Drawer 1228. Beaufort, SC 29901
sdonaldson@bcgov.net
843-255-6008

August 25, 2021

To: DAODAS

It is the Intent of Beaufort County Alcohol and Drug Abuse Department (BCADAD) to apply and compete for funding made available through the American Rescue Plan Act of 2021 (ARPA) and the Coronavirus Response and Relief Supplement Appropriations Act of 2021 via the Substance Abuse Block Grant COVID (SABG COVID) Supplement. It is the understanding of BCADAD that DAODAS is administering these funds through the U.S. Substance Abuse and Mental Health Services Administration (SAMHSA) under the CFDA number 93.788.

The intent of the department is to positively impact the Hispanic community in Beaufort County by:

- Recruiting and Hiring a Spanish Speaking Preventionist or someone to become In-Process;
- Obtain training in PRI and the South Carolina Code of Laws related to driving under the influence;
- Provide community-based education to Hispanic parishioners at local mission churches;
- Whereupon increasing knowledge of laws, alcohol and drug misuse, and alternatives to drinking and driving;
- Publicize DUI Checkpoints in Spanish to potentially curb driving under the influence;
- Evaluate impact of the intervention.

Should you have any questions or concerns, please contact me. I would be happy to discuss further.

Sincerely,

Steven Donaldson, CS, MAC, LAC, AADC
Executive Director
Beaufort County Alcohol and Drug Abuse Department

Applicant Information Form

	Primary Prevention Enhancement for County Authorities RFP		
1.	**Organization Information**	Organization Name	Beaufort Alcohol and Drug Abuse Department
		Mailing Address	PO Drawer 1228 Beaufort, SC 29901-1228
2.	**Substance Selected & Special Population of Focus**	Substance(s)	Alcohol
		Special Population(s)	Hispanics
3.	**Point of Contact**	Contact Name	Steve Donaldson
		E-mail Address	sdonaldson@bcgov.net
		Phone Number	843-255-6008
4.	**Grant Award Requested**		$260,311

Technical Proposal

1. Statement of Need

Beaufort County is the third in the overall census of Latinos by population in South Carolina, the first by percentage (16.84% or 20,799 people) in the state for Bluffton (16.4%), Port Royal (12.55% or 12,770) with the fourth highest, and Hilton head Island ranks fifth in Hispanic population with 11.8%. According to www.homesnacks.com/most-hispanic-cities-in-south-carolina and the U.S. Census Bureau Quick Facts site confirms this data.

2020 Beaufort County Population		%
Total	187117	100%
Male	91687	49%
Female	95429	51%
White	145951	78.20%
African American	33681	17.90%
American Indian	748	0.40%
Asian	2807	1.50%
Native Hawiian/ Pacific Islander	187	0.01%
2+ Races	3555	1.90%
Hispanic	20770	11.10%
Non-Hispanic	166347	88.90%

Table 1

Evidence suggests that Hispanic and non-Hispanic White men (NHW) have comparable prevalence rates of alcohol use. However, Hispanic men consistently have higher prevalence rates of alcohol misuse compared with NHW men. Consequently, Hispanic men experience disproportionate levels of adverse consequences of alcohol misuse when compared with NHW men, according to Valdez, Carvajal, and Garcia (2019) in Health Education & Behavior (Source: https://pubmed.ncbi.nlm.nih.gov/30755045/) Relatedly, Latinos are disproportionally higher in the incidence of driving under the influence (DUI) related arrest and fatal crashes nationally (42% vs. 29% Hispanic vs. NHW men).

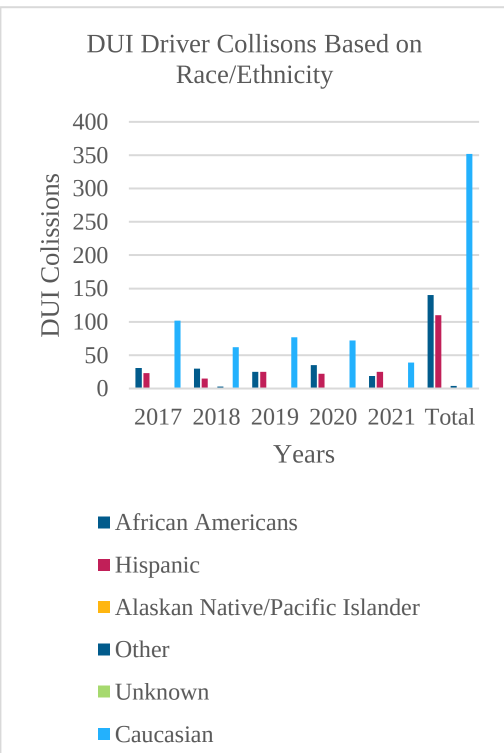


Chart 1

According to Valdez, Carvajal, Ruiz, Oren, and Garcia from the Journal Health Education & Behavior, 2019 Aug;46(4):648-655. doi: 10.1177/1090198119826212. Epub 2019 Feb 12, nearly 21% of Hispanic men report having a DUI. It is speculated some of this is related to a misunderstanding of DUI. In a publication by Sanchez, Romano, Dawson, et al. in 2016, it was reported that drinking and driving among recent Hispanic immigrants was high, and men typically reported drinking seven beers on average with a propensity for still driving, and www.ncbi.nim.nih.gov also points to research that describes the differences in Hispanic drinking pattens that of non-Hispanic whites and the propensity to higher volumes of alcohol. In Beaufort County, 512 Hispanics (37.10% illegal citizen status) were arrested with some type of DUI between 2017 and August 2021, per the demographic analysis of persons booked at the Beaufort County Detention Center. Gender differences found support the literature than a greater frequency of Hispanic men is arrested for DUIs. In Beaufort County, the data analyzed indicates that 74.68% of the DUI arrests among Hispanics between 2019 and 2021 were men. The gender differences could not be easily found in

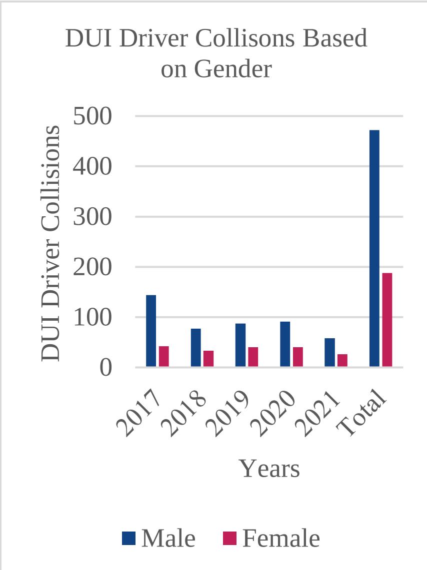


Chart 2

the data sets kept by race type before 2019. However, more men are arrested for DUIs and are involved in DUI crashes. Data from the South Carolina Office of Public Safety indicates that 16.41% of the drivers from Beaufort County contributing to alcohol involved collisions between 2017 and August 2021 were Hispanic with 71% being men (See chart 2). Furthermore, 82% of Hispanics seeking ADSAP services were men. Also, at BCADAD, 445 or 12.73% of the overall admissions to ADSAP were Hispanic with a ratio of nearly 4 to 1 men to women. Those Hispanics attending ADSAP Services at BCADAD and those Hispanics involved in alcohol involved car crashes may or may not be correlated. It's also not clear how many of those of an "illegal" status are involved ian car crashes, but it is clear none of them are accessing services at BCADAD. To that end, there is a segment of our community who drinks and drives. They may not understand the laws related to drinking and driving and may not understand the dangers to drinking and driving until adverse consequences occur.

As such, Beaufort Alcohol and Drug Abuse Department (BCADAD) is compelled to enhance prevention and early intervention services to the Bluffton, Hilton Head, and Port Royal Hispanic Communities, given the high concentration of Hispanics living in those parts of Beaufort. Providing information to high school students in densely populated Hispanics is deemed essential, as well in the communities and neighborhoods where they live, especially given the high percentage of Hispanic men arrested for DUI, receiving services for ADSAP, and for their high incidence for involvement in alcohol-related fatal and non-fatal car crashes.

It seems prudent to work in the schools, given that in parts of Beaufort County, first-generation or children of migrant workers make up a majority of the public schools. Hispanics have become the face of Hilton Head Island, per "The story of 'La Isla': How Hispanic students became the face of Hilton Head" (Island Packet, Aug 26, Lucas Larson, Chiara Eisner), Latino & Hispanic student population grows in Hilton Head SC | Hilton Head Island Packet. The article also indicates that many of these students are first generation or the children of migrant workers with acculturation issues. On Sunday, August 29, 2021 the same demographics in school were reported as Hilton Head Island. Given those circumstances, the BCADAD intends to target 9th through 12th graders with Class Action, which is part of the Project Northland alcohol prevention curriculum series, a multilevel, multiyear program proven to delay the age at which young people begin drinking, reduce alcohol use among those who have already tried drinking, and limit the number of alcohol related problems of young drinkers. To that end, intervene early. However, adults with a lack of clear understanding of SC DUI Laws and to the dangers of alcohol and drug misuse, community outreach is deemed warranted to create safer roads in Beaufort County.

Accompanying the school age intervention, the BCADAD Prevention Department will present the South Carolina Code of Laws related to DUI, and educational materials from the Prime for

Life curriculum in a secular environment in Hispanic neighborhoods, to provide information to assist with preparing families to do culturally appropriate interventions. The thinking behind using Prime for Life came from https://primeforlife.org/sites/default/files/2020 article, which indicates that data from a five state study, including South Carolina, showed positive changes in beliefs and intentions. As such, with the potential that the family and neighborhoods can influence behaviors in the Hispanic communities, providing the PRI curriculum to these groups seems beneficial.

Finally, the BCADAD will widely disseminate information to the Hispanic Community through various media related to various strategies. One strategy relates to creating a wider visibility of Prevention programs available to the Hispanic population by Spanish speaking facilitators. Another relates to advertising community forums where DUI and alcohol prevention, abuse and misuse information is provided, and lastly, publish and broadcast DUI Checkpoint information in Spanish, to deter drinking and driving.

The BCADAD does not have a Spanish speaking Preventionist nor the manpower to commit to the Spanish population at this time, much less the capacity of staff who speak Spanish. During the COVID era, revenues have been reduced, and it is not justifiable to add expenditures through the creation of new positions, especially to a Prevention department that always runs a deficit. However, if the project can boast a lower incidence of DUI arrests and fatalities, measured by crash data and Beaufort County Detention Center arrest data, an argument may be leveraged to have Beaufort County Council to continue to fund a new position after the end of the funding period or else risk widening a visible service gap.

Plan to Implement Selected Strategies:

The strategies to be used are both evidence and non-evidenced base strategies. The BCADAD Blueprint for Healthy Youth Strategy selected is from the SAMSHA Model Program, Project Northland's "Class Action". The selection of participants in Class Action is based upon Hispanic density of a community and a memorandum of agreement with the Beaufort County School District. The curriculum will be taught to fidelity by the bilingual Preventionist in grades 9 through 12 only. At minimum, in selected classes in Port Royal, Bluffton, and Hilton Head where Hispanics are densely populated. The intended benefit is to raise awareness and to influence healthier choices, as it relates to alcohol use. Benefit will be measured by self-report in surveys to be distributed and collected at each session for monthly reporting purposes (during the school year). All data collected will also be imported into the department's continuous quality improvement (CQI) outcome matrix by the Prevention Director and reported to all stakeholders, as well as changes made to enhance service delivery.

Another strategy is for the bilingual Preventionist to be trained in Prime for Life and to learn the South Carolina Code of Laws as they relate to driving under the influence (DUI). That information will be used in the community forums via information dissemination. According to Valdez, Carvajal, and Garcia (2019), its hypostasized that Hispanics do not know the laws related to DUI, and nearly 21% of the men interviewed reported getting a DUI. As such, understanding the laws may be helpful to comply with the law, especially those undocumented. Satisfaction data will also be collected by the bilingual Preventionist at each of these sessions and incorporated into the CQI processes of BCADAD and shared with the churches hosting the events for other dissemination.

Information dissemination is a key component to the project. Advertising in digital television, radio, print ads, and social media in Spanish is intended. Furthermore, law enforcement in densely populated Hispanic areas have committed to providing DUI checkpoint days and times for the BCADAD to publish in Spanish, to reduce the number of DUIs and crashes by Hispanics. Crash and DUI data will be collected, reviewed, and analyzed quarterly for trends. It should be noted that the quasi-experimental design selected requires monthly collection of data. However, the South Carolina Department of Public Safety (SCDPS) indicates data collection at minimum should only be sought quarterly, in view of the lack of data integrity sought monthly. It should also be noted that although a memorandum of agreement was sought, the SCPDS indicated the request may not be approved and probably not within the time sought for application submission. Ross Hatfield indicated to avoid FOIA and fees, obtaining the information from SC-DAODAS is suggested.

Lastly, through relationship building with Hispanic Community partners, the BCADAD can become more visible and a resource to those in need of services beyond ADSAP and part of more prevention coalitions through this endeavor.

Month	**Key Activities November 2021- September 2022**
November	**A.** Develop Protocols & Resource Manual/**B**. Purchase Technology for grant staff./ **C.** Deliverable.
December	A. Hire & Onboard grant staff/ B. Deliverable.
January	A. Seek & Schedule PRI Training./ B. Get "In-Process" with SCAPPA. C. Research SC Code of Laws related to DUI, Review Grant Goals./ D. Deliverable.
February	A. Develop Presentation Materials./ B. Hold Community Stakeholders Meeting (individually or as a group)./ C. Complete PRI Training./ D. Deliverable.
March	A. Attend Prevention Quarterly. B. Attend AET Monthly./C. Schedule Forum Presentations for the rest of the year./D. Print literature in Spanish./ E. Deliverable.
April	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Design and start Quantitative and Qualitative Satisfaction Data./E. deliverable
May	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
June	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
July	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
August	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
September	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F.School Presentations.
Annual Report	This will be shared with stakeholders

Month	**Key Activities October 2022- September 2023**
October	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable. /F. Annual Report./G. School Presentations.
November	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
December	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.

January	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
February	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
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April	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
May	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
June	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
July	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
August	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable/ F. School Presentations.
September	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
Annual Report	This will be shared with stakeholders

Month	**Key Activities October 2023- September 2024**
October	A. Forum Presentation. /B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable. /F. Annual Report./G. School Presentations.
November	A. Forum Presentation. /B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
December	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
January	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
February	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
March	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
April	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
May	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable./F. School Presentations.
June	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
July	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
August	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
September	A. Forum Presentation./B. AET Meeting./C. Aggregate Monthly Crash Data./D. Quantitative and Qualitative Satisfaction Data./E. Deliverable.
Annual Report:	This will be shared with all stakeholders.

It is worth noting that through the data collection, it has become increasingly clear that the Cultural Diversity Plan of the department needs to change from “contracting with interpreters” to hiring staff who are bilingual, and provide existing staff with the resources needed to learn to understand and speak Spanish. Not to do so will lead to widening service gaps in the future.

Potential Barriers:

There are many potential barriers. To start, recruiting a bilingual Preventionist or a qualified person to be certified as a Preventionist may be difficult. The Behavioral Health Services Association (BHSA), Executive Director, Laura Aldinger sent out a recent salary study conducted on 29 of the public alcohol and drug agencies in South Carolina. As of August 1, 2021, there are 105 vacancies. Similarly, the Coronavirus era experience has demonstrated that filling vacant positions is difficult. Therefore, recruitment may be challenging. However, BCADAD plans to utilize grant partners to help disseminate the word into the Hispanic Community as part of BCADAD's recruitment efforts.

A secondary anticipated barrier relates to trust. PASOs and other community outreach organizations indicate that developing trust will be key to having participation in the community forums. As evidence by the high number of DUIs by undocumented Hispanics, community partners with established trust will be key to having a wide turnout. The BCADAD is relying on advertisements in and by trusted and utilized media sources by the Hispanic population in Beaufort County.

Sustainability:

The BCADAD intends to treat this project as a demonstration project. If there is documented and sustained improvement that can be captured through data collection, the data will be used in future grants and or request for continued funding in the BCADAD County Plan, through Beaufort County Council, or participating churches.

Attachment 1 – SMART Goals and Objectives

Goals:

Goal #1: Decrease youth substance use in the community by implementing evidence-based programs within the school district that address behaviors that may lead to the initiation of use.

Objectives:

a. The BCADAD Prevention Department will purchase the Class Action curriculum and review all lessons by July 2022.
b. By the start of August, 2022m the Prevention Department will have at least one school scheduled in Port Royal, Bluffton, and Hilton Head Island with students ranging from grades 9 through 12 scheduled to participate in the Class Action curriculum.
c. By the end of the 2022-2023 school year, district BCADAD's Prevention Department will have conducted at least classes on the dangers underage drinking in youth in grades 9 through 12 in densely populated Hispanic areas receiving the Class Action curriculum (2 school years).

Goal #2: Increase the knowledge of Hispanic Communities of South Carolina Driving Under the Influence Laws and Healthy Choices that may lead to socially and culturally appropriate family interventions and education.

Objectives:

a. The BCADAD Bilingual Staff will be trained in Prime for Life by March 2022 and select meaningful materials for dissemination at monthly community forums to start in April 2022.
b. The BCADAD Bilingual Prevention Staff will review and learn the South Carolina Laws and translate those laws into culturally meaningful language for dissemination by the end of March 2022.
c. The BCADAD Bilingual Prevention Staff will provide at least one presentation on Prime for Life and South Carolina Code of DUI Laws to Hispanic attendees in Port Royal, Bluffton, or Hilton Head by the end of each month, starting in April 2022 through September 2023.

Goal #3: Through Community presentations and information to the Hispanic Community, including broadcasting DUI checkpoint information, Hispanic drivers will make healthier choices and reduce their risk for DUIs and Alcohol related crashes.

Objectives:

a. * The BCADAD will broadcast DUI Checkpoint information in Spanish within 72 hours of teach event in the Bluffton, and Port Royal communities, starting in January 2022 until September 2023.
b. The BCADAD will obtain DUI arrest and crash data quarterly, starting in April 2022 and track the changing values until Sept 2023 as part of a Quasi-Experimental design study.
c. By self-report, attendees at Community Forums and in schools will complete targeted surveys after each presentation to obtain both qualitative and quantitative data to guide program delivery and quality to ensure benefit.

*Hilton Head Island does not have their own police. The county sheriff polices the island. Per Captain Robert Bromage, The Beaufort County Sheriff's Department does not do DUI or Safety Checkpoints on Hilton Head. The department will urge the 14^{th} Curcuit AET Team to lobby for such activites.

Qualifications and Experience

Capacity and Competencies

Organizational Structure and Staffing Plan:
The BCADAD is a department of Beaufort County Government. There are two service locations serving the citizens of Beaufort County. One location is South of the Broad River in Bluffton and the other is North of the Broad in Beaufort. The department provides Prevention, Intervention, Treatment, and Recovery services in both locations, virtually, and or in the community.
The department's Prevention Department has a director, Wade Bishop, and two prevention staff. One preventionist is in each service location. This department will serve as the teammates of a new full-time bilingual employee who is eligible for Prevention certification. This staff will be supervised by Wade Bishop (see below for resume) who is a senior certified preventionist through IC&RC. Wade would be the supervisor for this initiative and grant personnel.
The grant funded Preventionist would work primarily out of the Bluffton service location, given the density of Hispanic speaking citizens South of the Broad River. However, traveling North of the Broad River will be required to provide services in the Port Royal community.

Key Personnel:

Steven Donaldson, M.Ed. LAC, CS, MAC, AADC
Steven Donaldson is the Executive Director of The Beaufort County Alcohol and Drug Abuse Department, designated as the local authority on alcohol and drug abuse services. Mr. Donaldson has over thirty years' experience in the alcohol and other drug and mental health services field. He has worked and supervised in the areas of intervention and treatment both on an Inpatient and an Outpatient basis and maintains a working knowledge of all programs and services from Prevention to Recovery. Steve is responsible for approving and monitoring budgetary expenditures, planning comprehensive annual strategic plans and goals, determining program priorities, and revising and updating policies and procedures through planning, establishing, and administering business functions. He ensures the department meets the standards for the international accreditation process with The Center of Accreditation for Rehabilitative Facilities (CARF). Mr. Donaldson received his bachelor's degree in Political Science, Master of Education degree and Alcohol and Drug Studies degree from the University of South Carolina. He is also a CARF Surveyor and served as the chair and a member of the Addiction Professionals of South Carolina (APSC- formerly known as SCAADAC) and assisted in the transition from NAADAC to IC&RC in South Carolina and bringing a Peer Recovery Support Services credential under the umbrella of APSC.

Wade E. Bishop, CSPS
Wade Bishop is the Director of Prevention Services and Supervisor of Peer Support Services at Beaufort County Alcohol and Drug Abuse Department, designated as the local authority on alcohol and drug abuse services. Mr. Bishop has over thirty-five years of experience in the alcohol and other drug abuse services field. He has worked and supervised in the areas of prevention, intervention and treatment and maintains a working knowledge of all programs and services. Mr. Bishop is responsible for planning comprehensive annual strategic plans and goals, focusing on prevention service within the department. He ensures the agency meets the standards for the international accreditation process with The Center of Accreditation for

Rehabilitative Facilities (CARF), specific to Health and Safety and Prevention Program standards. Mr. Bishop received his bachelor's degree in Individual and Family Studies from The Pennsylvania State University. He is a certified Senior Prevention Specialist and has held certification as a CACI, School Intervention Program (ScIP) group facilitator and Alcohol Drug Safety Action Program (ADSAP) Level 1 group facilitator, during his employment with Beaufort County Alcohol and Drug Abuse Department (BCADAD). Mr. Bishop currently serves on the South Carolina Association of Prevention Professionals and Advocates (SCAPPA) Certification Commission and has served on the Peer Review Committee of over 25 years (serving as the chairman for over 20 years). He also serves as a member of the SCAPPA Professional Development Committee.

The Bilingual Preventionist to be hired to work on this project must have the following qualifications:

- Bachelor's degree in a human service degree field from an accredited institution.
- Bilingual in Spanish and English, ideally of Hispanic descent.
- A Valid South Carolina Driver's License.
- Eligible to work in the United States.
- Prevention certified by IC&RC, SCAPPA, or must have the ability to become SCAPPA certified.

The BCADAD has been in operation for 47 years. Although Prevention has not worked primarily with a Hispanic Speaking population, the department has been contracting with Spanish speaking personnel for many years, given the change to the demographics in the Beaufort Community. To that end, literature of the department and the agency newsletter are in Spanish. There have been other enhancements through the direction of the BCADAD Cultural Diversity Plan. Incrementally, progress is being made with diversity and inclusivity.

The department will be working with several churches in Port Royal, Bluffton, and Hilton Head, the Beaufort County School Department (See MOAs) to provide evidence-based curriculum and other information, as well as the South Carolina Department of Public Safety for data collection.

Organizational Experience:

The BCADAD has had collaborations with the school system, but no formal relationships with the community churches. The BCADAD collaborates with the schools to provide ScIP and the Bridge Program, in addition to serving on many committees and coalitions in Beaufort for several years.

St Gregory the Great in Bluffton has been a constant source of support to BCADAD. The Spanish Outreach Coordinator has routinely advertised BCADAD personnel vacancies, in the department's effort to diversify staff. Nevertheless, the department is no stranger to collaborations. The BCADAD Prevention division is involved in several coalitions. For example, Low County Alliance for Healthy Youth (LACHY), a local Opioid Consortium, the Human Services Alliance of the Low county, Collaborative of Organization of Services for Youth (COSY), Collaborative of Service for Adults (CODA) and Citizens Opposed to Domestic Abuse (CODA), and Together for Beaufort County.

Training:

The Class Action manualized curriculum to be used in the schools does not require training. Following the guidance in the manual without deviation is the methodology to maintain fidelity to the program. However, the BCADAD will seek a Trainer of Trainers training from Hazelden on the entire Northland curriculum to benefit other community providers, including teachers.
It should be noted that the regions lead on the Alcohol Enforcement Team and senior preventionist from Jasper County has offered to be a resource for using the Class Action curriculum, in view of her experience and use of it. To that end, relationships exist through coalition involvement to ensure fidelity to evidence-based curriculums.

Additionally, staff for this project will be trained in the Prime for Life curriculum by the PRI Institute, since it is proprietary. Becoming PRI certified will be a requirement before using the educational materials at any church forums. Learning the DUI Code if Laws in South Carolina will not require training.

Privileging will be conducted to ensure the bilingual Preventionist is prepared to provide community services. The to be hired Preventionist will provide all services under Supervision until demonstrating the ability to provide those services independently and or certified by both SCAPPA, The PRI Institute, and has gone through the Hazeldon training on Class Action.

Partnerships:

Organization	Contact	Contact Info	Location	Signed MOU
Port Royal Police Department	Chief Alan Beach	abeach@portroyal.org	Port Royal	*Not unless awarded
Pasos	Yajaira Benet-Uzcategui	(843) 379-7837	Beaufort County	*Not unless awarded
Saint Gregory the Great Catholic Church	Nora Araujo	Naraujo@sgg.cc	Bluffton	*Not unless awarded
AET	Nicole Smith	nsmith@nlcbhsa.org	Jasper County	*Not unless awarded
Beaufort County School District	Lakinsha R. Swinton	lakinsha.swinton@beaufort.k12.sc.us	Beaufort County	*Not unless awarded
South Carolina Department	Ross Hatfield	RossHartfield@scdps.gov	Richland County, SC	*Not unless awarded

of Public Safety				
Bluffton Police Department	Chief Stephanie Price	sprice@townofbluffton.com 843-706-4550	Bluffton	*Not unless awarded
Saint Peters Catholic Church	Father Andrew	(843) 522-9555	Lady's Island	*Not unless awarded

Informal arrangements with the Beaufort County Sheriff's Department who polices Hilton Head Island for DUI Checkpoint Studies have been discussed. Currently, the South Carolina State Highway Patrol is the only law enforcement entity doing any sort of safety checkpoints on the island. Customarily those checkpoints have related to saturation checkpoints and not DUI checkpoints. Therefore, more discussions in the community will need to occur to encourage DUI checkpoints before data the BCADAD can alert any such event.

* Committing through an MOA without first having the resources to keep to any commitment was not done. Drafts of all MOAs are attached to be fully executed, if awarded, are attached.

Attachment 2 –Evaluation Plan

The BCADAD is planning to collect in report on data in a couple of ways.
First, the department plans to use the pre-grant data on crashes and DUIs and alcohol related crashes in Beaufort County as a baseline and track both of those data points quarterly to measure change, starting after the first quarter of community interventions.

Grant Year 1	Oct1-Dec 31, 2021	Jan 1-Mar 31, 2022	Apr 1-June 30, 2022	July 1-Sept 30, 2022	Data source	Responsible Staff	Analysis Method (% of change per quarterly)
Reduce Hispanics Arrested for DUI by 10% each quarter.					Beaufort County Detention Center	To be Hired Preventionist	q.1 q.2 q.3 q.4
Hispanics involved in alcohol related crashes					South Carolina Department of Public Safety	To be Hired Preventionist	q.1 q.2 q.3 q.4
Hispanics attending ADSAP Services at BCADAD					Carelogic Reports	Quality Assurance Director	q.1 q.2 q.3 q.4

Repeat for Grant Year 2 & 3

Secondly, a survey for students and for adults will be developed to assess benefit and satisfaction with materials presented and aggregated for report and quality improvement purposes. Data will be collected in English and Spanish for both qualitative and quantitative information. The goal will be for 90% satisfaction and to establish benefit.

Finally, each quarter a report will be created to look at the values of arrests, crashes, and satisfaction. This data will be shared with all stakeholders. Other data reporting required by the grant body will occur monthly.

Attachment 3- Community Survey

Survey Questions for Students:

On a scale of 1-10 (one not good, and 10 the best), please circle number that best meets your satisfaction of learning needs:

School: ______________________________ Grade: _____ Gender: _____ Race: ___________

1. The information presented was helpful to my learning about the dangers to alcohol and drugs:
   1 2 3 4 5 6 7 8 9 10
2. What is the most important thing you got out of today's class:

____

____

____

Survey Questions for Community Forums:

On a scale of 1-10 (one not good, and 10 the best), please circle number that best meets your satisfaction of learning needs:

Gender: _____ Race: ___________

1. The information presented was helpful to my learning about the dangers to alcohol and drugs:
   1 2 3 4 5 6 7 8 9 10
2. What is the most important thing you got out of today's class:

____

____

____

3. What other things related to DUI Laws or Alcohol and Drug Issues do you need to learn more about?

Information from both the satisfaction and data collection from the Beaufort County Detention Center and the South Carolina Office of Public Safety will be forward to the CQI for outcome matrix entry no later than the 23rd day of the new month following a quarters end. The Preventionist will also aggregate data and share in their grant report as part of their deliverable reporting (quarterly, in this case). An annual report will also be prepared, and an overarching report to compare data values related to DUI arrests and alcohol related crashes among Hispanics. Throughout the project the data input into the CQI outcome matrix will be monitored and utilized for continued funding opportunities for program sustainability.

Attachment 4
BCADAD Budget/Budget Narrative

A total of **$260,311**is requested by the Beaufort County Alcohol and Drug Abuse Department.

Personnel:

	Year1	**Year 2**	**Year 3**	**Total**
# Personnel = 1 To be hired	Effort =100%	Effort =100%	Effort =100%	**100%**
Salary	47,694	47,694	49,124	**144,512**
Cola	0	1,430	1,474	**2,904**
Fringe (32.5%)	15,501	15,963	16,444	**51,890**
Total Personnel	63,195	64,817	67,042	**$195,054**

Justification:

Preventionist (Bilingual) $47,694k +32.5% fringe (Identified with the project and not claimed as Indirect Cost)

This position is the sole personnel for the project. The proposed salary is the department minimum, plus the identified fringe rate of 32.5%, based upon Beaufort County Human Resource department allocations. It should be noted that personnel cost is the higher expense, and those rates are established by Beaufort County Government. An entry level salary is all that is going to be offered, despite the value in recruiting a bilingual staff that is key for this project. The salary typically gets a 3% Cost of Living is allocated by the Beaufort County Council Annually. As such, the grant personnel will be budgeted for such an increase.

This person will be working primarily with a Hispanic audience by doing services within the Beaufort County School District in cities with a high density of Hispanics living. Similarly, adult audiences will be targeted to do community forums by presenting information related to SC DUI Laws, information from the Prime for Life curriculum, and serving as a resource for other needed alcohol and drug information. The person would also work with local law enforcement and Hispanic media sources by providing DUI Checkpoint information. Further, this person will be coordinating information gathering from law enforcement and the South Carolina Office of Public Safety and then disseminating it to digital television, radio, print ads, and reports, as appropriate. All grant deliverables will be the responsibility of this position.

Operating Costs:

Training and Travel:

Hazeldon Class Action Training	495	0	0	**495**
PRI Training	0	0	0	**0**
Hotel and Per Diem for PRI	484	0	0	**484**
SCAPPA/Prevention Training Bucket	500	500	500	**1,500**
Conference and Community Forum, and Health Fair Display Materials in	1,750	500	500	**2,750**

Spanish, and vender fees				
Other Destination Mileage (Local travel @.56)	4,480	6,720	6,720	**17,920**
Total Training and Travel Expenses:	7,709	7,720	7,720	**$23,149**

Justification:
Training and Travel- The cost of the training is largest in year one when the new Preventionist. Fees for PRI Institute, Hazeldon, and SCAPPA In-process fees, hotel, per diems, and milage are budgeted. In years two and three, the bilingual Preventionist will be allocated a training budget of $500, which includes any hotel, mileage, or per diem (County rates, per established policy), in view of the lost cost and ongoing trainings offered through both SC DAODAS, the region, and BHSA.
Conference and Community Forum, and Health Fair expenses are budgeted Spanish table linen, a highboy signage display through DisplaystoGo are priced just below $1,000 plus taxes. Pens with the agency logo written in Spanish for $250, and a $500 vender fee for an annual Latin Festival are budgeted in year one. Years two and three will use the same items used at health fairs, community forums, and the Latin Festival. The only anticipated additional expenses for years two and three are for vender fees. Other opportunities to display at health fairs are usually free. Therefore, once the foundation for displays and set-up spend in year one is paid, other than the Latin Festival, no other expenses will be budgeted.
Other Destination Mileage – The Preventionist working in Beaufort will be traveling from Bluffton to Port Royal and Hilton Head on a regular basis. Year one has been prorated to 8 months, in view of the time it will take to recruit, train, and be ready for traveling to provide interventions. Both years two and three are budgeted at a full year @.56 cents per mile, which is the 2021 IRS rate https://www.gsa.gov/portal/category/26429 @1,000 miles per month or 250 miles per week. This seems reasonable, given the 871 square mile radius of Beaufort County.

The expenses for training seem justifiable, in view of the intention to provide evidence-based curriculums in schools. To keep the cost low, the 14th Circuit AET Director is providing no cost consolation on the "Class Action" curriculum, and the BCADAD will have ADSAP staff monitor and provide feedback when presenting PRI information and the SC DUI Code of Laws at community forums. Other Prevention supervision will be provided by Wade Bishop. No supervision fees are budgeted.

Supplies and Materials:

Supplies and Materials				
Office Supplies				
Computer	780	0	0	**780**
Computer Bag	50	0	0	**50**
Business Cards	185	0	0	**185**
Hand Sanitizer	72	72	0	**144**
Brochures and Flyers	250	250	250	**750**

Pens, paper, staples, stickems	296	75	75	**225**
Total Supplies and Materials:	1,633	397	325	**$2,355**

Justification:
Supplies and Materials- Startup cost for a computer, Surface Pro, at county rate ($780), computer bag ($50) given employees ability to carry computer while working in the community. The office supplies, such as paper, pens, Post-Its ($296/75 are needed to take notes, for organization, and to use during presentations. Anticipated expenses:

- Year one:

Office supplies from ULINE for startup:
S-21131 Memo 5 x 8" x 12 per pack x $13
S-21132 Letter 8 1/2 x 11 3/4" 12 per pack x $16
Stapler: H-2029 $21
Desk Top Staples: S-14138 $3
Pens S-21758 BIC® Gel-ocity™ Fine @ $1.40 $17
S-19661 3M Post-It® Pad 25 x 30" 30 2 $63 (For presentations)
S-17272 Desk Post-Its $150
H-255 Sharpie® King Size $2.10 x6 $13
$296

- Hand sanitizer will be purchased in bulk during year one and two @ 12 pack of 8-ounce hand sanitizer $35.83 x 2 cases= $71.66. If more is needed in year three, slippage from this line item will be used if necessary. The sanitizer will aid in the safety of staff working with the public at all community forum events.
- Year two/ Year three- Only necessary replenishment. The grant will not be charged for printer or toner allocations. Office supplies are only having $75 allocated for years two and three, given replenishment cost is deemed less and some leftover supplies are anticipated.
- The department also is providing low-cost business cards to the bilingual Preventionist, which is deemed essential when making connections to the Hispanic community. Five hundred cards will cost $185.
- Brochures and Flyers are estimated, given the departments history of using both Staples and Broad Street printing. Brochures and flyers will also be developed, printed, and distributed to alert Hispanic citizens about scheduled community forums and BCADAD. These materials will be distributed on community partner community information boards and for dissemination at health fairs, and like venues.

Technology Services:

Technology Services				
Relias	50	50	50	**50**
Total Technology Services:	50	50	50	**$150**

Justification: Technology Services- All personnel must have a Relias training account. This is for onboarding and accreditation, beyond the learning experience.

Contractual Services:

Contractual Services:				
TV, Radio, and Print Ads	6,133 (&8 months)	9,200	9,200	**24,533**
Palmetto Breeze Bus Advertising @ set up fee $250 + $25 per month on inside of bus 7% sales tax, x3 buses=	749	963	963	**2,675**
Contractual Services Total:	6,882	10,163	10,163	**$27,208**

Justification:

Advertising- Advertising is deemed critical. The department intends to run ads in Vaqueva Magazine, do radio spots, and place ads on Spanish social networks and digital television on Monday, Wednesday, and Friday. This service will also assist the project by pushing out alerts to planned DUI checkpoints. The owner, Alberto Ortega has quoted BCADAD cost at 50%, in view of the plans for making a multi-year commitment and to do a public service. Year one has been prorated to eight months.

The BCADAD plans to place the Preventionist business card in a “Michelangelo” format inside of the Palmetto Breeze buses on three routes in the more densely populated Hispanic areas. The captions on the advertising have not been developed. However, they will be alerting citizens to learn more about community forums that will alert them to the SC DUI Code of Laws and to more information about alcohol and drug misuse.

Administrative Costs:

Total Administrative Costs (5%)	3,949	4,154	4,265	**$12,368**

Justification:

Administrative Cost-A 5% Administrative fee will be included for operations activities related to the additional position for administrative support, payroll processing, fees for physicals and TB test, and time to develop and upload deliverable reports.

GRAND TOTAL	Year 1	Year 2	Year 3	**$Totals**
Total Personnel	63,195	64,817	67,042	**$195,054**
Total Operating Expenses	16,274	18,330	18,258	**$52,558**
Subtotal	79,469	83,147	85,300	**$247,916**
Administrative Fee	3,973	4,157	4,265	**$12,395**
Grand Total	**83,442**	**87,304**	**89,565**	**$260,311**

Attachment 5 – Health Disparities Impact Statement

The BCADAD will work with DAODAS to refine and submit a Health Disparity Impact Statement (HDIS) within the first six months of the sub-award, which will be a data-driven quality-improvement effort to ensure underserved subpopulations are addressed in the grant. The HDIS will consists of three components:
(1) identify the number of Hispanics individuals to be served during the grant period and identify subpopulation.
(2) implement a quality-improvement plan to address subpopulation differences based on the data on access, use, and outcomes of service activities.
(3) and identification of methods in the development of the BCADAD's Cultural Diversity Plan to ensure adherence to the National Standards for Culturally and Linguistically Appropriate Services in Health and Health Care.

RESOLUTION 2021/_____

A RESOLUTION AUTHORIZING THE COUNTY ADMINISTRATOR TO ACCEPT A GRANT OFFERED BY THE UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES, DEPARTMENT OF ALCOHOL AND OTHER DRUG ABUSE SERVICES

Whereas, there has been made available certain grant funds to be administered by the Department of Alcohol and Other Drug Abuse Services, to be awarded to Beaufort County Alcohol and Drug Abuse Department; and

Whereas, Beaufort County has submitted to the Department of Alcohol and Other Drug Abuse Services and the Department of Alcohol and Other Drug Abuse Services has awarded Beaufort County, the following:

1. Operation Mariposa Grant CFDA number 93.788 in the amount of $260,311

NOW THEREFORE, IT IS HEREBY RESOLVED, at a duly called meeting of Beaufort County Council, that the County Administrator is hereby provided the authority necessary to execute the aforementioned grant from the Untied States Department of Health and Human Services.

Adopted this _____ day of __________________, 2021

COUNTY COUNCIL OF BEAUFORT COUNTY

____

Joseph Passiment, Chairman

Clerk to Council

____

Sarah Brock

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

Rural Opioid Implementation RFP- 2022

MEETING NAME AND DATE:

Community Services Committee

November 1, 2021

PRESENTER INFORMATION:

Steve Donaldson, Director of the Alcohol and Drug Abuse Department

10 minutes.

ITEM BACKGROUND:

Grant is completely written from the last funding cycle, although was not accepted for submission due to a clerical error. Therefore, the plan is simply to change a few dates and budget items and resubmit.

PROJECT / ITEM NARRATIVE:

Increase local capacity & Infrastructure necessary to reduce opiate misuse

FISCAL IMPACT:

No matching fees or financial outlay by Beaufort County. This grant would pay 5% towards the director's salary and enhance revenue streams.

STAFF RECOMMENDATIONS TO COUNCIL:

Approve the Alcohol and Drug Department in applying for the Rural Opioid Implementation.

OPTIONS FOR COUNCIL MOTION:

Motion to approve submittal of grant application for Rural Opioid Implementation RFP- 2022 or motion to disapprove submittal of grant application for Rural Opioid Implementation RFP – 2022.

BUDGET JUSTIFICATION

LINE ITEM	JUSTIFICATION	YEAR 1	YEAR 2	YEAR 3	TOTAL
PERSONNEL					
Director	5% of Director salary for ultimate oversight, county reporting, Project Director supervision, and contract developments and oversight.	$4,400	$4,400	$4,400	$13,200
Project Director	One full time oversee all aspects of project implementation and operation of the project including scheduling, staff hiring, supervision, consultant management, execution of deliverables, coordination of all program elements, budgeting, and reporting.	$63,500	$63,500	$63,500	$190,500
Clinical Social Worker	One full time clinical social worker to project clinical supports, case management, and patient monitoring.	$43,500	$58,000	$58,000	$159,500
Peer Recovery Support Specialist	One Full time individual to manage peer recover support services, and insurance enrollment as outlined in proposal narrative. To be hired Q2 of Y1.	$25,500	$34,000	$34,000	$93,500
	TOTAL PERSONNEL:	**$136,900**	**$159,900**	**$159,900**	**$456,700**
FRINGE	Includes: FICA – 6.20%, health insurance (full time positions only) 10.56%, state retirement 15.56% provided as mandated by board policy, Employer Tort Liability .013 or 32.33% **TOTAL FRINGE:**	**$45,359**	**$51,405**	**$51,405**	**$148,169**
TRAVEL **Travel to required meetings.**	Two staff to travel to Washington D.C annually plus attend regional Meetings plus Regional meetings (location unknown). Travel and per diem annually for these purposes is $3,000.	$4,125	$4,125	$4,125	$12,375
Local mileage reimbursement	Estimated 501 miles @57.5 cents per mile.	$288	$288	$288	$864
	TOTAL TRAVEL:	**$4,413**	**$4,413**	**$4,413**	**$13,239**

LINE ITEM	JUSTIFICATION	YEAR 1	YEAR 2	YEAR 3	TOTAL
SUPPLIES					
Advertising & Printing	Three Palmetto Breeze buses in target zip codes @$250/$25 per month; Art Set-up fee, 7% sales tax, $8,961; Rack cards for hospitals, the FQHC, United Way, pharmacies, and consortium members. Set-up & card stock approx.. $1,000 annually	$9,961	$9,961	$9,961	$29,883
Environmental Prevention Supplies	InfoUSA phone data $1,000/yr x 3 years ($3,000), Robo Calls $150 x 3 per year x 3 years ($1,350) & RX drug drop boxes 5 @ $120/box ($600)	$1,650	$1,650	$1,650	$4,950
Narcan	62 doses @ 2 for $50 per state contract x 3 years	$1,550	$1,550	$1,550	$4,650
Phone	Cell phone purchase for new staff. Agency procurement rate.	$800	$0	$0	$800
Computer	Surface Pros for new project staff will cost $800 each or @3,200.	$3,200	$0	$0	$3,200
Ballistic Jackets	Ballistic Jacket @ $800x5 or $4,000 is for consortium members assigned to do post overdose follow-up, as recommended by the fire rescue and emergency medicine consortium members.	$4,000	$0	$0	$4,000
Office Equipment & Supplies	Office supplies and minor office equipment will include a computer bag, pencils, pens, paperclips, staplers, scratch pads, legal pads, and file folders, and associate labels for record-keeping. Costs are estimated to be higher in year one and titrate down after that. Year one budget is $250/$750 or $1,000.	$1,000	$1,000	$1,000	$3,000
	TOTAL SUPPLIES:	**$22,161**	**$14,161**	**$14,161**	**$50,483**

BEAUFORT COUNTY CADAD ALCOHOL & DRUG ABUSE DEPARTMENT

Voice–Vision-Leadership

LINE ITEM	JUSTIFICATION	YEAR 1	YEAR 2	YEAR 3	TOTAL
CONTRACTUAL					
APRN	Subcontract staffing for provision of MAT expansion and treatment services in county detention facility.	$55,120	$55,120	$55,120	$165,360
CLINICAL SUPERVISOR	Subcontract staffing for clinical supervision of expanded caseloads and staffing.	$20,000	$20,000	$20,000	$60,000
EVALUATION SUPPORT	Project evaluation support to monitor process and outcome objectives, data dashboard, assist with Continual Quality Improvement Monitoring and reporting. $4,000 per quarter, incudes travel	$12,000	$12,000	$12,000	$36,000
FAVOR TRAINING	Lowcountry FAVOR training tailored for law enforcement, hospital personnel, emergency medicine, and the community. The fees include speaker fees (preparation and training time), mileage, and printed materials @$6,532 annually.	$6,532	$6,532	$6,532	$19,596
	TOTAL CONTRACTUAL:	**$93,652**	**$93,652**	**$93,652**	**$280,956**
OTHER					
Phone/Internet	$64 per phone for new project staff @30 months. $1,920 plus $269 taxes or $2,189 for year 1 and @ 36 months in year 2 and 3 or $2,304 plus taxes $323	$2,189	$2,627	$2,627	$7,443
Insurance	Malpractice protection for project staff	$2,475	$2,475	$2,475	$7,425
County Fees	Facility Maintenance allocation= $2,166; phone, x4= $400; Carelogic x5= $ 2,660; Relias LMS x5= $750; Fleet PM = $775 Vehicle Insurance $833; Professional Liability $2,286; Fuels & Lubricants $ 950; Onboarding physicals /TB $1,375 ($275 per personx5); Agency License/Membership $150	$12,345	$11,245	$11,245	$34,835
		$17,009	**$16,347**	**$16,347**	**$49,703**
	GRAND TOTAL:	**$319,494**	**$339,878**	**$339,878**	**$999,250**

Item 2.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

HRSA

Health Resources & Services Administration

Federal Office of Rural Health Policy
Rural Strategic Initiatives Division

Rural Communities Opioid Response Program-Implementation

Funding Opportunity Number: HRSA-22-057
Funding Opportunity Types: New and Competing Continuation
Assistance Listings (CFDA) Number: 93.912

NOTICE OF FUNDING OPPORTUNITY

Fiscal Year 2022

Application Due Date: January 13, 2022

Ensure your SAM.gov and Grants.gov registrations and passwords are current immediately!
HRSA will not approve deadline extensions for lack of registration.
Registration in all systems, including SAM.gov and Grants.gov,
may take up to 1 month to complete.

Issuance Date: October 15, 2021

Sabrina Hope Frost
Public Health Analyst, Federal Office of Rural Health Policy
Telephone: (301) 945-5131
Email: ruralopioidresponse@hrsa.gov for program-specific questions

Please contact the Grants Management Specialist on page 38 of the NOFO for budget-related questions (e.g., allowable costs, SF-424 A form, etc.).

Authority: 42 U.S.C. 912(b)(5) (§ 711(b)(5) of the Social Security Act)

508 COMPLIANCE DISCLAIMER

Note: Persons using assistive technology may not be able to fully access information in this file. For assistance, please email or call one of the HRSA staff listed in Section VII. Agency Contacts.

EXECUTIVE SUMMARY

The Health Resources and Services Administration (HRSA) is accepting applications for fiscal year (FY) 2022 Rural Communities Opioid Response Program-Implementation (RCORP-Implementation). RCORP is a multi-year initiative by HRSA aimed at reducing the morbidity and mortality of substance use disorder (SUD), including opioid use disorder (OUD), in high-risk rural communities. This funding opportunity, RCORP-Implementation, will advance RCORP's overall goal by strengthening and expanding SUD/OUD prevention, treatment, and recovery services to enhance rural residents' ability to access treatment and move towards recovery.

Funding Opportunity Title:	Rural Communities Opioid Response Program-Implementation
Funding Opportunity Number:	HRSA-22-057
Due Date for Applications:	January 13, 2022
Anticipated Total Annual Available FY 2022 Funding:	Approximately $50,000,000, subject to the availability of appropriated funds.
Estimated Number and Type of Awards:	Approximately 50 grants
Estimated Award Amount:	Up to $1,000,000 for the three-year period of performance. Award recipients will receive the full award amount in the first year of the period of performance and are required to allocate it across all three years.
Cost Sharing/Match Required:	No
Period of Performance:	September 1, 2022 through August 31, 2025 (3 years)
Eligible Applicants:	All domestic public and private entities, nonprofit and for-profit, are eligible to apply. Domestic faith-based and community-based organizations, tribes, and tribal organizations and organizations based in the territories and freely associated states are also eligible to apply. See Section III.1 of this notice of funding opportunity (NOFO) for complete eligibility information.

Application Guide

You (the applicant organization/agency) are responsible for reading and complying with the instructions included in HRSA's *SF-424 Application Guide,* available online at http://www.hrsa.gov/grants/apply/applicationguide/sf424guide.pdf, except where instructed in this NOFO to do otherwise.

HRSA has scheduled the following technical assistance:

Webinar

Day and Date: Wednesday, November 10, 2021
Time: 12:30 – 2:00 p.m. ET
Call-In Number: 1-833-568-8864
Meeting ID: 160 852 4742
Passcode: 23233962
Weblink: https://hrsa-gov.zoomgov.com/j/1608524742?pwd=UFJvcGs5bHFiYXRkcGRleFd6REpnZz09

The webinar will be recorded. Please email ruralopioidresponse@hrsa.gov for a link to the recording.

Table of Contents

I. Program Funding Opportunity Description

1. Purpose

The Rural Communities Opioid Response Program (RCORP) is a multi-year initiative by the Health Resources and Services Administration (HRSA) aimed at reducing the morbidity and mortality of substance use disorder (SUD), including opioid use disorder (OUD), in high risk rural communities. This notice announces the opportunity to apply for funding under RCORP-Implementation. This funding opportunity, RCORP-Implementation, will advance RCORP's overall goal by strengthening and expanding SUD/OUD prevention, treatment, and recovery services to enhance rural residents' ability to access treatment and move towards recovery.

Given the complex and multifaceted nature of SUD/OUD, as well as the need to secure community buy-in and generate adequate patient volume to sustain services, HRSA requires that applicants be part of broad, multi-sectoral consortia. HRSA expects that consortia funded by RCORP-Implementation will sustain the SUD/OUD-related services in rural areas made possible by this funding opportunity both during and beyond the period of performance.

The target population for the award is: 1) individuals who are at risk for, have been diagnosed with, and/or are in treatment and/or recovery for OUD; 2) their families and/or caregivers; and 3) other community members[1] who reside in HRSA-designated rural areas, as defined by the Rural Health Grants Eligibility Analyzer. In addition to this target population, applicants are encouraged to give special consideration to rural populations that have historically suffered from poorer health outcomes or health disparities, as compared to the rest of the rural population.

The primary focus of the RCORP-Implementation award program is OUD. However, recognizing that many individuals with OUD use multiple substance and/or have other co-occurring conditions, consortia may also use RCORP-Implementation support to help address other SUD-related needs of the target population of individuals and families affected by OUD. Applicants should link any additional activities they propose to the needs of their target population and service area. Please note that no competitive advantage, funding priority, or preference is associated with proposing activities beyond the core/required activities outlined in the Program-Specific Instructions section of this NOFO.

2. Background

RCORP-Implementation is authorized by Section 711(b)(5) of the Social Security Act (42 U.S.C. 912(b)(5)).

The Rural Communities Opioid Response Program is administered through HRSA's Federal Office of Rural Health Policy, which is charged with supporting activities related to improving health care in rural areas.

[1] Applicants are encouraged to include individuals in the community who are involved in improving health care in rural areas.

In 2017, HHS declared the opioid crisis a nationwide public health emergency. Rural providers and communities in particular face a number of challenges in providing and accessing SUD/OUD services. In July 2020, nearly two-thirds of all rural counties (63.1%) had at least one clinician with a Drug Enforcement Administration (DEA) waiver but more than half of small and remote rural counties lacked one.[2] In addition to workforce shortages, rural communities face barriers such as stigma, transportation, and costs associated with setting up MAT and other SUD/OUD services.[3]

Rural residents who use opioids are more likely than their urban counterparts to have socioeconomic vulnerabilities, including limited educational attainment, poor health status, lack of health insurance, and low income,[4] which may further limit their abilities to access treatment. The opioid epidemic has also led to an increase in people who inject drugs (PWID), which in turn has increased the risk of transmission of viruses such as human immunodeficiency virus (HIV) and hepatitis B and C viruses (HBV and HCV) through shared equipment. Rural communities are particularly vulnerable to outbreaks of HIV and HCV among uninfected PWID.[5]

Recent Centers for Disease Control and Prevention data suggest that synthetic opioids are increasingly playing a role in psychostimulant-involved deaths. Drug overdose deaths involving psychostimulants with abuse potential, including methamphetamine, increased by over a third in rural communities between 2016 and 2017.[6]

The COVID-19 pandemic forced rural communities to adapt and stretch limited resources and exacerbated the opioid crisis. Over 81,000 drug overdose deaths occurred in the United States in the 12 months ending in May 2020, the highest number of overdose deaths ever recorded in a 12-month period, according to recent provisional data from CDC.[7] From 1999 through 2019, the rate of drug overdose deaths increased from 4.0 per 100,000 to 19.6 in rural counties.[8]

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[2] Andrilla CHA, Patterson DG. Tracking the geographic distribution and growth of clinicians with a DEA waiver to prescribe buprenorphine to treat opioid use disorder. *J Rural Health.* 2021; 1-6. https://doi.org/10.1111/jrh.12569

[3] See, e.g., *Implementing Medication-Assisted Treatment for Opioid Use Disorder in Rural Primary Care: Environmental Scan Volume 1,* AHRQ, https://integrationacademy.ahrq.gov/sites/default/files/mat_for_oud_environmental_scan_volume_1_1.pdf

[4] Lenardson, Jennifer et al (2016), "Rural Opioid Abuse: Prevalence and User Characteristics," Maine Rural Health Research Center, http://muskie.usm.maine.edu/Publications/rural/Rural-Opioid-Abuse.pdf

[5] Van Handel MM et al, "County-level vulnerability assessment for rapid dissemination of HIV or HCV infections among persons who inject drugs, United States," J Acquir Immune Defic Syndr (2016): https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5479631/; See also Centers for Disease Control and Prevention, "Managing HIV and Hepatitis C Outbreaks Among People Who Inject Drugs," March 2018, https://www.cdc.gov/hiv/pdf/programresources/guidance/cluster-outbreak/cdc-hiv-hcv-pwid-guide.pdf.

[6] See, e.g., Kariisa et al (2019), "Drug Overdose Deaths Involving Cocaine and Psychostimulants with Abuse Potential—United States, 2003-2017," CDC Morbidity and Mortality Weekly Report, https://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6817a3-H.pdf.

[7] Center for Disease Control. (December 2020) *Expanded prevention efforts needed* [Press release]. Retrieved from https://www.cdc.gov/media/releases/2020/p1218-overdose-deaths-covid-19.html

[8] Hedegaard H, Spencer MR. Urban–rural differences in drug overdose death rates, 1999–2019. NCHS Data Brief, no 403. Hyattsville, MD: National Center for Health Statistics. 2021. DOI: https://dx.doi. org/10.15620/cdc:102891.

RCORP supports and encourages projects that address the needs of a wide range of population groups, including, but not limited to, low-income populations, the elderly, pregnant women, youth, adolescents, ethnic and racial minorities, people/persons experiencing homelessness, and individuals with special health care needs.

Addressing issues of equity should include an understanding of intersectionality and how multiple forms of discrimination impact individuals' lived experiences. Individuals and communities often belong to more than one group that has been historically underserved, marginalized, or adversely affected by persistent poverty and inequality. Individuals at the nexus of multiple identities often experience unique forms of discrimination or systemic disadvantages, including in their access to needed services.

As part of HRSA's overall strategy for addressing SUD/OUD in rural communities, in FY 2022, HRSA will provide funds for the National Health Service Corps (NHSC) Rural Community Loan Repayment Program (LRP) under separate funding opportunity to award eligible providers (Allopathic/Osteopathic Physicians, Physician Assistants, Psychiatrists, Nurse Practitioners, Certified Nurse-Midwives, Psychiatric Nurse Specialists, Health Service Psychologists, Licensed Clinical Social Workers, Marriage and Family Therapists, Licensed Professional Counselors, SUD counselors, Clinical Pharmacists, Registered Nurses and Nurse Anesthetists) who are working at a rural NHSC-approved SUD treatment facility. Clinicians working at NHSC-approved RCORP consortium member site will receive funding priority. RCORP-Implementation applicants are encouraged to leverage the NHSC Rural Community LRP to support the recruitment and retention of eligible providers from the SUD workforce.

- For additional information on the Rural Community LRP and Sites, see Appendix A. For a list of current rural NHSC-approved SUD facilities, visit HRSA's Health Workforce Connector.
- To learn how to become an NHSC site, visit the NHSC website.

In 2019, the U.S. Department of Health and Human Services (HHS) Rural Health Task Force developed the "Healthy Rural Hometown Initiative" (HRHI). The HRHI is an effort that seeks to address the underlying factors that are driving growing rural health disparities related to the five leading causes of avoidable death (heart disease, cancer, unintentional injury/substance use, chronic lower respiratory disease, and stroke). RCORP-Implementation supports the HRHI initiative by aiming to reduce mortality from unintentional injury resulting from drug overdose. While applicants and award recipients to RCORP-Implementation do not need to explicitly link their activities to the HRHI, HRSA may plan to use the performance data submitted by RCORP-Implementation award recipients to demonstrate how RCORP-Implementation supports the overall goal of the HRHI. For more information on the Healthy Rural Hometown Initiative, see page 29 of the HHS Rural Action Plan.

For information on other HRSA-supported SUD/OUD funding opportunities, resources, technical assistance, and training, visit https://www.hrsa.gov/opioids. For information on other federal SUD/OUD resources, please see **Appendix B**.

II. Award Information

1. Type of Application and Award

Types of applications sought: New and Competing Continuation

HRSA will provide funding in the form of a grant.

2. Summary of Funding

HRSA estimates approximately $50,000,000 to be available to fund approximately 50 recipients over a three-year period of performance. The actual amount available will not be determined until the enactment of the final FY 2022 federal appropriation. You may apply for a ceiling amount of up to $1,000,000 total cost (includes both direct and indirect, facilities and administrative costs). This program notice is subject to the appropriation of funds, and is a contingency action taken to ensure that, should funds become available for this purpose, HRSA can process applications and award funds appropriately.

The period of performance is September 1, 2022 through August 31, 2025 (three years). Award recipients will receive the full award amount in the first year of the three-year period of performance, and must allocate the funding across each of the three years. Additionally, recipients must submit a budget and budget narrative for each of the three years of the period of performance. While you must distribute the funding across each of the three years, the budget does not need to be evenly split across the three-year period of performance, and can vary based on your community's needs.

All HRSA awards are subject to the Uniform Administrative Requirements, Cost Principles, and Audit Requirements at 45 CFR part 75.

III. Eligibility Information

1. Eligible Applicants

Applicant Organization Specifications

Eligible applicants include all domestic public or private, non-profit or for-profit entities, including faith-based and community-based organizations, tribes, and tribal organizations. In addition to the 50 U.S. states, organizations in the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, American Samoa, the U.S. Virgin Islands, the Federated State of Micronesia, the Republic of the Marshall Islands, and the Republic of Palau may apply.

The applicant organization may be located in an urban or rural area and should have the staffing and infrastructure necessary to oversee program activities, serve as the fiscal agent for the award, and ensure that local control for the award is vested in the targeted rural communities.

Service Delivery Specifications

All planned activities supported by this program **must exclusively target and be located in HRSA-designated rural counties and rural census tracts, as defined by the HRSA Rural Health Grants Eligibility Analyzer.** Within partially rural counties, **only** HRSA-designated rural census tracts are eligible to receive activities and services supported by this award.

NOTE: Beginning with FY 2022 grants, FORHP has modified its list of areas eligible for Rural Health funding. No areas were removed from the prior listing but 295 outlying Metro counties are now considered fully rural. Applicants can check the Rural Health Grants Eligibility Analyzer or the List of Rural Census Tracts document to determine eligibility status of an address or county.

While all service delivery sites supporting RCORP-Implementation projects must be exclusively located in HRSA-designated rural areas, given the shortage of service delivery sites in HRSA-designated rural areas, some exceptions apply in the specific instances listed below. In order to qualify for one of these exceptions, the applicant must establish that the non-rural service delivery site is a primary service provider for the target rural service area and that the delivery site will directly contribute to building health service delivery infrastructure within the target rural service area (see Attachment 9 for additional instructions on submitting required documentation for these exceptions).

- Critical Access Hospitals (CAHs) that are not located in HRSA-designated rural areas.
- Entities eligible to receive Small Rural Hospital Improvement (SHIP) funding and that are not located in HRSA-designated rural areas. Eligible entities under this exception include hospitals that are non-federal, short-term general acute care and that: (i) are located in a rural area as defined in 42 U.S.C. 1395ww(d) and (ii) have 49 available beds or less, as reported on the hospital's most recently filed Medicare Cost Report.
- Entities that are located in urban areas of partially rural counties in their target service area if the service delivery site is located in an incorporated city, town, or village, or unincorporated census-designated place (CDP), with 49,999 or fewer people.
- Telehealth service delivery sites located in an urban facility, but exclusively serving patients in HRSA-designated rural areas

Consortium Specifications

HRSA requires that applicants be part of broad, multi-sectoral consortia comprised of the following:

- At least four or more separately owned entities, including the applicant organization. The entities should all have different EINs and have established working relationships. Tribal applicants may be eligible for an exception to the EIN requirement, as described in the Eligibility section.
- At least 50 percent, of members in each consortium must be located within HRSA-designated rural areas or census tracts, as defined by the **HRSA Rural Eligibility Analyzer.** Applicants must provide a single letter of commitment signed by **all consortium members reflected in the proposed work plan.** See Attachment 3 for additional information.
- Members from multiple sectors and/or disciplines that have a demonstrated history of collaborating to address SUD/OUD in a rural area. Applicants are encouraged to incorporate individuals and community sectors particularly affected by SUD/OUD, including health and social service organizations, employers, individuals in recovery, law enforcement and first responders, teachers and school systems, child welfare agencies, etc.
    - Note while individuals may be included as consortium members, there must also be at least four separately owned **entities/organizations** to meet HRSA's required consortium specifications. See **Appendix C** for a non-exhaustive list of potential consortium partners.

If awarded, recipients must notify consortium members who will be serving as subcontractors/subrecipients that they must be registered in SAM.

NOTE: HRSA is aware that tribes and tribal governments may have an established infrastructure without separation of services recognized by filing for EINs. In the case of tribes and tribal governments, only a single EIN located in a HRSA designated rural area is necessary for eligibility as long as the EIN is associated with an entity located in a HRSA-designated rural area. **Tribes and tribal entities under the same tribal governance must still meet the consortium criteria of four or more entities committed to the proposed approach**

FY 2020 and FY 2021 RCORP-Implementation Award Recipients and Consortium Members:

Applicants that are FY 2020 or FY 2021 RCORP-Implementation award recipients and/or Consortium Members are ONLY eligible to apply for this funding opportunity if they meet the following conditions:

1. **Target Geographic Rural Service Area:** The target geographic rural service area proposed in this application does not overlap **at all** with the one currently served by the consortium for the FY 20 or FY 21 RCORP-Implementation award and all proposed services are delivered in the new target rural service area. FY

2020 and FY 2021 RCORP-Implementation award recipients and/or consortium members should demonstrate they meet these conditions in **Attachment 7**; **and**

2. **Consortium Membership:** At least 50 percent of the consortium members proposed in this application are physically located in the new service area and are signatories to the letter of commitment (**Attachment 3**).

2. Cost Sharing/Matching

Cost sharing/matching is not required for this program.

3. Other

HRSA may not consider an application for funding if it contains any of the non-responsive criteria below:

- Exceeds the ceiling amount;
- Fails to satisfy the deadline requirements referenced in Section IV.4; and/or
- Exceeds the page limit (80 pages).

HRSA will only accept your **last** validated electronic submission, under the correct funding opportunity number, before the Grants.gov application due date as the final and only acceptable application.

NOTE: Organizations may not serve as the applicant organization on more than one FY 2022 RCORP-Implementation application. Only one application can be associated with an EIN.

- **Exception to Multiple Submissions Policy:** In general, multiple applications associated with the same EIN are not allowable. However, HRSA recognizes a growing trend towards greater consolidation within the rural health care industry and the possibility that multiple organizations with the same EIN could be located in **different** rural service areas that have a need for SUD/OUD services. **Therefore, at HRSA's discretion, separate applications associated with a single EIN may be considered for this funding opportunity if the applicants provide HRSA with the following information in Attachment 8**:

    1. Names, street addresses, and EINs of the applicant organizations;
    2. Name, street address, and EIN of the parent organization;
    3. Names, titles, email addresses, and phone numbers for points of contact at each of the applicant organizations and the parent organization;
    4. Proposed RCORP-Implementation service areas for each applicant organization (these should not overlap);

5. Justification for why each applicant organization must apply to this funding opportunity separately as the applicant organization, as opposed to serving as consortium members on other applications;
6. Assurance that the applicant organizations will each be responsible for the planning, program management, financial management, and decision making of their respective programs, independent of each other and/or the parent organization; and
7. Signatures from the points of contact at each applicant organization and the parent organization.

Applications associated with the same EIN must be independently developed and written. HRSA reserves the right to deem applications that provide insufficient information in **Attachment 8** to be ineligible. In this instance, assuming all other eligibility criteria are met, HRSA will only accept the last validated electronic submission associated with the EIN.

Note that this exception does not apply to a single organization (e.g., a parent organization/headquarters) that wants to apply more than once for this funding opportunity on behalf of its satellite offices or clinics.

If multiple entities that share an EIN apply for this funding opportunity, the applicant organization names (as reflected in Box 8A of the SF-424 Application Page) should be different and reflect the names of the satellite offices/clinics. If HRSA receives multiple FY 2022 RCORP-Implementation applications with the same applicant organization name (as reflected in Box 8A of the SF-424 Application Page), only the last submitted and validated application will be reviewed.

IV. Application and Submission Information

1. Address to Request Application Package

HRSA ***requires*** you to apply electronically. HRSA encourages you to apply through Grants.gov using the SF-424 workspace application package associated with this notice of funding opportunity (NOFO) following the directions provided at http://www.grants.gov/applicants/apply-for-grants.html.

The NOFO is also known as “Instructions” on Grants.gov. You must select “Subscribe” and provide your email address for HRSA-22-057 in order to receive notifications including modifications, clarifications, and/or republications of the NOFO on Grants.gov. You will also receive notifications of documents placed in the RELATED DOCUMENTS tab on Grants.gov that may affect the NOFO and your application. *You are ultimately responsible for reviewing the For Applicants page for all information relevant to this NOFO.*

2. Content and Form of Application Submission

Application Format Requirements
Section 4 of HRSA's *SF-424 Application Guide* provides general instructions for the budget, budget narrative, staffing plan and personnel requirements, assurances, certifications, etc. You must submit the information outlined in the HRSA *SF-424* Application Guide in addition to the program-specific information below. You are responsible for reading and complying with the instructions included in HRSA's *SF-424 Application Guide* except where instructed in the NOFO to do otherwise. You must submit the application in the English language and in the terms of U.S. dollars (45 CFR § 75.111(a)).

See Section 8.5 of the *HRSA SF-424 Application Guide* for the Application Completeness Checklist.

Application Page Limitation
The total size of all uploaded files included in the page limit may not exceed the equivalent of **80 pages** when printed by HRSA. The page limit includes the abstract, project and budget narratives, attachments, and letters of commitment and support required in the *Application Guide* and this NOFO. Standard OMB-approved forms that are included in the workspace application package do not count in the page limit. Please note: If you use an OMB-approved form that is not included in the workspace application package for HRSA-22-057, it may count against the page limit. Therefore, we strongly recommend you only use Grants.gov workspace forms associated with this NOFO to avoid exceeding the page limit. Indirect Cost Rate Agreement and proof of non-profit status (if applicable) do not count in the page limit.

<u>It is the responsibility of the applicant to take appropriate measures to ensure your application does not exceed the specified page limit.</u>

Applications must be complete, within the specified page limit, and validated by Grants.gov under the correct funding opportunity number prior to the deadline.

Debarment, Suspension, Ineligibility, and Voluntary Exclusion Certification

1) You certify on behalf of the applicant organization, by submission of your proposal, that neither you nor your principals are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.
2) Failure to make required disclosures can result in any of the remedies described in 45 CFR § 75.371, including suspension or debarment. (See also 2 CFR parts 180 and 376, and 31 U.S.C. § 3321).
3) If you are unable to attest to the statements in this certification, you must include an explanation in *Attachments 10-15: Other Relevant Documents*.

See Section 4.1 viii of HRSA's *SF-424 Application Guide* for additional information on all certifications.

Program Requirements and Expectations

HRSA requires that applicants be part of a broad, multi-sectoral consortia. For the purposes of RCORP-Implementation, a consortium is an organizational arrangement among four or more separately owned domestic public or private entities, including the applicant organization, with established working relationships. The entities, including the applicant organization, must all have different Employment Identification Numbers (EINs).[9]

HRSA expects that consortia funded by RCORP-Implementation will sustain the SUD/OUD-related services in rural areas made possible by this funding opportunity both during and beyond the period of performance. Over the course of the three-year period of performance, RCORP-Implementation award recipients will complete detailed plans for sustaining their consortia and SUD/OUD services beyond the RCORP-Implementation period of performance.

Finally, RCORP-Implementation award recipients are expected to work closely with a HRSA-funded technical assistance (TA) provider throughout the three-year period of performance. Targeted TA is provided to each award recipient at no additional cost, and is intended to help recipients achieve desired project outcomes, sustain services, align their performance reporting/evaluative activities, implement quality improvement efforts, and overcome challenges to project implementation. HRSA will provide more information about TA support upon receipt of award.

Program-Specific Instructions

In addition to application requirements and instructions in Section 4 of HRSA's *SF-424 Application Guide* (including the budget, budget narrative, staffing plan and personnel requirements, assurances, certifications, and abstract), include the following:

Core Activities

Over the course of the three-year period of performance, consortia must implement **all core activities** described below, which are aimed at improving health care in HRSA-designated rural areas. If a consortium is already implementing one or more of the core activities within the service area, applicants may propose to expand or enhance those activities.

Note: Applicants must make progress on each core activity in every year of the grant. Consortium members do not have to complete all required core activities individually, nor do all core activities have to be implemented in every part of the target rural service area. Implementation of the core activities should reflect the demonstrated needs and capacity of the target rural service area.

Foundational Core Activities

[9]Tribal entities may be exempt from this requirement. Please reference Eligible Applicants for more information.

- Track and collect aggregate data and other information from consortium members to fulfill HRSA reporting requirements, and use this data to support continuous improvement of services and activities.
- Develop processes for achieving financial and programmatic sustainability beyond the period of performance, including (but not limited to) training providers, administrative staff, and other relevant stakeholders to optimize reimbursement for clinical encounters through proper coding and billing across insurance types.
- Address the SUD-related needs of populations that have historically suffered from poorer health outcomes or health disparities, as compared to the rest of the target rural population. Examples of these populations include, but are not limited to, persons/people experiencing homelessness, racial and ethnic minorities, people who are pregnant, adolescents and youth, LGBTQ individuals, the elderly, individuals with disabilities, etc.
- Leverage partnerships at the local/community, state, and regional levels, including with rural counties and municipalities, health plans, law enforcement, community recovery organizations, faith-based organizations, and others to secure buy-in for the proposed project and ensure that it complements (versus duplicates) existing SUD/OUD resources.

Prevention Core Activities

- Support culturally and linguistically appropriate substance use prevention activities and evidence-based programs, delivered in diverse environments (e.g., schools, community centers) and to diverse participants.
- Increase access to naloxone within the target rural service area and provide training on overdose prevention and naloxone administration for community members likely to respond to an overdose.
- Train community members and other stakeholders on safe storage and disposal of prescription drugs with potential for misuse.
- Identify and screen individuals at risk for SUD/OUD and co-occurring disorders disorders/infectious complications (including HIV, viral hepatitis, mental illness, etc.), and provide, or make referrals to, prevention, harm reduction, early intervention, treatment, and other support services.
- Train and strengthen collaboration with and between law enforcement and first responders to enhance their capability of responding and/or providing emergency treatment to those with SUD/OUD.

Treatment and Recovery Core Activities

- Recruit, train, mentor, and retain interdisciplinary teams of clinical and social service providers, to support an integrated approach to SUD/OUD treatment, including evidence-based behavioral therapy (e.g., cognitive behavioral therapy, community reinforcement approach, etc.), U.S Food and Drug Administration-approved pharmacotherapy (e.g., buprenorphine, naltrexone), and any other necessary supportive services. This activity must include providing support to providers who are seeking DATA 2000 waivers.
- Create community linkages and referral systems for a seamless entry into MAT/SUD treatment from primary care, emergency departments, law enforcement/first responders, community-based organizations, social service organizations, etc.
- Ensure linkages to and coordination with home and community-based social services (such as case management, housing, employment, food assistance, transportation, etc.) to support individuals in recovery, including those discharged from inpatient treatment facilities and/or the criminal justice system.
- Expand the peer workforce to provide support in various settings, including hospitals, emergency departments, law enforcement departments, jails, SUD/OUD treatment programs, and in the community.
- Support the development of recovery support services such as recovery community organizations, recovery homes, mutual aid groups, and other recovery resources and infrastructure to expand the availability of and access to recovery support services.

Additional Activities

If capacity exists, award recipients may use funding to implement additional activities that strengthen the consortium's ability to deliver prevention, treatment, and/or recovery services for SUD/OUD that improve health care in their service area. Applicants must provide detailed descriptions of all additional activities in the Project Narrative, as well as justifications for how those activities will advance RCORP-Implementation's goal and fulfill the needs of the target population. No funding priority or preference is associated with proposing additional activities. Please see **Appendix D** for a non-exhaustive list of allowable additional activities

Requirements for Service Provision

All activities funded by this award must exclusively occur in HRSA-designated rural areas, as defined by the Rural Health Grants Eligibility Analyzer. Please note the exceptions under Eligible Applicants. Additionally, RCORP-Implementation is a payer of last resort, and award recipients should bill for all services covered by a reimbursement plan and make every reasonable effort to obtain payments. At the same time, award recipients may not deny services to any individual because of an inability to pay.

Services should aim to eliminate pre-requisites to entering MAT, be individualized to the needs and circumstances of the patient, promote retention in treatment, recognize the need to manage recurrence of substance use and address ambivalence in patient motivation.

Target Population

The target population for this award are: 1) individuals who are at risk for, have been diagnosed with, and/or are in treatment and/or recovery for OUD; 2) their families and/or caregivers; and 3) other community members[10] who reside in HRSA-designated rural areas, as defined by the Rural Health Grants Eligibility Analyzer.

Applicants are encouraged to focus on rural populations that have historically suffered from poorer health outcomes, health disparities, and other inequities, as compared to the rest of the target population, when addressing SUD in the proposed service area. Examples of these populations include, but are not limited to, racial and ethnic minorities, people/persons experiencing homelessness, pregnant women, youth and adolescents, etc.

i. Project Abstract

Use the Standard OMB-approved Project Abstract Summary Form 2.0 that is included in the workspace application package. Do not upload the abstract as an attachment or it will count toward the page limitation. For information required in the Project Abstract Summary Form, see Section 4.1.ix of HRSA's *SF-424 Application Guide.*

Please include the following information in your abstract:

1. Project Title
2. Requested Award Amount
3. Applicant Organization Name
4. Applicant Organization Address
5. Applicant Organization Facility Type (e.g., Rural Health Clinic, Critical Access Hospital, Tribe/Tribal Organization, Health System, Institute of Higher Learning, Community-based Organization, Foundation, Rural Health Network, etc.)
6. Project Director Name and Title
7. Project Director Contact Information (phone and email)
8. Are you a current FY20 or FY21 RCORP-Implementation award recipient?
9. EIN Exception Request in **Attachment 8**? (Y/N) - Note: HRSA reserves the right to deem applications that provide insufficient information in **Attachment 8**, or are nearly identical in content, to be ineligible. In this instance, assuming all other eligibility criteria are met, HRSA will only accept the last submitted application associated with the EIN.

10. How the Applicant **First** Learned About the Funding Opportunity (**select one**: State Office of Rural Health, HRSA News Release, Grants.gov, HRSA Project

[10] Applicants are encouraged to include individuals in the community who are involved in improving health care in rural areas.

Officer, HRSA Website, Technical Assistance Provider, State/Local Health Department)

11. Number of Consortium Members & List of Consortium Members
12. Previous or Current RCORP Award Recipient? (**specify:** FY18 RCORP-Planning Applicant Organization; FY18 RCORP-Planning Consortium Member; FY19 RCORP-Planning Applicant Organization; FY19 RCORP-Planning Consortium Member; FY20 RCORP-Planning Application Organization; FY20 RCORP-Planning Consortium Member; FY19 RCORP-MAT Expansion; FY19 RCORP- Implementation Applicant Organization; FY19 RCORP-Implementation Consortium Member, FY20 RCORP-Implementation Applicant Organization; FY20 RCORP-Implementation Consortium Member; FY 21 RCORP- Implementation Applicant Organization; FY21 RCORP-Implementation Consortium Member; FY20 RCORP-NAS Applicant Organization; FY20 RCORP-NAS Consortium Member; FY21 RCORP-Psychostimulant Support Applicant Organization; FY21 RCORP-Psychostimulant Support consortium member)
13. Brief Description of the Target Population
    - Indicate approximately what percentage (if any) of the target population is American Indian/Alaskan Native;
    - If applicable, provide 2-3 sentences regarding how this project specifically targets tribal populations;
    - If applicable, provide 2-3 sentences regarding how this project will target populations who have historically suffered from poorer health outcomes or health disparities, as compared to the rest of the target rural population (e.g., racial/ethnic minorities; persons/people experiencing homelessness; veterans; etc.).
14. Target Service Area (**must be exclusively rural, as defined by the Rural Health Grants Eligibility Analyzer**)
    - Fully Rural Counties: Provide the county name and state
    - Partially-Rural Counties: Provide county name, state, **and** the rural census tract (**list of rural census tracts**)
15. Does target service area overlap with an existing FY 19 or FY 20 RCORP-Implementation award recipient's service area? (Y/N)

NARRATIVE GUIDANCE

To ensure that you fully address the review criteria, the table below provides a crosswalk between the narrative language and where each section falls within the review criteria. Any forms or attachments referenced in a narrative section may be considered during the objective review.

Narrative Section	Review Criteria
Introduction	(1) Need
Needs Assessment	(1) Need
Methodology	(2) Response
Work Plan	(2) Response
Resolution of Challenges	(2) Response
Evaluation and Technical Support Capacity	(3) Evaluative Measures and (4) Impact
Organizational Information	(3) Evaluative Measures and (5) Resources/Capabilities
Budget Narrative	(6) Support Requested - the budget narrative section should include sufficient justification to allow reviewers to determine the reasonableness of the support requested.

ii. Project Narrative

This section provides a comprehensive description of all aspects of the proposed project. It should be succinct, self-explanatory, consistent with forms and attachments, and organized in alignment with the sections and format below so that reviewers can understand the proposed project.

Use the following section headers for the narrative:

- *INTRODUCTION -- Corresponds to Section V's Review Criterion #1 – "Need"*

  This section should clearly and succinctly summarize the overarching goals of the proposed project. In particular, you should provide a description of the target rural service area counties and/or rural census tracts; the characteristics and needs of the target population and service area; the consortium's proposed approach to meeting those needs; and the consortium's history of collaborating to address SUD/OUD in rural areas and capacity to implement the proposed project.

- *NEEDS ASSESSMENT -- Corresponds to Section V's Review Criterion #1 – "Need"*

  Describe, in detail, the needs of the target rural population as they relate to the core activities and any additional proposed activities. Provide supporting data and statistics from appropriate sources (e.g., local, state, tribal, and federal) that reflects the most recent timeframe available. Where possible, compare the data for the target rural population to regional, statewide, and/or national data to demonstrate need. Please cite the data sources (including year) you use to provide this data.

Applicants encountering difficulty obtaining data are encouraged to contact their state or local health departments and/or refer to data and information provided by the Rural Health Information Hub and the Opioid Misuse Community Assessment Tool developed by NORC at the University of Chicago. If you are still unable to locate appropriate and accurate data, please provide an explanation for why the data could not be found and how you will leverage the RCORP-Implementation award to strengthen the quality and availability of OUD/SUD data in your target rural service area.

Specifically, the Needs Assessment section should include detailed, quantitative descriptions of the following:

- The target rural population, including demographic and social determinants of health indicators;
  - Describe the extent to which the population you propose to serve includes subpopulations that have historically suffered from poorer health outcomes, health disparities, and other inequities compared to the rest of the target population. Examples of these populations include, but are not limited to, persons/people experiencing homelessness, racial and ethnic minorities, people who are pregnant, adolescents and youth, LGBTQ individuals, the elderly, individuals with disabilities, etc.
  - Describe which segments of the target rural population are most at risk for, and/or are most likely to be diagnosed with, OUD. This may include certain age groups, racial/ethnic groups, persons/people experiencing homelessness, etc.
- The prevalence and impact of SUD/OUD in the target rural service area. Examples can include, but are not limited to, the number/ percentage of children in the foster care system as a result of their caregivers' OUD; number of individuals with infectious complications as a result of OUD; the number of SUD/OUD hospitalizations and/or emergency room visits; etc.
- Overview of existing SUD/OUD-related prevention, treatment, and recovery support services in the target rural service area, including any federal, state, or locally funded SUD/OUD initiatives such as other RCORP projects.
  - Please reference the RCORP website for a list of RCORP award recipients in each program—Planning, Implementation, Neonatal Abstinence Syndrome, and MAT Expansion—as well as this table of RCORP award recipient service areas for more information.
- SUD/OUD-related health care needs and gaps in prevention, treatment, and recovery services in the **target rural service area**.

- *METHODOLOGY -- Corresponds to Section V's Review Criterion #2 – "Response"*

The Methodology Section should provide clear, actionable strategies for how you will achieve each of the core activities. Your methodology should directly link to and reflect the data and information provided in the "Needs Assessment" section of the Project Narrative.

The methodology should include a thorough, detailed explanation of how you will achieve each core activity and how you will collaborate, and not duplicate, existing OUD/SUD programming in the target rural service area, including other RCORP awards. In addition, the methodology should also address the following for each set of core activities:

Foundational Core Activities

Explain in detail how your proposed approach to achieving the foundational core activities will improve health care in the target rural area and:

- Support consortium members to ensure that they are able to collect and report accurate, reliable data to fulfill HRSA reporting requirements. Examples can include, but are not limited to, providing financial support to consortium members to strengthen their capacity to track and report data, and/or designating an individual at each consortium member organization who will be responsible for reporting that organization's data to the applicant organization (in addition to the required Data Coordinator described in the Staffing Plan);
- Ensure that all activities and services complement, and do not duplicate, any existing initiatives and efforts in the target rural service area.
- Utilize the data collected as part of HRSA's reporting requirements to inform and improve the project's activities and service delivery;
- Ensure that activities and services are sustainable beyond the period of performance, particularly for underinsured/uninsured populations, and for those populations that have historically suffered from poorer health outcomes or health disparities, as compared to the rest of the target rural population (examples of these populations include, but are not limited to, persons/people experiencing homelessness, racial and ethnic minorities, people who are pregnant, adolescents and youth, LGBTQ individuals, the elderly, individuals with disabilities, etc.);
- Sustain consortium membership beyond the period of performance;
- Secure target population support and engagement; and
- Ensure that proper coding and billing across insurance types is implemented across the consortium and that billing/coding information/education is available to other key service providers in the target rural service area, as needed.

Prevention Core Activities

Explain in detail how your proposed approach to achieving the prevention core activities will improve health care in the target rural area and will:

- Directly address the demonstrated need of the target rural service area;
- Improve family members', caregivers', and the public's understanding of evidence-based prevention, treatment, and recovery strategies for SUD/OUD,
- Reduce stigma associated with SUD/OUD;
- Reach populations that have historically suffered from poorer health outcomes or health disparities, as compared to the rest of the rural population. Examples of these populations include, but are not limited to, persons/people experiencing homelessness, racial and ethnic minorities, people who are pregnant, adolescents and youth, LGBTQ individuals, the elderly, individuals with disabilities, etc.
- Ensure that those who are most likely to witness an overdose are prepared to respond;
- Minimize the potential for the development of SUD/OUD; and,
- Minimize the potential for those with SUD/OUD to develop infectious complications or other co-occurring disorders.

Treatment and Recovery Core Activities

Explain in detail how your proposed approach to achieving the treatment and recovery core activities will improve health care in the target rural area and will:

- Reduce stigma and other barriers to care;
- Enable individuals, families, and caregivers to find, access, and navigate evidence-based, affordable treatments for SUD/OUD;
- Support integration of health care delivery and social service entities for seamless, coordinated, whole-person-oriented care;
- Ensure access to care and supportive services for populations that have historically suffered from poorer health outcomes or health disparities, as compared to the rest of the rural population. Examples of these populations include, but are not limited to, persons/people experiencing homelessness, racial and ethnic minorities, people who are pregnant, adolescents and youth, LGBTQ individuals, the elderly, individuals with disabilities, etc.

Additional Activities (if applicable)

- If proposing additional activities, you must provide a detailed description of the activities, clearly justify why they are needed, and explain how they will improve health care in the target rural area and benefit the target population.

- *WORK PLAN -- Corresponds to [Section V's Review Criterion #2 – "Response"]*

This section describes the processes that you will use to achieve the strategies in the "Methodology" section. Note that while the "Methodology" section of the Project Narrative centers on the overall strategy for fulfilling the core/additional activities, the work plan is more detailed and focuses on the tasks, activities, and timelines by which you will execute your strategy.

The work plan activities should align with your methodology section, and should include the following:

- Specific tasks/sub-activities that you will undertake to achieve all core activities and, if applicable, any additional activities, (as outlined in the "Program-Specific Instructions" section of this NOFO);
- Responsible individual(s) and/or consortium member(s) for each task/sub-activity;
- Timeframes to accomplish all tasks/sub-activities;
- How the proposed task/sub-activity will improve the health care delivery system in the target rural service area;
- Any products/deliverables associated with each task/required core activity/ additional activity.

The work plan must reflect a three-year period of performance. Each task/activity in the work plan should have beginning and completion dates. It is not acceptable to list "ongoing" as a timeframe. Note that while award recipients should make progress towards completing each core activity during each year of the award, activities do not need to be **completed** until the end of the three-year period of performance.

Please provide your work plan in **Attachment 1.** (It is appropriate to refer reviewers to **Attachment 1** in this section instead of including the work plan twice in the application.)

It is strongly encouraged that you provide your work plan in a table format and that you clearly delineate which tasks/deliverables/sub-activities correspond to which core and/or additional activities.

- *RESOLUTION OF CHALLENGES -- Corresponds to Section V's Review Criterion #2 – "Response"*

  Describe challenges that your consortium is likely to encounter in implementing the proposed work plan and the approaches you will use to resolve each challenge. You should highlight both internal challenges (e.g., maintaining cohesiveness among consortium members) and external challenges (e.g., stigma around SUD/OUD in the target rural service area, securing patient engagement in treatment, geographical limitations, policy barriers, etc.). **You must detail potential challenges to sustaining services after the period of performance ends and how your consortium intends to overcome them.**

- *EVALUATION AND TECHNICAL SUPPORT CAPACITY -- Corresponds to Section V's Review Criterion(a) #s 3 and 4 – "Evaluative Measures" and "Impact"*

  Describe the process (including staffing and workflow) for how you will track, collect, aggregate, and report data and information from all consortium members to fulfill HRSA reporting requirements. **You must clearly demonstrate how the applicant organization will support and enable consortium members to collect accurate data in response to HRSA reporting requirements.** Examples include, but are not limited to, allocating a portion of award funding to each consortium member to support data collection, and/or designating an individual at each member organization who will be responsible for collecting and reporting the HRSA-required data to the application organization.

  Applicants should also demonstrate that the consortium has the capacity and is committed to working with a HRSA-funded evaluator to take part in a larger, RCORP-wide evaluation. Finally, applicants should clearly describe their plan for updating participating entities, the target rural service area, and the broader public on the program's activities, lessons learned, and success stories. You should provide examples of mediums and platforms for disseminating this information.

  It is the applicant organization's responsibility to ensure compliance with HRSA reporting requirements. Applicants should make every reasonable effort to track, collect, aggregate, and report data and information from all consortium members throughout the period of performance. Finally, consortium members should commit to sharing aggregate (**not** patient-level or other personally identifiable information) performance data and information with the applicant organization to fulfill HRSA reporting requirements in the signed Letter of Commitment (**Attachment 3**).

- *ORGANIZATIONAL INFORMATION -- Corresponds to Section V's Review Criterion #s 3 and 5 – "Evaluative Measures" and "Resources and Capabilities"*

  This section provides insight into the organizational structure of the consortium and the consortium's ability to implement the activities outlined in the work plan. See the Program-Specific Instructions and the Eligibility sections for additional information on consortium requirements and specifications.

NOTE: It is appropriate to refer reviewers to the relevant attachment(s) in this section instead of including the information twice in the application.

Applicants should include the following information:

<u>Consortium Membership (Attachment 2)</u>

For each member of the consortium reflected on the proposed work plan, including the applicant organization, include the following information. It is **highly encouraged** that you provide this information in a table format.

- Organization (or individual) name;
- Street address;
- Contact information (Consortium member representative's name, title, email);
- EIN (tribal entities may be exempt from this requirement; for individuals, indicate N/A);
- Service delivery sites (street address, including county) where services supported by the RCORP-Implementation award will be administered;
- Sector represented (e.g., health care, public health, education, law enforcement, tribal entity, etc.);
- Current and/or previous RCORP awards received (list award name, year, and whether the entity served as the applicant organization or consortium member);
- Specify (yes/no) whether consortium member is a National Health Service Corps (NHSC) site or NHSC–eligible site (see https://nhsc.hrsa.gov/sites/eligibility-requirements.html for more details);
- Specify (yes/no) whether consortium member is located in a HRSA-designated rural county or rural census tract of an urban county, as defined by the Rural Health Grants Eligibility Analyzer; and
- Specify (yes/no) whether consortium member has signed the Letter of Commitment (**Attachment 3**).

<u>Consortium Letter of Commitment (Attachment 3)</u>

All consortium members reflected in the proposed work plan, including the applicant organization, must sign and date a **single** letter of commitment (**Attachment 3**) that delineates the expertise, roles, responsibilities, and commitments of each consortium member. At least 50 percent of signatories must be physically located in HRSA-designated rural areas, as defined by the Rural Health Grants Eligibility Analyzer. Consortium members must represent diverse sectors and disciplines. Electronic signatures are acceptable. If you are unable to obtain a given signature, please provide a brief explanation why.

The letter of commitment must identify each consortium member organization's roles and responsibilities in the project, the activities in which they will be included, how the organization's expertise is pertinent to the project, and the length of commitment to the project. The letter must also include statements indicating that:

- Consortium members understand that the RCORP-Implementation award is to be used for the activities proposed in the work plan;

- That the activities must exclusively benefit populations in the target rural service area and that the award is not to be used for the exclusive benefit of any one consortium member; and
- A commitment to sharing accurate, aggregate (**not** patient-level or other personally identifiable information) performance data and information with the applicant organization to fulfill HRSA reporting requirements.

Stock or form letters are not recommended.

Letters of Commitment should be submitted as part of the electronic application package through Grants.gov. HRSA will not accept or consider Letters of Commitment or Support received through other means, including through the mail, e-mail, etc.

Organizational Chart (Attachment 4)
Provide a one-page organizational chart that clearly depicts the relationships and/or hierarchy among all consortium members participating in the project.

Staffing Plan (Attachment 5)
Provide a detailed and clear staffing plan that includes the following information for each proposed project staff member reflected in the proposed work plan. It is recommended that you provide this information in a table format:

- Name;
- Title;
- Organizational affiliation;
- Full-time equivalent (FTE) devoted to the project;
- Roles/responsibilities on the project; and
- Timeline and process for hiring/onboarding, if applicable.

The staffing plan should directly link to the activities proposed in the work plan. If a staff member has yet to be hired (TBH), please put “TBH” in lieu of a name and detail the process and timeline for hiring and onboarding the new staff, as well as the qualifications and expertise required by the position. All key staff associated with the project should be hired within 60 days of the project start date.

All staffing plans must include a Project Director and a Data Coordinator (although not recommended, the same individual can serve both roles):

- **Project Director:** The Project Director is the point person on the award and makes staffing, financial, and other decisions to align project activities with project outcomes. You should detail how the Project Director will facilitate collaborative input and engagement across consortium members to complete the proposed work plan during the period of performance**. The Project Director is a key staff member and an FTE of at least 0.25 is required for this position. If awarded, the Project Director is expected to attend monthly calls with HRSA/Technical Assistance team.** If the Project Director serves as a Project Director for other federal awards, please list the federal awards as well as the percent FTE for that respective federal award. Any given staff member, including the Project Director, may not bill for more than 1.0 FTE across federal awards. **More than one Project Director is allowable in the staffing plan. However, only one Project Director can be designated in Box 8f of the SF-424 A Application Page. If awarded, this is the Project Director who will be officially reflected in the Notice of Award. If there is more than one Project Director, a total FTE of at least 0.25 between the two Project Directors is allowable.**

- **Data Coordinator:** Applicants must designate at least one individual in the staffing plan to serve as a "Data Coordinator." The Data Coordinator is responsible for tracking, collecting, aggregating, and reporting quantitative and qualitative data and information from consortium members to fulfill HRSA's quarterly and biannual reporting requirements. Though not required, this position may include analyzing the data or utilizing the data to inform process or quality improvement. There is no minimum FTE for this position.

Finally, applicants should designate staff to attend regular meetings of the FY22 RCORP-Implementation Learning Collaborative. Further details will be available upon award.

Staff Biographical Sketches (Attachment 6)

All proposed staff members should have the appropriate qualifications and expertise to fulfill their roles and responsibilities on the award. For each staff member reflected in the staffing plan, provide a brief biographical sketch (not to exceed one page per staff member) that directly links their qualifications and experience to their designated RCORP-Implementation project activities. The names reflected in the staffing plan must align with the names identified in the biographical sketches

If a staff member will serve two separate and distinct roles on the award that do not overlap, please submit two separate biosketches for that individual. Please note that the individual must not exceed 1.0 FTE.

iii. Budget

The directions offered in the SF-424 Application Guide may differ from those offered by Grants.gov. Follow the instructions in Section 4.1.iv of HRSA's *SF-424 Application Guide* and the additional budget instructions provided below. A budget that follows the Application Guide will ensure that, if HRSA selects your application for funding, you will have a well-organized plan and, by carefully following the approved plan, may avoid audit issues during the implementation phase.

Reminder: The Total Project or Program Costs are the total allowable costs (inclusive of direct **and** indirect costs) you incur to carry out a HRSA-supported project or activity. Total project or program costs include costs charged to the award and costs borne by you to satisfy a matching or cost-sharing requirement, as applicable.

The Consolidated Appropriations Act, 2021 (P.L. 116-260), Division H, § 202 states, “None of the funds appropriated in this title shall be used to pay the salary of an individual, through a grant or other extramural mechanism, at a rate in excess of Executive Level II.” See Section 4.1.iv Budget – Salary Limitation of HRSA’s SF-424 Application Guide for additional information. Note that these or other salary limitations may apply in the following fiscal years, as required by law.

Indirect costs are those costs incurred for common or joint objectives, which cannot be readily and specifically identified with a particular project or program but are necessary to the operations of the organization, e.g., the cost of operating and maintaining facilities, depreciation, and administrative salaries. For some institutions, the term “facilities and administration” (F&A) is used to denote indirect costs. If your organization does not have an indirect cost rate, you may wish to obtain one through HHS’s Cost Allocation Services (CAS) (formerly the Division of Cost Allocation (DCA)). Visit CAS’s website to learn more about rate agreements, the process for applying for them, and the regional offices, which negotiate them. If indirect costs are included in the budget, attach a copy of the indirect cost rate agreement. If the indirect cost rate agreement is required per the NOFO, it will not count toward the page limit. Any non-federal entity that has never received a negotiated indirect cost rate, (except a governmental department or agency unit that receives more than $35 million in direct federal funding) may elect to charge a de minimis rate of 10 percent of modified total direct costs (MTDC) which may be used indefinitely. If chosen, this methodology once elected must be used consistently for all federal awards until such time as a non-federal entity chooses to negotiate for a rate, which the non-federal entity may apply to do at any time.

In addition, RCORP-Implementation requires the following:

1. **Technical Assistance Workshop:** Applicants should budget for two individuals to travel **annually** to a workshop. The workshop will likely be located in the Washington, DC area. If funded, more information will be provided upon receipt of award. Project officers will work with award recipients to make any budget adjustments if necessary once the details of these meetings are finalized.

iv. Budget Narrative

See Section 4.1.v. of HRSA’s *SF-424 Application Guide*.

In addition, the RCORP Implementation program requires the following:

RCORP-Implementation award recipients will receive the full award amount in the first year, but must allocate the award funding across each year of the three-year period of performance. Applicants are required to submit a budget and budget narrative for each of the three years of the grant.

Reminder: The Budget, SF-424A, and Budget Narrative amounts must align and cannot exceed the budget ceiling amount.

v. Attachments

Provide the following items in the order specified below to complete the content of the application. **Unless otherwise noted, attachments count toward the application page limitation.** Your indirect cost rate agreement and proof of non-profit status (if applicable) will not count toward the page limitation. **Clearly label each attachment**. You must upload attachments into the application. Any *hyperlinked* attachments will *not* be reviewed/opened by HRSA.

Attachment 1: Work Plan

Attach the work plan for the project that includes all information detailed in Section IV.2.ii. Project Narrative

Attachment 2: Consortium Membership

Attach the information for each consortium member detailed in the work plan (see Section IV.2.ii. Project Narrative). As a reminder, the consortium must consist of at least four separately owned entities (i.e., different EINs), including the applicant organization, and a majority (or at least 50 percent) must be located in a HRSA-designated rural area, as defined by the Rural Health Grants Eligibility Analyzer.

Attachment 3: Letter of Commitment

Attach a **single** letter of commitment signed by **all consortium members reflected in the proposed work plan**, including the applicant organization that delineates the expertise, roles, responsibilities, and commitments of each consortium member. At least 50 percent of signatories must be physically located in HRSA-designated rural areas, as defined by the Rural Health Grants Eligibility Analyzer. Electronic signatures are acceptable. If you are unable to obtain a given signature, please provide a brief explanation why.

The letter of commitment must identify each consortium member organization's roles and responsibilities in the project, the activities in which they will be included, how the organization's expertise is pertinent to the project, and the length of commitment to the project. The letter must also include a statement indicating that consortium members understand that the RCORP-Implementation award is to be used for the activities proposed in the work plan; that the activities must exclusively benefit populations in the target rural service area; and that the award is not to be used for the exclusive benefit of any one consortium member. Finally, consortium members should commit to sharing aggregate (**not** patient-level or other personally identifiable information) performance data and information with the applicant organization to fulfill HRSA reporting requirements. Stock or form letters are not recommended.

Attachment 4: Organizational Chart

Attach the one-page organizational chart in accordance with the instructions provided in Section IV.2.ii. Project Narrative.

Attachment 5: Staffing Plan

Attach the staffing plan that includes all of the information detailed in Section IV.2.ii. Project Narrative. As a reminder, all staffing plans should include a Project Director and a Data Coordinator position (the same individual may serve both roles).

Attachment 6: Staff Biographical Sketches

Attach brief biographical sketches (not to exceed one page per staff member) for each of the staff members listed on the staffing plan in accordance with the instructions provided in Section IV.2.ii. Project Narrative.

Attachment 7: Other RCORP Awards (if applicable)

Provide the following information for each additional past or current RCORP award the applicant organization has received (it is recommended you provide this information in a table format):

- Name of RCORP award (e.g., RCORP-Planning)
- Dates of award (e.g., September 30, 2018 to September 29, 2019)
- Indicate whether you serve/d as the applicant organization or consortium member
- Target rural service area for past or current RCORP award
    - For fully rural counties, list the county and state
    - For partially rural counties, list the county, state, and eligible rural census tract(s)
- Target rural service area for proposed FY 22 RCORP-Implementation award
    - For fully rural counties, list the county and state
    - For partially rural counties, list the county, state, and eligible rural census tract(s)
- List of consortium members for past or current RCORP award
- List of consortium members for proposed FY 22RCORP-Implementation award
- Detail how, if funded, activities performed under the RCORP-Implementation award will complement—and not duplicate—activities performed under current or previous RCORP awards.

Note that an applicant organization who is a current recipient of an FY20 or FY 21 RCORP-Implementation award, as either the applicant organization or consortium member, is not eligible to apply for this funding opportunity unless certain criteria are met, as detailed in the Eligibility Section of this NOFO.

Attachment 8: EIN Exception Request (if applicable)

In general, multiple applications associated with the same EIN are not allowable. However, HRSA recognizes a growing trend towards greater consolidation within the rural health care industry and the possibility that multiple organizations with the same EIN could be located in different rural service areas that have a need for SUD/OUD services. **Therefore, at HRSA discretion, separate applications associated with a single EIN may be considered for this funding opportunity if the applicants provide HRSA with the following information in Attachment 8**:

1. Names, street addresses, or EINs of the applicant organizations;
2. Name, street address, or EIN of the parent organization;
3. Names, titles, email addresses, and phone numbers for points of contact at each of the applicant organizations and the parent organization;
4. Proposed RCORP-Implementation service areas for each applicant organization (these should not overlap);
5. Justification for why each applicant organization must apply to this funding opportunity separately as the applicant organization, as opposed to serving as consortium members on other applications;
6. Assurance that the applicant organizations will each be responsible for the planning, program management, financial management, and decision making of their respective projects, independent of each other and/or the parent organization; and
7. Signatures from the points of contact at each applicant organization and the parent organization.

Applications associated with the same EIN should be independently developed and written. HRSA reserves the right to deem applications that provide insufficient information in **Attachment 8**, or are nearly identical in content, to be ineligible. In this instance, assuming all other eligibility criteria are met, HRSA will only accept the last submitted application associated with the EIN.

If multiple entities that share an EIN apply for this funding opportunity, the applicant organization names (as reflected in Box 8A of the SF-424 Application Page) should be different and reflect the names of the satellite offices/clinics. If HRSA receives multiple FY 2021 RCORP-Implementation applications with the same applicant organization name (as reflected in Box 8A of the SF-424 Application Page), only the last submitted and validated application will be reviewed.

Attachment 9: Exceptions to Service Delivery Sites

All exception requests must include a statement attesting that either the non-rural service delivery site is a primary service provider for the target rural service area and that the delivery site will directly contribute to building health service delivery infrastructure within the target rural service area (e.g., by providing mentorship/training opportunities for rural providers).

a) **Critical Access Hospitals (CAHs) that are not located in HRSA-designated rural areas** must provide the six-digit CMS Certification Number/Medicare Provider Number for the relevant service delivery site(s) in **Attachment 9**. If the service delivery site has been recently designated a CAH (less than a year ago), please submit the CAH approval letter from CMS in **Attachment 9.**

b) **Entities eligible to receive Small Rural Hospital Improvement (SHIP) funding and that are not located in HRSA-designated rural areas** must provide their six-digit CMS Certification Number/Medicare Provider Number for the relevant service delivery site(s) in **Attachment 9**. Eligible entities under this exception include hospitals that are non-federal, short-term general acute care and that: (i) are located in a rural area as defined in 42 U.S.C. 1395ww(d) and (ii) have 49 available beds or less, as reported on the hospital's most recently filed Medicare Cost Report.

c) **Entities that are located in urban areas of partially rural counties in their target service area** must provide a screenshot from the census website (2010 Census) documenting that service delivery sites are located in an incorporated city, town, or village, or unincorporated census-designated place (CDP), with 49,999 or fewer people. If the applicant searches a place and it does not appear in the Quick Facts dropdown list, this means that the place has less than 5,000 residents, and therefore, the site would be eligible. In this instance, please include screenshot documentation.

Attachments 10-15: Other Documents (if applicable)

If applicable, include other relevant documents including indirect cost rate agreements, letters of support from non-consortium members, etc.

3. Dun and Bradstreet Data Universal Numbering System (DUNS) Number Transition to the Unique Entity Identifier (UEI) and System for Award Management (SAM)

You must obtain a valid DUNS number, also known as the Unique Entity Identifier (UEI), and provide that number in the application. In April 2022, the *DUNS number will be replaced by the UEI, a "new, non-proprietary identifier" requested in, and assigned by, the System for Award Management (SAM.gov). For more details, visit the following webpages: Planned UEI Updates in Grant Application Forms and General Service Administration's UEI Update.

You must register with SAM and continue to maintain active SAM registration with current information at all times during which you have an active federal award or an application or plan under consideration by an agency (unless you are an individual or federal agency that is exempted from those requirements under 2 CFR § 25.110(b) or (c), or you have an exception approved by the agency under 2 CFR § 25.110(d))**.** For your SAM.gov registration, you must submit a notarized letter appointing the authorized Entity Administrator.

If you are chosen as a recipient, HRSA will not make an award until you have complied with all applicable SAM requirements. If you have not fully complied with the requirements by the time HRSA is ready to make an award, you may be deemed not qualified to receive an award, and HRSA may use that determination as the basis for making an award to another applicant.

If you have already completed Grants.gov registration for HRSA or another federal agency, confirm that the registration is still active and that the Authorized Organization Representative (AOR) has been approved.

Currently, the Grants.gov registration process requires information in three separate systems:

- Dun and Bradstreet (https://www.dnb.com/duns-number.html)
- System for Award Management (SAM) (https://sam.gov/content/home | SAM.gov Knowledge Base)
- Grants.gov (https://www.grants.gov/)

For more details, see Section 3.1 of HRSA's *SF-424 Application Guide*.

In accordance with the Federal Government's efforts to reduce reporting burden for recipients of federal financial assistance, the general certification and representation requirements contained in the Standard Form 424B (SF-424B) – Assurances – Non-Construction Programs, and the Standard Form 424D (SF-424D) – Assurances – Construction Programs, have been standardized. Effective January 1, 2020, the forms themselves are no longer part of HRSA's application packages; instead the updated common certification and representation requirements will be stored and maintained within SAM. Organizations or individuals applying for federal financial assistance as of January 1, 2020, must validate the federally required common certifications and representations annually through SAM.gov.

If you fail to allow ample time to complete registration with SAM or Grants.gov, you will not be eligible for a deadline extension or waiver of the electronic submission requirement.

4. Submission Dates and Times

Application Due Date
The due date for applications under this NOFO is *January 13, 2022 at 11:59 p.m. ET*. HRSA suggests submitting applications to Grants.gov at least **3 calendar days before the deadline** to allow for any unforeseen circumstances. See Section 8.2.5 – Summary of emails from Grants.gov of HRSA's *SF-424 Application Guide* for additional information.

5. Intergovernmental Review

RCORP-Implementation is subject to the provisions of Executive Order 12372, as implemented by 45 CFR part 100.

See Section 4.1 ii of HRSA's *SF-424 Application Guide* for additional information.

6. Funding Restrictions

You may request funding for a three-year period of performance for a ceiling amount of $1,000,000 (inclusive of direct **and** indirect costs). This program notice is subject to the appropriation of funds, and is a contingency action taken to ensure that, should funds become available for this purpose, HRSA can process applications and award funds appropriately.

The General Provisions in Division H of the Consolidated Appropriations Act, 2021 (P.L. 116-260) and Division A of the FY 2022 Extending Funding and Emergency Assistance Act (P.L. 117-43) are in effect at the time this NOFO is posted. Please see Section 4.1 of HRSA's SF-424 Application Guide for additional information. Awards will be made subsequent to enactment of the FY 2022 appropriation. The NOA will reference the FY 2022 appropriation act and any restrictions that may apply. Note that these or other restrictions will apply in the next fiscal year, as required by law.

You cannot use funds under this notice for the following purposes:
- To acquire real property;
- To purchase syringes;
- To supplant any services that already exist in the service area;
- For construction; and
- To pay for any equipment costs not directly related to the purposes of this award.

You are required to have the necessary policies, procedures, and financial controls in place to ensure that your organization complies with all legal requirements and restrictions applicable to the receipt of federal funding including statutory restrictions on use of funds for lobbying, executive salaries, gun control, abortion, etc. Like all other applicable grants requirements, the effectiveness of these policies, procedures, and controls is subject to audit.

Be aware of the requirements for HRSA recipients and subrecipients at 2 CFR § 200.216 regarding prohibition on certain telecommunications and video surveillance services or equipment. For details, see the HRSA Grants Policy Bulletin Number: 2021-01E.

All program income generated as a result of awarded funds must be used for approved project-related activities. Any program income earned by the recipient must be used under the addition/additive alternative. You can find post-award requirements for program income at 45 CFR § 75.307.

Minor Alteration and Renovation (A/R) Costs

Minor alteration and renovation (A/R) costs to enhance the ability of the consortium to deliver SUD/OUD services are allowable, but must not exceed $200,000 total over the three-year period of performance (or 20 percent of the total award amount). Additional post-award submission and review requirements apply if you propose to use RCORP-Implementation funding toward minor A/R costs. **You may not begin any minor A/R activities or purchases until you receive HRSA approval.** You should develop appropriate contingencies to ensure delays in receiving HRSA approval of your minor

A/R plans do not affect your ability to execute work plan activities and HRSA deliverables on time.

Examples of minor A/R include, but are not limited to:

- Reconfiguring space to facilitate co-location of SUD, mental health, and primary care services teams;
- Creating space to deliver virtual care that supports accurate clinical interviewing and assessment, clear visual and audio transmission, and ensures patient confidentiality;
- Creating or improving spaces for patients to participate in counseling and group visit services, and to access and receive training in self-management tools; and
- Modifying examination rooms to increase access to pain management options, such as chiropractic, physical therapy, acupuncture, and group therapy services.

The following activities are not categorized as minor A/R:

- Construction of a new building;
- Installation of a modular building;
- Building expansions;
- Work that increases the building footprint; and
- Significant new ground disturbance.

RCORP-Implementation award funds for minor renovations may not be used to supplement or supplant existing renovation funding; funds must be used for a new project. Pre-renovation costs (Architectural & Engineering costs prior to 90 days before the budget period start date) are unallowable.

Telehealth Infrastructure

If a service delivery site is located in an urban setting, the applicant organization may use RCORP-Implementation funds to purchase telehealth infrastructure for that site if the infrastructure will exclusively be used to provide services to rurally-located facilities within the target HRSA-designated rural service area.

Mobile Units or Vehicles

Mobile units or vehicles purchased with RCORP-Implementation award funds must be reasonably priced and used exclusively to carry out award activities. Additional post-award submission and review requirements apply if you propose to use RCORP-Implementation funding toward mobile units or vehicles. You may not begin any purchases until you receive HRSA approval. You should develop appropriate contingencies to ensure delays in receiving HRSA approval of your mobile unit or vehicle purchase do not affect your ability to execute work plan activities and HRSA deliverables on time.

Participant Support Costs

Participant support costs—i.e., direct costs for items such as stipends or subsistence allowances, travel allowances, and registration fees paid to or on behalf of participants or trainees (but not employees) in connection with conferences, or training projects—are allowable costs, subject to HRSA review and approval upon receipt of award.

NOTE: For the purposes of participant support costs, “employees” refer to individuals directly employed on an hourly, salaried or employment contract basis by the applicant organization/award recipient. Individuals employed by subcontractors, consortium members and subrecipients are not included in this definition.

Medication

Food and Drug Administration (FDA)-approved opioid agonist medications (e.g., methadone, buprenorphine products including buprenorphine/naloxone combination and buprenorphine mono-product formulations) for the maintenance treatment of OUD, opioid antagonist medication (e.g., naltrexone products) to prevent relapse to opioid use, and naloxone to treat opioid overdose are all allowable costs under RCORP-Implementation.

Payer of Last Resort

If awarded, recipients may use RCORP-Implementation funding as a payer of last resort -- i.e., all services covered by reimbursement should be billed and every effort should be made to obtain payment from third-party payers. Only after award recipients receive a final determination from the insurer regarding lack of full reimbursement can the RCORP-Implementation award be used to cover the cost of services for underinsured individuals. RCORP-Implementation award funds can also be used to cover the cost of services for uninsured patients.

*RCORP-Implementation funds **cannot** be used for the following purposes:*

- To supplant existing funding sources;
- To pay down bad debt. Bad debt is debt that has been determined to be uncollectable, including losses (whether actual or estimated) arising from uncollectable accounts and other claims. Related collection and legal costs arising from such debts after they have been determined to be uncollectable are also unallowable.
- To pay the difference between the costs to a provider for performing a service and the provider's negotiated rate with third-party payers (i.e., anticipated shortfall).

V. Application Review Information

1. Review Criteria

HRSA has procedures for assessing the technical merit of applications to provide for an objective review and to assist you in understanding the standards against which your application will be reviewed. HRSA has critical indicators for each review criterion to assist you in presenting pertinent information related to that criterion and to provide the reviewer with a standard for evaluation.

These criteria are the basis upon which the reviewers will evaluate and score the merit of the application. The entire proposal will be considered during objective review.

Six review criteria are used to review and rank RCORP-Implementation applications. Below are descriptions of the review criteria and their scoring points.

Criterion 1: NEED (20 points) – Corresponds to Section IV's "Introduction" and "Needs Assessment" sections

- The extent to which the applicant clearly outlines the project goals and anticipated outcomes of the project.
- The extent to which the applicant clearly defines and describes the target rural service area.
- The quality and relevance of the data that the applicant provides to demonstrate the target rural service area's need in the "Needs Assessment" section of the Project Narrative.
- The quality and appropriateness of the sources used to provide the data/information in the "Needs Assessment" section of the Project Narrative, **or** if the applicant is unable to locate appropriate and accurate data, the extent to which they provide an explanation for why the data could not be found and how they will leverage the RCORP-Implementation award to strengthen the quality and availability of OUD/SUD data in their target rural service area;
- The extent to which the applicant demonstrates that the target population's need for SUD/OUD prevention, treatment, and recovery services is high compared to the rest of the state, region, and/or country.
- The level of detail and clarity with which the applicant describes the target rural population, including the subpopulations most at risk for and/or most likely to be diagnosed with OUD and those who have historically suffered from poorer health outcomes, health disparities, and other inequities compared to the rest of the target population.
- The thoroughness with which the applicant details the existing SUD/OUD services in the target rural service area, including the anticipated impact the RCORP-Implementation project will have on those services.
- The thoroughness with which the applicant details the SUD/OUD needs and gaps within the target rural service area.

Criterion 2: RESPONSE (30 points) – Corresponds to Section IV's "Methodology," "Work Plan," and "Resolution of Challenges" sections

Methodology (10 points):

- The clarity and comprehensiveness of the applicant's proposed methods for fulfilling all core activities, as outlined in Section IV.2 of the NOFO.
    - If applicable, the extent to which the applicant details methods for fulfilling any additional activities and provides compelling justification for how those activities will advance RCORP's goal and fulfill the needs of the target population.
- The extent to which the proposed methods improve health care in the target rural area and:
    - Reduce stigma associated with SUD/OUD and other barriers to care;
    - Minimize the potential for developing SUD/OUD
    - Minimize the potential for individuals with SUD/OUD to develop infectious complications and other co-occurring disorders;
    - Support integration of health care delivery and social services;

  - Improve health access and reduce outcome disparities experienced by vulnerable populations within the target rural service area;
  - Secure target populations support and engagement;
  - Support the consortium's ability to report accurate, reliable data to fulfill HRSA's reporting requirements; and
  - Improve family, caregivers, and community members' understanding of SUD/OUD services and their ability to navigate SUD/OUD treatment options.
- The appropriateness of the methods proposed for fulfilling all core and additional activities given the needs and characteristics of the target population.
- The clarity and comprehensiveness of the applicant's proposed methods to ensure programmatic and financial sustainability of the proposed activities beyond the period of performance.

Work Plan (15 points):
- The clarity and completeness of the proposed work plan, including its inclusion of:
  - Responsible individuals and/or consortium members;
  - Feasible timeframes for achieving tasks/sub-activities ("ongoing" is not an acceptable timeframe);
  - Description of how each proposed task will improve health care delivery in rural areas;
  - Specific tasks/sub-activities to achieve all core activities and the deliverables associated with each core activity and, if applicable, additional activity(ies).
- The clarity with which the work plan reflects a three-year period of performance;
- The comprehensiveness and feasibility of the processes detailed for decreasing health access and outcome disparities within the target rural service area as identified by the applicant in the needs assessment;
- The extent to which the work plan details processes for achieving financial and programmatic sustainability beyond the period of performance, including the deliverables, responsible individuals and/or consortium members, and timelines associated with these processes; and
- The extent to which the work plan includes specific activities related to the tracking and collection of aggregate data and other information from consortium members to fulfill reporting requirements.

Resolution of Challenges (5 points):
- The clarity with which the applicant describes both internal and external challenges they are likely to face in implementing their proposed work plan, and the quality and feasibility of the solutions proposed to address them; and
- The extent to which the applicant details potential challenges and solutions to sustaining services after the period of performance ends.

Criterion 3: EVALUATIVE MEASURES (10 points) – Corresponds to Section IV's "Evaluation and Technical Support Capacity" and "Organizational Information" sections

- The clarity and comprehensiveness of the applicant's proposed processes (including staffing and workflow) for tracking, collecting, aggregating, and reporting data and information from all consortium members to fulfill HRSA reporting requirements;
- The clarity with which the applicant designates at least one qualified individual in the staffing plan (**Attachment 5**) to serve as a "Data Coordinator"; and
- The extent to which the Letter of Commitment (**Attachment 3**) contains an explicit commitment by consortium members to sharing aggregate (**not** patient-level or other personally identifiable information) performance data and information with the applicant organization to fulfill HRSA reporting requirements.

Criterion 4: IMPACT (10 points) – Corresponds to Section IV's "Evaluation and Technical Support Capacity" section

- The clarity and comprehensiveness of the applicant's proposed plan for updating participating entities, the target rural service area, and the broader public on the program's activities, lessons learned, and success stories; and
- The extent to which the applicant provides examples of mediums and platforms for disseminating this information.

Criterion 5: RESOURCES/CAPABILITIES (20 points) – Corresponds to Section IV's "Organizational Information" section

- The clarity with which the applicant demonstrates that the consortium is comprised of at least four separately owned (i.e., different EINs) entities, including the applicant organization (**see Attachment 2**);
    - **Note: Tribal applicants are exempt from this requirement (applicant organizations will indicate whether they are a tribal entity in the Project Abstract). Applicants who meet this exception should not be penalized for not meeting this criteria during the review process**
- The clarity with which the applicant demonstrates that at least 50 percent of the consortium members are physically located in HRSA-designated rural areas, as defined by Rural Health Grants Eligibility Analyzer (**see Attachment 2**);
- The clarity with which the applicant details consortium members representation of diverse sectors and disciplines;
- The clarity with which the applicant demonstrates that all services will be provided exclusively in HRSA-designated rural areas, as defined by Rural Health Grants Eligibility Analyzer or meets the exception requirements **(Attachments 9, 10,12);**
- The extent to which all consortium members reflected in the proposed work plan, including the applicant organization, have signed and dated a **single** letter of commitment (**Attachment 3**) that contains, at a minimum, the following elements:
    - Description of each consortium member organization's roles and responsibilities in the project, the activities in which they will be included, how the organization's expertise is pertinent to the project, and the length of commitment to the project;

- A statement indicating that consortium members understand that the RCORP-Implementation award is to be used for the activities proposed in the work plan; that the activities must exclusively benefit populations in the target rural service area; and that the award is not to be used for the exclusive benefit of any one consortium member; and
- An explicit commitment by consortium members to sharing aggregate (**not** patient-level or other personally identifiable information) performance data and information with the applicant organization to fulfill HRSA reporting requirements.
- **Note: Tribal applicants are exempt from the four separate EINs requirement.**

- The clarity of the Organizational Chart (**Attachment 4**) and extent to which it depicts the relationships and/or hierarchy among all consortium members participating in the project.

Criterion 6: SUPPORT REQUESTED (10 points) – Corresponds to Section IV's "Budget and Budget Narrative" section

- The degree to which the estimated cost to the government for proposed award-funded activities is reasonable given the scope of work;
- The extent to which the applicant includes a budget and budget narrative for each of the three years of the award;
- The extent to which the applicant allocates the award across a three-year period of performance (i.e., the applicant should not plan to spend the entire award in the first two years); and
- The clarity and comprehensiveness of the budget narrative, including the extent to which the applicant logically documents how and why each line item request (such as personnel, travel, equipment, supplies, and contractual services) supports the goals and activities of the proposed work plan and project.

2. Review and Selection Process

The objective review process provides an objective evaluation of applications to the individuals responsible for making award decisions. The highest ranked applications receive consideration for award within available funding ranges. HRSA may also consider assessment of risk and the other pre-award activities described in Section 3 below. See Section 5.3 of HRSA's *SF-424 Application Guide* for more details.

3. Assessment of Risk

HRSA may elect not to fund applicants with management or financial instability that directly relates to the organization's ability to implement statutory, regulatory, or other requirements (45 CFR § 75.205).

HRSA reviews applications receiving a favorable objective review for other considerations that include past performance, as applicable; cost analysis of the project/program budget; assessment of your management systems, ensuring continued applicant eligibility; and compliance with any public policy requirements, including those requiring just-in-time submissions. HRSA may ask you to submit additional programmatic or administrative information (such as an updated budget or "other support" information) or to undertake certain activities (such as negotiation of an indirect cost rate) in anticipation of an award. However, even at this point in the process, such requests do not guarantee that HRSA will make an award. Following review of all applicable information, HRSA's approving and business management officials will determine whether HRSA can make an award, if special conditions are required, and what level of funding is appropriate.

Award decisions are discretionary and are not subject to appeal to any HRSA or HHS official or board.

HRSA is required to review and consider any information about your organization that is in the Federal Awardee Performance and Integrity Information System (FAPIIS). You may review and comment on any information about your organization that a federal awarding agency previously entered. HRSA will consider your comments, in addition to other information in FAPIIS in making a judgment about your organization's integrity, business ethics, and record of performance under federal awards when completing the review of risk as described in 45 CFR § 75.205 HHS Awarding Agency Review of Risk Posed by Applicants.

HRSA will report to FAPIIS a determination that an applicant is not qualified (45 CFR § 75.212).

VI. Award Administration Information

1. Award Notices

HRSA will release the Notice of Award (NOA) on or around the start date of September 1, 2022. See Section 5.4 of HRSA's *SF-424 Application Guide* for additional information.

2. Administrative and National Policy Requirements

See Section 2.1 of HRSA's *SF-424 Application Guide*.

If you are successful and receive a NOA, in accepting the award, you agree that the award and any activities thereunder are subject to:

- all provisions of 45 CFR part 75, currently in effect or implemented during the period of the award,
- other federal regulations and HHS policies in effect at the time of the award or implemented during the period of award, and
- applicable statutory provisions.

Accessibility Provisions and Non-Discrimination Requirements
Federal funding recipients must comply with applicable federal civil rights laws. HRSA supports its recipients in preventing discrimination, reducing barriers to care, and promoting health equity. Non-discrimination legal requirements for recipients of HRSA federal financial assistance are available at the following address: https://www.hrsa.gov/about/organization/bureaus/ocrdi#non-discrimination. For more information on recipient civil rights obligations, visit the HRSA Office of Civil Rights, Diversity, and Inclusion website.

Executive Order on Worker Organizing and Empowerment
Pursuant to the Executive Order on Worker Organizing and Empowerment, HRSA strongly encourages applicants to support worker organizing and collective bargaining and to promote equality of bargaining power between employers and employees. This may include the development of policies and practices that could be used to promote worker power. Applicants can describe their plans and specific activities to promote this activity in the application narrative.

Requirements of Subawards
The terms and conditions in the NOA apply directly to the recipient of HRSA funds. The recipient is accountable for the performance of the project, program, or activity; the appropriate expenditure of funds under the award by all parties; and all other obligations of the recipient, as cited in the NOA. In general, the requirements that apply to the recipient, including public policy requirements, also apply to subrecipients under awards, and it is the recipient's responsibility to monitor the compliance of all funded subrecipients. See 45 CFR § 75.101 Applicability for more details.

Data Rights
All publications developed or purchased with funds awarded under this notice must be consistent with the requirements of the program. Pursuant to 45 CFR § 75.322(b), the recipient owns the copyright for materials that it develops under an award issued pursuant to this notice, and HHS reserves a royalty-free, nonexclusive, and irrevocable right to reproduce, publish, or otherwise use those materials for federal purposes, and to authorize others to do so. In addition, pursuant to 45 CFR § 75.322(d), the Federal Government has the right to obtain, reproduce, publish, or otherwise use data produced under this award and has the right to authorize others to receive, reproduce, publish, or otherwise use such data for federal purposes, e.g., to make it available in government-sponsored databases for use by others. If applicable, the specific scope of HRSA rights with respect to a particular grant-supported effort will be addressed in the NOA. Data and copyright-protected works developed by a subrecipient also are subject to the Federal Government's copyright license and data rights.

3. Reporting

Award recipients must comply with Section 6 of HRSA's *SF-424 Application Guide* **and** the following reporting and review activities:

a) **Progress Report**. The recipient must submit a progress report to HRSA on a **biannual** basis. These progress reports should reflect data and information from across consortium members, not just the applicant organization. These reports should reflect award recipients' progress towards completing the core/required activities as outlined in this NOFO to ensure that continuation of the award is in the best interests of the Federal government. More information will be provided upon receipt of award.

b) **Performance Improvement Measurement System (PIMS) Reports.** The recipient must submit quantitative performance reports on a **biannual basis** to demonstrate that their project is advancing the overall goal of RCORP of strengthening and expanding prevention, treatment, and recovery services for rural individuals who misuse opioids to enhance their ability to access treatment and move towards recovery. These data should reflect the performance of all consortium members, not just the applicant organization. Performance indicators have been developed and approved for RCORP-Implementation and focus on service provision, workforce, sustainability, and demographics. As a reminder, RCORP-Implementation award recipients are expected to work with a HRSA-funded evaluator to take part in a larger, RCORP-wide evaluation. Further information will be provided upon receipt of award.

c) **Sustainability Plan.** Building off the sustainability strategies outlined in your application, award recipients will submit a sustainability plan that identifies strategies for achieving programmatic and financial sustainability beyond the period of performance and ensuring that services remain accessible and affordable to individuals who need them most, including the uninsured and the underinsured. HRSA will provide further information during the period of performance.

d) **Mental/Behavioral Health Disparities Impact Statement.** The award recipient will submit an "Impact Statement" within the first nine months of the award that describes how the consortium will reduce mental/behavioral health disparities in the target rural service area and continuously monitor and measure the project's impact on health disparities to inform process and outcome improvements. This deliverable will be modeled from the Substance Abuse and Mental Health Services Administration (SAMHSA) Disparities Impact Statement (DIS), and will entail developing a plan to improve access to care, use of service and outcomes related to behavioral health disparities of the identified subpopulation(s) within the target rural service area. The plan should identify subpopulation(s) within the target rural service area experiencing disparities, current access/use of care, capacity building needs, quality of care, prevalence of SUD and psychostimulant use. In this statement, you may be asked to include elements, including, but not limited to: (1) the number of individuals to be reached during the award period and identify subpopulations (i.e., racial, ethnic, sexual, and gender minority groups) vulnerable to behavioral health disparities; (2) a quality improvement plan for the use of program data on access, use, and outcomes to support efforts to decrease the differences in access to care, use of services, and outcomes of award activities; and (3) methods for the development of policies and procedures to ensure adherence to the National Culturally and

Linguistically Appropriate Services Standards. Further information will be provided during the period of performance.

e) **Federal Financial Report (FFR).** The FFR (SF-425) is required no later than January 30 for each budget period. The report is an accounting of expenditures under the project that year. The recipient must submit financial reports electronically. HRSA will provide more detailed information in the NOA.

f) **Integrity and Performance Reporting.** The NOA will contain a provision for integrity and performance reporting in FAPIIS, as required in 45 CFR part 75 Appendix XII.

Note that the OMB revisions to Guidance for Grants and Agreements termination provisions located at 2 CFR § 200.340 - Termination apply to all federal awards effective August 13, 2020. No additional termination provisions apply unless otherwise noted.

VII. Agency Contacts

You may request additional information and/or technical assistance regarding business, administrative, or fiscal issues related to this NOFO by contacting:

Benoit Mirindi, PhD, MPH.
Grants Management Specialist
Division of Grants Management Operations, OFAM
Health Resources and Services Administration
5600 Fishers Lane, Mailstop 10SWH03
Rockville, MD 20857
Telephone: (301) 443-6606
Email: bmirindi@hrsa.gov

You may request additional information regarding the overall program issues and/or technical assistance related to this NOFO by contacting:

Sabrina Frost
Public Health Analyst
Attn: RCORP-Implementation
Federal Office of Rural Health Policy
Health Resources and Services Administration
5600 Fishers Lane
Rockville, MD 20857
Telephone: (301) 945-5131
Email: sfrost@hrsa.gov

You may need assistance when working online to submit your application forms electronically. Always obtain a case number when calling for support. For assistance with submitting the application in Grants.gov, contact Grants.gov 24 hours a day, 7 days a week, excluding federal holidays at:

Grants.gov Contact Center
Telephone: 1-800-518-4726 (International callers, please dial 606-545-5035)
Email: support@grants.gov
Self-Service Knowledge Base: https://grants-portal.psc.gov/Welcome.aspx?pt=Grants

Successful applicants/recipients may need assistance when working online to submit information and reports electronically through HRSA's Electronic Handbooks (EHBs). Always obtain a case number when calling for support. For assistance with submitting information in the EHBs, contact the HRSA Contact Center, Monday–Friday, 7 a.m. to 8 p.m. ET, excluding federal holidays at:

HRSA Contact Center
Telephone: (877) 464-4772 / (877) Go4-HRSA
TTY: (877) 897-9910
Web: http://www.hrsa.gov/about/contact/ehbhelp.aspx

VIII. Other Information

Technical Assistance

HRSA has scheduled following technical assistance:

Webinar

Day and Date: Wednesday, November 10, 2021
Time: 12:30 – 2:00 p.m. ET
Call-In Number: 1-833-568-8864
Meeting ID: 160 852 4742
Passcode: 23233962
Weblink: https://hrsa-gov.zoomgov.com/j/1608524742?pwd=UFJvcGs5bHFiYXRkcGRleFd6REpnZz09

The webinar will be recorded. Please email ruralopioidresponse@hrsa.gov for a link to the recording.

Tips for Writing a Strong Application

See Section 4.7 of HRSA's *SF-424 Application Guide*.

Appendix A: Rural Communities Opioid Response Program (RCORP) and the National Health Service Corps (NHSC)

HRSA encourages award recipients to leverage National Health Service Corps funding to strengthen the SUD workforce in rural communities. The Further Consolidated Appropriations Act, 2021 (P.L.116-260) appropriated funding to the NHSC for the purpose of expanding and improving access to quality Opioid Use Disorder (OUD) and other SUD treatment in underserved areas nationwide. A portion of the NHSC's funding will be used for rural workforce expansion to combat the opioid epidemic, which has had a particularly significant impact on rural communities. Accordingly, the NHSC Rural Community LRP will make loan repayment awards in coordination with the Rural Communities Opioid Response Program (RCORP) initiative within the Federal Office of Rural Health Policy (FORHP).

A part of this initiative, the NHSC Rural Community Loan Repayment Program (LRP) will recruit and retain medical, nursing, and behavioral/mental health clinicians with specific training and credentials, and are part of an integrated care team, providing evidence-based SUD treatment and counselling in eligible communities of need, designated as Health Professional Shortage Areas (HPSAs). The NHSC will make awards of up to $100,000 for three years to eligible providers under the NHSC Rural Community LRP. HRSA seeks providers with Drug Addiction Treatment Act of 2000 (DATA) waivers and SUD-licensed or SUD-certified professionals to provide quality evidence-based SUD treatment health care services at SUD treatment facilities located in Health Professional Shortage Areas (HPSAs). For this initiative, the NHSC Rural Community LRP has expanded the list of eligible disciplines to include pharmacists, registered nurses, SUD counselors and nurse anesthetists. NHSC Rural Community LRP will provide a funding preference for applicants serving at rural NHSC-approved SUD treatment facilities that are RCORP Consortium member sites.

Eligibility
To be eligible for NHSC service, a provider must:

- Be a U.S. citizen or national;
- Currently work, or have accepted employment , at a rural-NHSC-approved site;
- Have unpaid government or commercial loans for school tuition, reasonable educational expenses, and reasonable living expenses, segregated from all other debts; and
- Be licensed to practice in state where the employer site is located.

Eligible Occupations
Members of the SUD integrated treatment team who qualify for NHSC SUD expansion include:

Primary Care:
Physician (MD or DO)
Nurse Practitioner
Certified Nurse-Midwife
Physician Assistant

New Program Disciplines:
Substance Use Disorder Counselors
Pharmacists
Registered Nurses
Nurse Anesthetists (RCORP NHSC LRP only)

Mental Health:
Physicians (MD or DO)
Health Service Psychologist
Licensed Clinical Social Worker
Psychiatric Nurse Specialist
Marriage and Family Therapist
Professional Counselor
Physician Assistant
Nurse Practitioners

Eligible Site Criteria
NHSC-approved sites must:

- Be located in and serve a federally designated HPSA;
- Be an outpatient facility providing SUD services;
- Utilize and prominently advertise a qualified discounted/sliding fee schedule (SFS) for individuals at or below 200 percent of the federal poverty level;
- Not deny services based on inability to pay or enrollment in Medicare, Medicaid, and Children's Health Insurance Program (CHIP);
- Ensure access to ancillary, inpatient, and specialty care;
- Have a credentialing process that includes a query of the National Practitioner Data Bank; and
- Meet all requirements listed in the NHSC Site Agreement.

For more complete information about site eligibility and the site application process, please see the NHSC Site webpage and the NHSC Site Reference Guide. For a list of current NHSC-approved sites, please see HRSA's Health Workforce Connector.

Eligible Site Types
Regular Application Process:
1. Certified Rural Health Clinics;
2. State or Local Health Departments;
3. State Prisons;
4. Community Mental Health Centers;
5. School-Based Clinics;
6. Mobile Units/Clinics;
7. Free Clinics;
8. Critical Access Hospitals (CAH);
9. Community Outpatient Facilities; and
10. Private Practices.

Newly-eligible SUD Site Types:
1. Opioid Treatment Program (OTP);
2. Office-based Opioid Agonist Treatment (OBOT); and
3. Non-Opioid SUD treatment sites.

Auto-Approval Process:
1. Federally-Qualified Health Centers (FQHC);
2. FQHC Look-Alikes;
3. American Indian Health Facilities: Indian Health Service (IHS) Facilities, Tribally Operated 638 Health Programs, and Urban Indian Health Programs);
4. Federal Prisons; and
5. Immigration and Customs Enforcement.

Please note that all NHSC sites must deliver comprehensive mental/behavioral health on an outpatient basis, with the exception of CAHs and IHS hospitals. NHSC-approved sites must provide services for free or on a SFS to low-income individuals, and:
1. Offer a full (100 percent) discount to those at or below 100 percent of the federal poverty level;
2. Offer discounts on a sliding scale up to 200 percent of the federal poverty level;
3. Use the most recent HHS Poverty Guidelines;
4. Utilize family size and income to calculate discounts (not assets or other factors); and
5. Have this process in place for a minimum of 6 months.

Note:
• A health care organization of a consortium must receive NHSC site approval prior to members of their workforce applying for NHSC Rural Community Loan Repayment Program.
• Consortium members do not receive auto-approval based on their RCORP status.

Consortium members must meet all NHSC site eligibility criteria. All NHSC sites, except SUD treatment facilities, Critical Access Hospitals and Indian Health Service Hospitals, are required to provide an appropriate set of services for the community and population they serve. NHSC-approved sites must provide services for free or on a sliding fee schedule to low-income individuals. More information can be found here.

Additional information on the SFS can be found in the recently updated SFS Information Package.

Appendix B: Resources for Applicants

Several sources offer data and information that may help you in preparing the application. Please note HRSA is not affiliated with all of the resources provided, however, you are especially encouraged to review the reference materials available at the following websites:

HRSA Resources:

- **HRSA Rural Communities Opioid Response Program (RCORP) Website**
  Provides information regarding HRSA's RCORP initiative.
  Website: https://www.hrsa.gov/rural-health/rcorp
  RCORP Technical Assistance website: https://www.rcorp-ta.org/
  RCORP-Rural Centers of Excellence on Substance Use Disorder:
  https://www.hrsa.gov/rural-health/rcorp/rcoe

- **HRSA Opioids Website**
  Offers information regarding HRSA-supported opioid resources, technical assistance and training.
  Website: https://www.hrsa.gov/opioids

- **HRSA Data Warehouse**
  Provides maps, data, reports and dashboard to the public. The data integrate with external sources, such as the U.S. Census Bureau, providing information about HRSA's grants, loan and scholarship programs, health centers and other public health programs and services.
  Website: https://datawarehouse.hrsa.gov/

- **Ending the HIV Epidemic: A Plan for America**
  Learn how HRSA—in conjunction with other key HHS agencies, including the Centers for Disease Control and Prevention (CDC), the National Institutes of Health (NIH), the Indian Health Service (IHS), and the Substance Abuse and Mental Health Services Administration (SAMHSA)—is supporting the President's new initiative to reduce new HIV infections by 75 percent in the next five years and by 90 percent in the next 10 years.
  Website: https://www.hiv.gov/federal-response/ending-the-hiv-epidemic/overview

- **UDS Mapper**
  The UDS Mapper is a mapping and decision-support tool driven primarily from data within the Uniform Data System. It is designed to help inform users about the current geographic extent of U.S. federal (Section 330) Health Center Program award recipients and look-alikes. Applicants can use this resource to locate other collaborative partners.
  Website: https://www.udsmapper.org/index.cfm

- **National Health Service Corps (NHSC)**
  HRSA's Bureau of Health Workforce administers the NHSC Loan Repayment Program, which is authorized to provide loan repayment to primary health care professionals in exchange for a commitment to serve in a Health Professional Shortage Area.

  - For general information about NHSC, please visit: https://nhsc.hrsa.gov/
  - For state point of contacts, please visit here: https://nhsc.hrsa.gov/sites/helpfullcontacts/drocontactlist.pdf

- **Primary Care Offices (PCOs)**
  The PCOs are state-based offices that provide assistance to communities seeking health professional shortage area designations and recruitment assistance as NHSC-approved sites. To locate contact information for all of the PCOs, visit here: https://bhw.hrsa.gov/shortage-designation/hpsa/primary-care-offices

Other Resources:

- **American Society of Addiction Medicine (ASAM)**
  Offers a wide variety of resources on addiction for physicians and the public.
  Website: https://www.asam.org/resources/the-asam-criteria/about

- **Case Study: Medication Assisted Treatment Program for Opioid Addiction**
  Learn about Vermont's Hub & Spoke Model for treating opioid addiction here: http://www.astho.org/Health-Systems-Transformation/Medicaid-and-Public-Health-Partnerships/Case-Studies/Vermont-MAT-Program-for-Opioid-Addiction/

- **Centers for Disease Control and Prevention (CDC)**
  Offers a wide variety of opioid-related resources, including nationwide data, state-specific information, prescription drug monitoring programs, and other useful resources, such as the *Guideline for Prescribing Opioids for Chronic Pain*.
  Website: https://www.cdc.gov/drugoverdose/opioids/index.html

  - ***Managing HIV and Hepatitis C Outbreaks Among People Who Inject Drugs: A Guide for State and Local Health Departments (March 2018):*** https://www.cdc.gov/hiv/pdf/programresources/guidance/cluster-outbreak/cdc-hiv-hcv-pwid-guide.pdf

  - **National Center for Health Statistics**
    Provides health statistics for various populations.
    Website: http://www.cdc.gov/nchs/

  - **Syringe Services Programs**
    For more information on these programs and how to submit a Determination of Need request visit here: https://www.cdc.gov/hiv/risk/ssps.html

- **Community Health Systems Development Team at the Georgia Health Policy Center**
  Offers a library of resources on topics such as collaboration, network infrastructure, and strategic planning.
  Website: http://ruralhealthlink.org/Resources/ResourceLibrary.aspx

- **Legal Services Corporation**
  Legal Services Corporation (LSC) is an independent nonprofit established by Congress in 1974 to provide financial support for civil legal aid to low-income Americans.
  Website: https://www.lsc.gov/

- **National Area Health Education Center (AHEC) Organization**
  The National AHEC Organization supports and advances the AHEC Network to improve health by leading the nation in recruitment, training and retention of a diverse health work force for underserved communities.
  Website: http://www.nationalahec.org/

- **National Association of County and City Health Officials (NACCHO)** NACCHO created a framework that demonstrates how building consortiums among local health departments, community health centers, health care organizations, offices of rural health, hospitals, nonprofit organizations, and the private sector is essential to meet the needs of rural communities.
  Website: http://archived.naccho.org/topics/infrastructure/mapp/

- **National Institutes of Health (NIH)**
  - **HEALing Communities Study:** Learn about the multi-site implementation research study launched by NIH and SAMHSA to test the impact of an integrated set of evidence-based practices across health care, behavioral health, justice, and other community-based settings.
    Website: https://heal.nih.gov/research/research-to-practice/healing-communities

  - **National Institute on Drug Abuse (NIDA):** NIDA advances science on the causes and consequences of drug use and addiction and applies that knowledge to improve individual and public health.
    Website: https://www.drugabuse.gov/about-nida

- **National Opinion Research Center (NORC) at the University of Chicago—Overdose Mapping Tool**
  NORC and the Appalachian Regional Commission have created the Overdose Mapping Tool to allow users to map overdose hotspots in Appalachia and overlay them with data that provide additional context to opioid addiction and death.
  Website: http://overdosemappingtool.norc.org/

- **National Organization of State Offices of Rural Health (NOSORH)—Toolkit**
  NOSORH published a report on lessons learned from HRSA's Rural Opioid Overdose Reversal Grant Program and compiled a number of tools and resources communities can use to provide education and outreach to various stakeholders.
  Website: https://nosorh.org/rural-opioid-overdose-reversal-program/

- **Providers Clinical Support System**
  PCSS is a program funded by the Substance Abuse and Mental Health Services Administration (SAMHSA) created in response to the opioid overdose epidemic to train primary care providers in the evidence-based prevention and treatment of opioid use disorders (OUD) and treatment of chronic pain.
  Website: https://pcssnow.org/

- **Primary Care Associations (PCAs)**
  To locate contact information for all of the PCAs, visit here:
  http://www.nachc.org/about-nachc/state-affiliates/state-regional-pca-listing/

- **Rural Health Information Hub – Community Health Gateway**
  Offers evidence-based toolkits for rural community health, including systematic guides, rural health models and innovations, and examples of rural health projects other communities have undertaken.
  Website: https://www.ruralhealthinfo.org/community-health

  - **Rural Health Information Hub – Rural Response to Opioid Crisis**
    Provides activities underway to address the opioid crisis in rural communities at the national, state, and local levels across the country.
    Website: https://www.ruralhealthinfo.org/topics/opioids

  - **Rural Health Information Hub - Rural Prevention and Treatment of Substance Abuse Toolkit**
    Provides best practices and resources that organizations can use to implement substance abuse prevention and treatment programs.
    Website: https://www.ruralhealthinfo.org/toolkits/substance-abuse

- **Rural Health Research Gateway**
  Provides access to projects and publications of the HRSA-funded Rural Health Research Centers, 1997-present, including projects pertaining to substance use disorder.
  Website: http://www.ruralhealthresearch.org/

- **Substance Abuse and Mental Health Services Administration (SAMHSA)** Offers a wide variety of resources on the opioid epidemic, including data sources, teaching curriculums, evidence-based and best practices, and information on national strategies and initiatives.
  Website: https://www.samhsa.gov/

  - **SAMHSA Evidence-Based Practices Resource Center**
    Contains a collection of scientifically based resources for a broad range of audiences, including Treatment Improvement Protocols, toolkits, resource guides, clinical practice guidelines, and other science-based resources.
    Website: https://www.samhsa.gov/ebp-resource-center

  - **SAMHSA State Targeted Response to the Opioid Crisis Grants**
    This program awards grants to states and territories and aims to address the opioid crisis by increasing access to treatment, reducing unmet treatment need, and reducing opioid overdose related deaths through the provision of prevention, treatment and recovery activities for OUD.
    List of individual grant award activities:
    https://www.samhsa.gov/sites/default/files/grants/pdf/other/ti-17-014-opioid-str-abstracts.pdf

  - **SAMHSA State Opioid Response Grants**
    The program aims to address the opioid crisis by increasing access to medication-assisted treatment using the three FDA-approved medications for the treatment of opioid use disorder, reducing unmet treatment need, and reducing opioid overdose related deaths through the provision of prevention, treatment and recovery activities for opioid use disorder (OUD) (including prescription opioids, heroin and illicit fentanyl and fentanyl analogs).

Website: https://www.samhsa.gov/grants/grant-announcements/ti-18-015
List of awarded states: https://www.hhs.gov/about/news/2019/09/04/state-opioid-response-grants-by-state.html

- **SAMHSA Peer Recovery Resources**
  - https://www.samhsa.gov/brss-tacs
  - https://www.samhsa.gov/brss-tacs/recovery-support-tools/peers/core-competencies-peer-workers

- **Other Opioid Use Disorder Resources**
  - "TIP 63: Medications for Opioid Use Disorder"
    https://store.samhsa.gov/product/TIP-63-Medications-for-Opioid-Use-Disorder-Full-Document/PEP20-02-01-006
  - "The ASAM National Practice Guideline for the Treatment of Opioid Use Disorder – 2020 Focused Update"
    https://www.asam.org/Quality-Science/quality/2020-national-practice-guideline

- **State Offices of Rural Health (SORHs)**
  All 50 states have a SORH. These offices vary in size, scope, organization, and in services and resources, they provide. The general purpose of each SORH is to help their individual rural communities build health care delivery systems.
  List of and contact information for each SORH: https://nosorh.org/nosorh-members/nosorh-members-browse-by-state/

- **State Rural Health Associations (SRHAs)**
  To locate contact information for all of the SRHAs, visit here:
  https://www.ruralhealthweb.org/programs/state-rural-health-associations

- **U.S. Department of Agriculture (USDA)**
  Provides information and resources—including relevant USDA funding opportunities such as the Community Facilities Loan and Grant Program—for rural communities that want to address the opioid epidemic. Visitors can also share feedback on what prevention, treatment and recovery actions have been effective in addressing the opioid epidemic in their rural communities.
  Website: https://www.usda.gov/topics/opioids

- **U.S. Department of Labor**
  - **Federal Bonding Program:** The U.S. Department of Labor established The Federal Bonding Program in 1966 to provide Fidelity Bonds for "at-risk," hard-to-place job seekers. The bonds cover the first six months of employment at no cost to the job applicant or the employer.
    Website: https://nicic.gov/federal-bonding-program-us-department-labor-initiative

  - **Work Opportunity Tax Credit:** The Work Opportunity Tax Credit (WOTC) is a federal tax credit available to employers for hiring individuals from certain target groups who have consistently faced significant barriers to employment.
    Website: https://www.doleta.gov/business/incentives/opptax/

- **U.S. Department of Health and Human Services (HHS)**
  Provides resources and information about the opioid epidemic, including HHS' 5-point strategy to combat the opioid crisis.
  https://www.hhs.gov/opioids/
  https://www.outreach.usda.gov/USDALocalOffices.htm

Appendix C: Potential Consortium Members

Examples of potential partner organizations include, but are not limited to:

- Community Members, such as:
    - Individuals in Recovery;
    - Youth;
    - Parents;
    - Grandparents;
    - Individuals who have historically suffered from poorer health outcomes, health disparities, and other inequities, as compared to the rest of the target population;

- Health care providers, such as:
    - Critical access hospitals or other hospitals;
    - Rural health clinics
    - Local or state health departments;
    - Federally qualified health centers;
    - Ryan White HIV/AIDS clinics and community-based organizations;
    - Substance abuse treatment providers;
    - Mental and behavioral health organizations or providers;
    - Opioid Treatment Programs;
- HIV and HCV prevention organizations;
- Entities that are owned or managed by people from minority groups;
- Single State Agencies (SSAs);
- Prisons;
- Primary Care Offices;
- State Offices of Rural Health;
- Law enforcement;
- Cooperative Extension System Offices;
- Emergency Medical Services entities;
- School systems;
- Primary Care Associations;
- Poison control centers;
- Maternal, Infant, and Early Childhood Home Visiting Program local implementing agencies;
- Universities;
- Healthy Start sites; and
- Other social service agencies and organizations.

Appendix D: Allowable Additional Activities (Optional)

While RCORP-Implementation award recipients are required to implement all core/required activities outlined in the Program-Specific Instructions section of this NOFO, HRSA recognizes that some applicants may have the capacity (e.g., staffing, infrastructure, resources, etc.) to pursue additional activities beyond the core/required activities. Under these circumstances, award recipients may propose additional activities that aim to improve health care and reduce SUD/OUD morbidity and mortality in high-risk rural communities.[11] Proposals for additional activities will be evaluated on a case-by-case basis by HRSA Program Staff. Examples include, but are not limited to, the following:

1. Advance telehealth direct care and consultation approaches to MAT. Note that the Drug Enforcement Agency (DEA) has issued a clarification of current law allowing the prescribing of MAT via telehealth under certain circumstances.

2. Create space to deliver virtual care that supports accurate clinical interviewing and assessment, clear visual and audio transmission, and ensures patient confidentiality.

3. Purchase Food and Drug Administration (FDA)-approved opioid agonist medications (e.g., methadone, buprenorphine products including buprenorphine/naloxone combination and buprenorphine mono-product formulations) for the maintenance treatment of OUD, opioid antagonist medication (e.g., naltrexone products) to prevent relapse to opioid use, and naloxone to treat opioid overdose.

4. Perform minor renovations to facilitate co-location of SUD, mental health, and primary care services teams. Please reference the Funding Restrictions section of the NOFO for more information on minor renovations.

5. Provide training and education to patients, families, and communities on SUD prevention and treatment, mental health, neo-natal abstinence syndrome, trauma-informed care, suicide prevention, and opioid overdose.

6. Test and implement new payment models that facilitate and incentivize coordinated care.

7. Implement or expand access to evidence-based and/or promising practices that enhance better pain management through implementing opioid prescribing guidelines and other evidence-based methods of pain management.

8. Identify at least one individual within the consortium who has the capacity and ability to manage HIV care and treatment; understands the HIV care continuum to better identify gaps in HIV services; and can develop strategies to improve engagement in care and outcomes for people with HIV.

[11] Applicants will demonstrate the level of need and risk in their communities in the Project Narrative section of this NOFO.

9. Provide support for pregnant and postpartum women to enter and adhere to family centered OUD treatment, reduce the risk of relapse, and prevent, and reduce and manage medical complications in the newborn and other children, using approaches that minimize stigma and other barriers to care, and to support the long-term recovery of the women.

10. Recruit, train, and mentor interdisciplinary teams, including clinical and social service providers, who can engage with, and provide evidence-based psychosocial treatment to, the target population and address underlying social determinants of health.

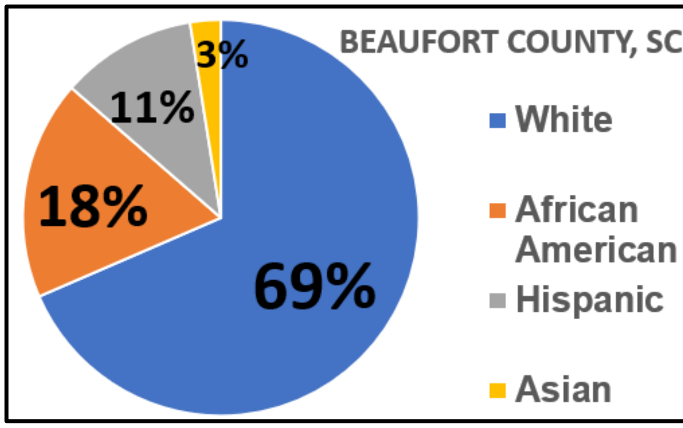
11. Address other SUD-related needs of the target population, given that many individuals with OUD are polysubstance users or have co-occurring conditions.

Appendix E: Application Completeness Checklist

- ✓ Have I read this NOFO thoroughly and referred to the SF-424 Application Guide where indicated?
- ✓ Is my organization part of a multi-sector consortium comprised of at least four separately owned entities, at least fifty percent of whom are located in HRSA-designated rural areas?
- ✓ Are all of my proposed service delivery sites physically located in HRSA-designated rural areas?
  - o If not, have I included an exception request in Attachment 9 and attested that the non-rural service delivery site is a primary service provider for the target rural service area and that the delivery site will directly contribute to building health service delivery infrastructure within the target rural service area?
- ✓ If I share an EIN with another applicant, have I submitted the information requested in Attachment 8?
- ✓ Does my budget total $1,000,000 (or less), inclusive of direct and indirect costs?
- ✓ Have I submitted a budget and budget narrative for each of the three years of the period of performance?
- ✓ Does my proposed project reduce the morbidity and mortality of SUD/OUD within an exclusively rural service area, including among subpopulations that have historically faced health disparities, outcomes, and other inequities?
- ✓ Do my "Work Plan" and "Methodology" sections reflect all core activities outlined in the Program-Specific Instructions section of the NOFO?
- ✓ Does my work plan reflect a three-year period of performance?
- ✓ Have all consortium members reflected in the work plan signed and dated a single Letter of Commitment and are at least 50 percent of the signatories located in HRSA-designated rural areas?
- ✓ Have I designated a Project Director who will serve at least 0.25 FTE on the grant and a Data Coordinator?
- ✓ Have I completed all forms and attachments as requested in Section IV of this
- ✓ NOFO and in the SF-424 Application Guide?
- ✓ Will I apply at least 3 calendar days before the deadline to accommodate any unforeseen circumstances?
- ✓ Have I confirmed that my application does not exceed the 80-page limit?

CRITERION I: NEED (INTRODUCTION & NEEDS ASSESSMENT)

A. Extent to Which Applicant Clearly States Service Area and Characteristics and Needs of Target Rural Population

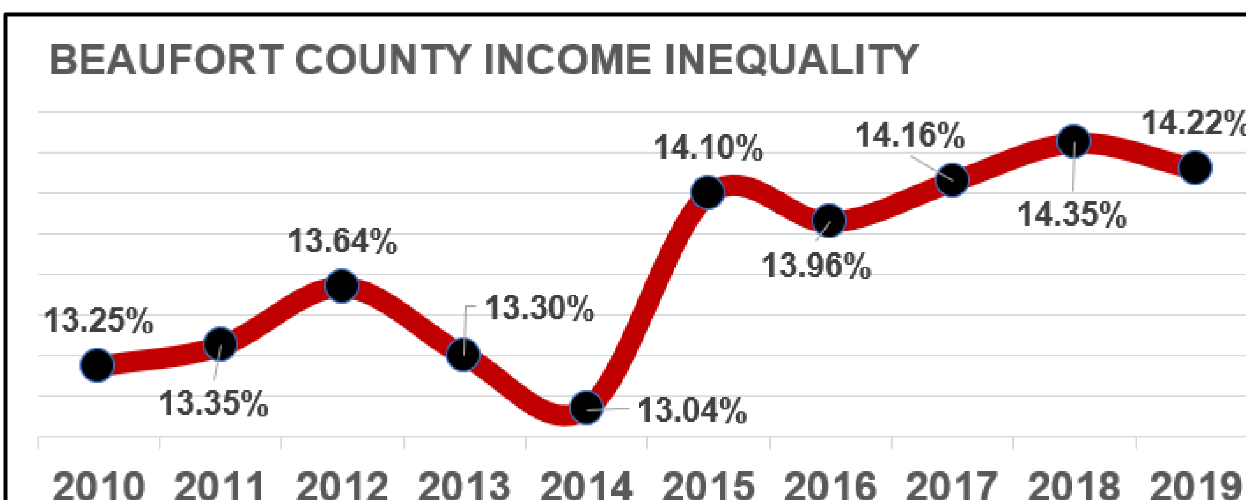


The focus of the proposed project lies in **Beaufort County, South Carolina**—one of the **south's fastest growing counties**, although with this growth has come staggering levels of **community distress**, **social and economic division**, and upheaval.

Perhaps one of the most significant changes in the community is its growing transformation from a cluster of **small rural towns**, **slow and southern**, into a national destination for **tourists, retirees, college students**, and **commerce**. The entire population of Beaufort County is 186,095 spanning **42 census tracts**. Of those tracts, **17 are rural** (40.5%), with a total census of 72,895, or **39.2% of the total county**.

Beaufort County Eligible Census Tracts		
45013000100	45013000400	45013000503
45013000200	45013000501	45013000600
45013000300	45013000502	45013000700
45013000800	45013000902	45013000903
45013000901	45013001101	45013001000

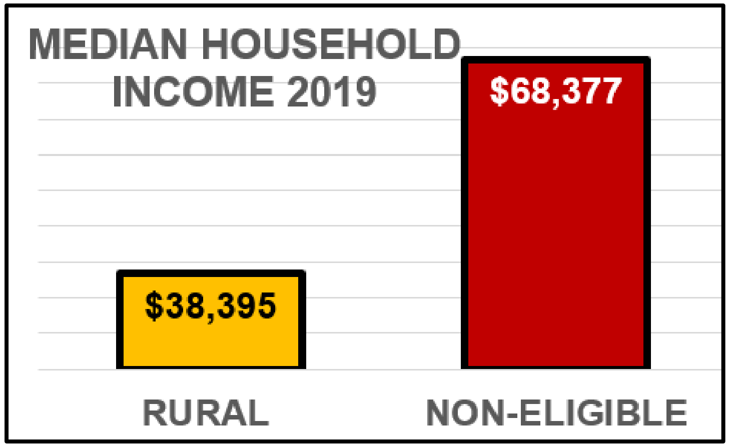
The problems to be addressed with the proposed project can best be understood within context of these demographic population changes. With an estimated **3 million[1] tourists each year,** the county has become a proverbial "**Tale of Two Cities**" -- **comfortable and affluent**, predominantly white, and others: **poor, undereducated**,

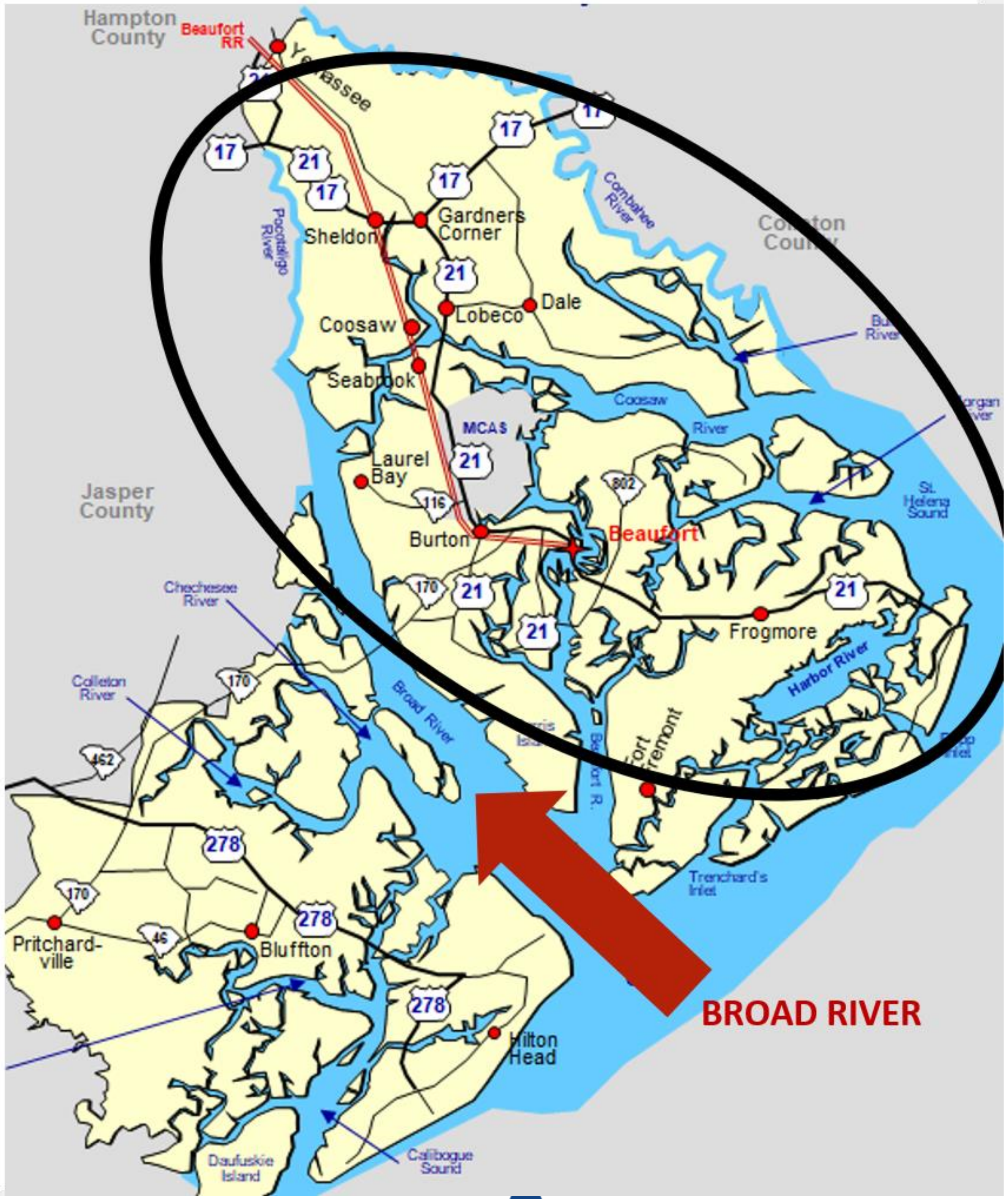


[1] Economic and Fiscal Impact Analysis, Regional Transactions Concepts, 2016.

employed in **tourism service jobs**, but increasingly **unable to keep pace with growing housing costs** as many new tourists make the transition to **permanent residents**.

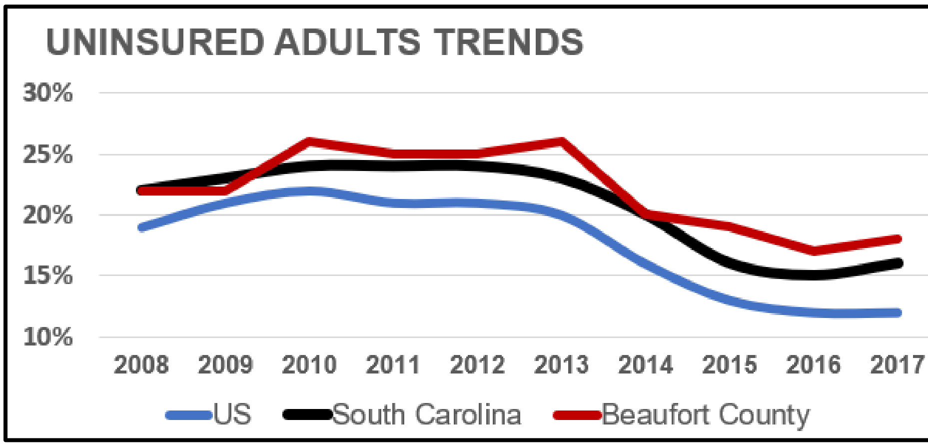
This growing income inequality portends a wide range of social distress—from **crime, poverty**, and **educational failure** to **addiction and violence**. The map to the right depicts the central geographic structure of the county, **divided by the broad river**. The encircled area includes all eligible census tracts, all rural. Everything south of the river is non-rural. While the median **household income** for the southern portion is **surpassed the U.S. average in 2018**, residents in the **target area earn 46% less**, and a staggering 14% of these households report **less than $15,000 a year in income.** This division between north and south will be returned to **repeatedly throughout the narrative** to better understand the unique risk factors at work in the target service area.





Voice–Vision-Leadership

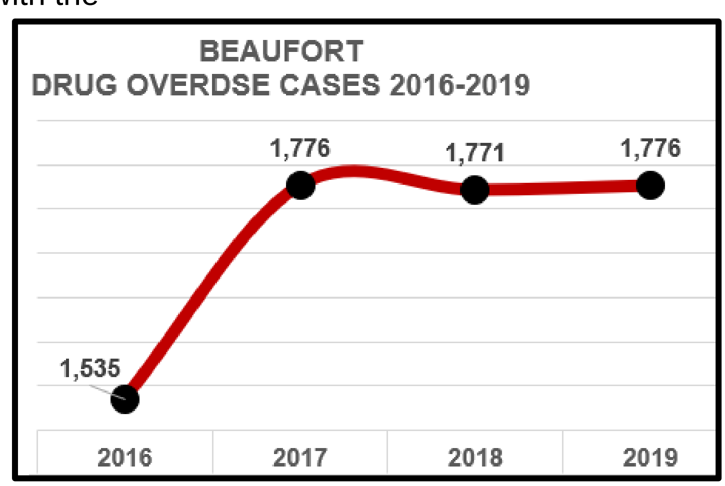
The health status of individuals residing in many rural communities is dire, a condition that unfortunately is mirrored within the proposed target census tracts. The US Census Bureau's Small Area Health Insurance Estimates (SAHIE) program produces estimates of **health insurance coverage** for all states and counties. Although the rate uninsured individuals have dropped dramatically over the past decade, South Carolina ranks **42nd in the nation on individuals lacking health insurance**, with Beaufort County **consistently exceeding state average.**



To further illustrate the bifurcated structure of the county, the entire eligible rural census tracts have all been designated **Medically Underserved Areas** by the Federal Health Resources and Services Administration (HRSA), while the southern non-eligible census tracks are not[2].This is especially problematic with regards to **accessing treatment services**, with only one **behavioral health provider** for every 660 residents, **13% higher than the state average**[3]. The county also falls behind state average for access to primary care physicians, with **one for every 1,430 individuals, 7% higher than the US average**.

AREA	SCORE
PRIMARY CARE	
Sheldon	**51.5**
Helena / Port Royal	**59.9**
BEHAVIORIAL HEALTH	
Beaufort County	**14**

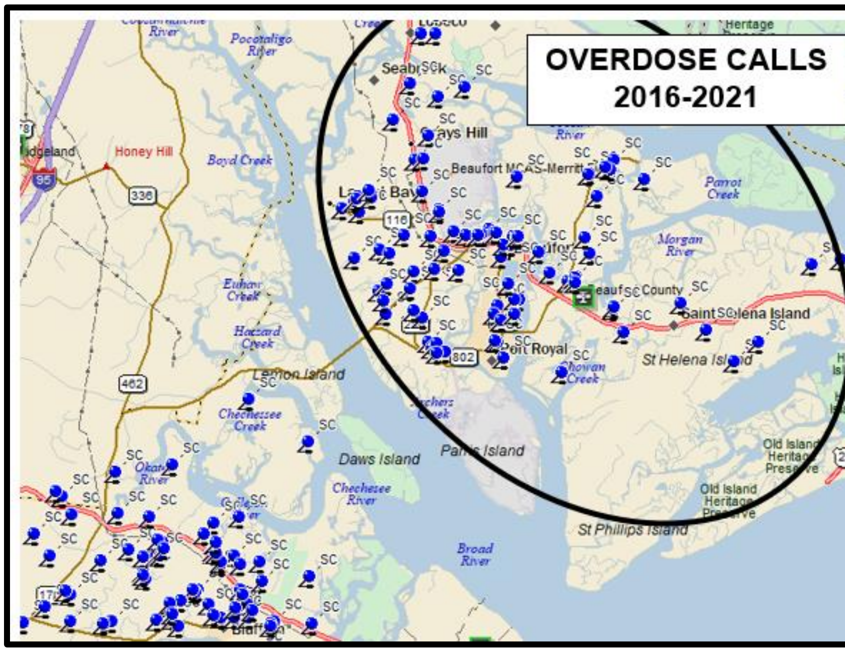
It is no surprise that over the past five years, national attention to **opioid misuse,** especially **overdose**, has occupied the national discourse, overshadowed with the onset of Covid-19. While every state has seen massive rises in the abuse of opioids, **South Carolina is currently grappling with the largest heroin death rate in the country** at a **57% increase** between 2014 and 2015.



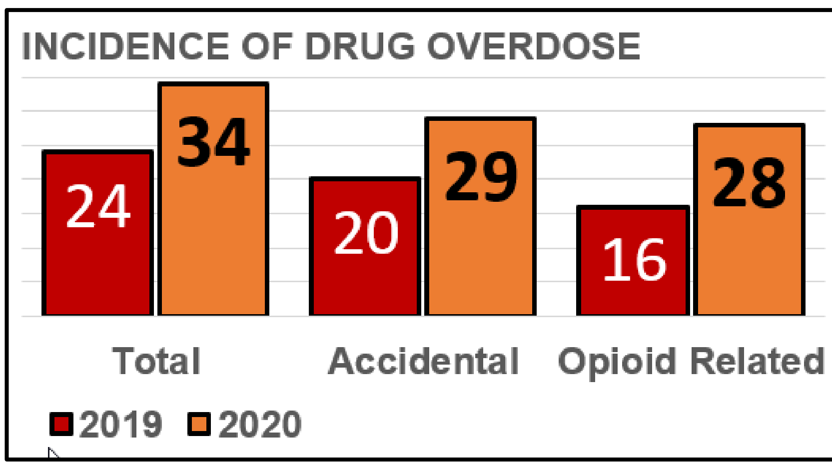
While opioid misuse and overdose is **not confined to the target rural census tracts,** it is nonetheless most

[2] South Carolina Department of Health and Environmental Control, 2014
[3] County Health Rankings, Robert Wood Johnson, 2020

prominently and disproportionately located in the southern region, again, as evidenced in the map.



During the execution of a rigorous community **needs assessment** comprised of **local, state, and federal** archival sources, **service provider data**, **law enforcement** scan, **emergency room** statistics, and overall service delivery **utilization patterns**, an interesting pattern emerged, best explained as an artifact of **Covid restrictions**, while not officially a shelter in place order, places significant limitations on residents in all counties.



While the number of drug overdoses has steadily increased beginning in 2019 and continuing through the next year, the overall **rate of increases appears to decline somewhat**. For example, a review of emergency room data reveals **412 opioid related visits in 2019**, but with **only 208 the next year.** While policy leaders predicted that shelter-im-place orders could cause an increase in what is known as "**deaths of despair**," while increases in psychiatric stressors have been reported, it is presently **unknown whether suicide ratees similarly changed** during stay-at-home periods[4]. reveals what appears to be a decreased in drug related suicide but increase for homicides.

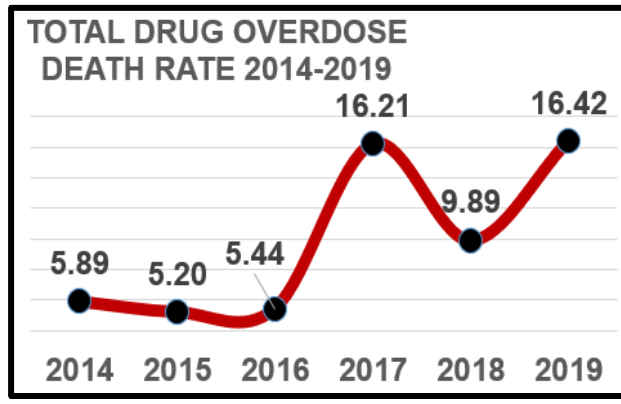
Suicides:	**2020**	12 of 32 suicides involved drugs or alcohol **(37.5%)**
	2019	14 of 27 suicides involved drugs or alcohol **(52%)**
Homicides:	**2020**	11 of 13 homicides were drugs or alcohol related **(84.6%)**
	2019	11 of 17 homicides were drugs or alcohol related **(64.7%)**

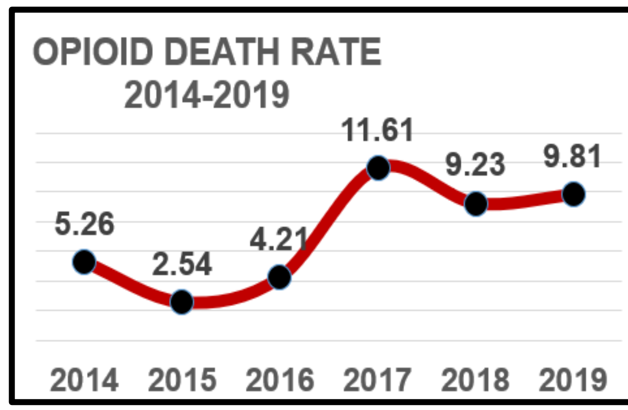
[4] Suicide Deaths During COVID 19 Home Advisory, Journal of American Medical Assoc.. Faust, 2021.

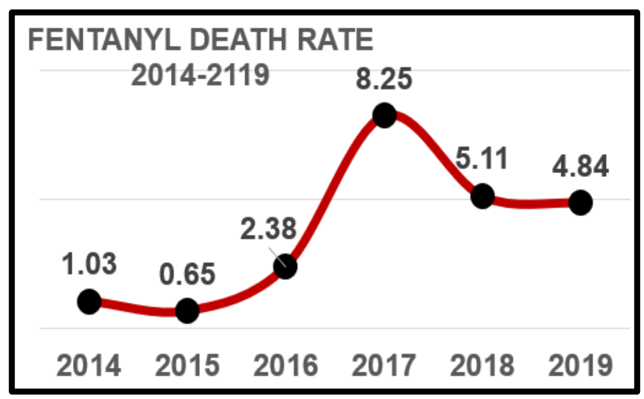
It is especially important to note that the incidence and prevalence of **opioid misuse and overdoes does not occur in isolation,** but as part of a broader clinical picture that often involves abuse of many different substances including **psychostimulants, heroin**, and increasingly, **synthetic opioids** in the form of **fentanyl.**

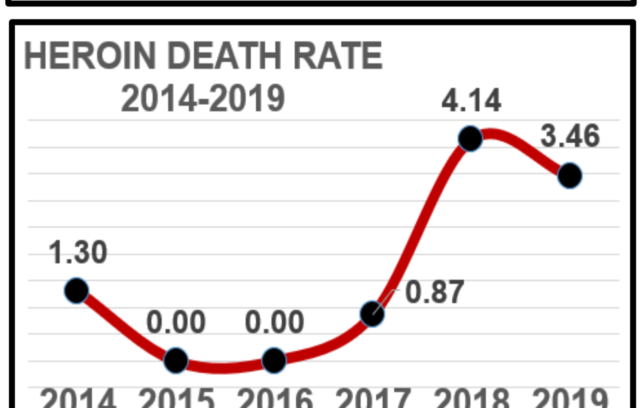
A longitudinal review of drug related deaths for the community reveals quite similar patterns, with a **linear increase** in **total deaths, opioid deaths**, **fentanyl deaths**, and **heroin.** While the linear increase is comparable across substance, the sheer scope of **opioid deaths in most cases overshadows that of fentanyl or heroin**, in some cases, **double or even trip the rate.**

A **segmentation analysis** for the target community suggests that the problem has a **differential impact based on several domains**. First, a study published by the Journal of Health Justice documents that drug overdose is the **leading cause of death after release from prison**[5]. Given restricted access to substances while incarcerated, **personal tolerance is likely lowered.** Upon release, many individuals resort to using at their previous dosage and greatly increases the risk of overdose or death. Local detention center data reveals an **average of 50 inmates with drug related histories enrolled each month,** with 30-40% incarcerated well over two or more days. In addition, medical staff report an average of **20 inmates a month that are assessed for**



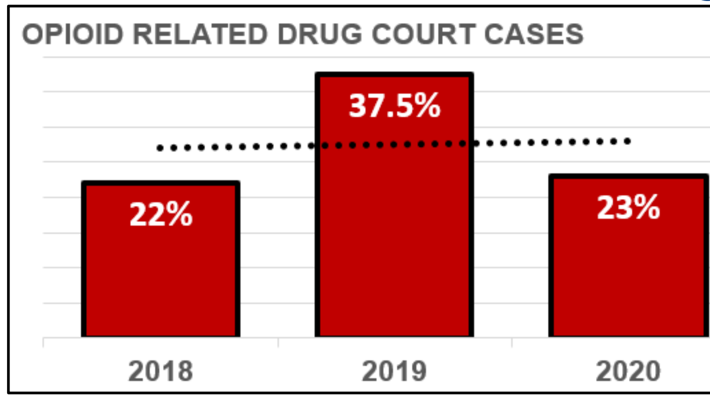






[5] Reducing overdose after release from incarceration; Waddell, Health Justice, Dec. 8, 2020.

withdrawal. This pattern has remained stable, with **6% of inmates screened from 2014 through 2019 included opioid use.** Drug misuse in criminal justice populations is also evidenced in local **Adult Drug Court** docket where opioid related cases have surged over the past three years, although the Covid suppression is evident within this data as well.



Next, another **differential target population** includes those with **blood related infections**. The prevalence of **Hepatitis-C-Virus** (HCV) infections is high among opioid-dependent individuals. Prior research on the simultaneous treatment of both conditions has primarily assessed success as it pertains to HCV[6]; although, it has been noted that favorable substance-use-therapy outcomes may improve the likelihood of HCV-treatment initiation and success Local data shows a **40% increase since 2014 in the Hep C rate** in Beaufort. Likewise, **HIV**-infected persons are more likely to have chronic pain, receive **opioid** analgesic treatment, receive higher doses of opioids, and to have substance **use** disorders and mental illness compared with the general population, putting them at increased risk for **opioid use disorder**. Again, the HIV incidence rate in the county went up 50% since 2018.

While much of the data appears to differentiate based on target population, and not location, there is much evidence that problems related to opioid use disorder also have a place-related impact within the targeted rural census tracts. Therefore, in addition to archival data collection and review, the needs assessment also included an analysis on **where and when activities are most acute within the rural target tracts**. Using **Geographic Information System (GIS) Mapping** to geo-code the database onto **census bureau shapefiles** most relevant to the potential risk for opioid use and misuse. National trend data related to the incidence and prevalence of opioid misuse and overdoses has spotlighted several high-risk target populations:

- Homes with **senior citizens** (most likely to suffer falls or illness requiring painkillers)
- Imputation of **Health Insurance Coverage**, by Age and Educational Attainment
- **Veteran Status** (often linked in literature as a risk factor)
- **Disability Status** (likewise a potential risk factor associated with misuse[7])

In each case, the maps on the next page reveal the **highest density of at-risk individuals reside in the target rural census tracts**.

[6] Association between Hepatitis C Virus and Opioid Use while In Buprenorphine treatment: preliminary findings. Murphy, Dweik, McPherson, & Roll; Am Journal of Drug Abuse, 2025, 41 (1) 88-92.
[7] When Addictions, Opioid and Disability Meet; Wilson, National Center on Disability and Journalism

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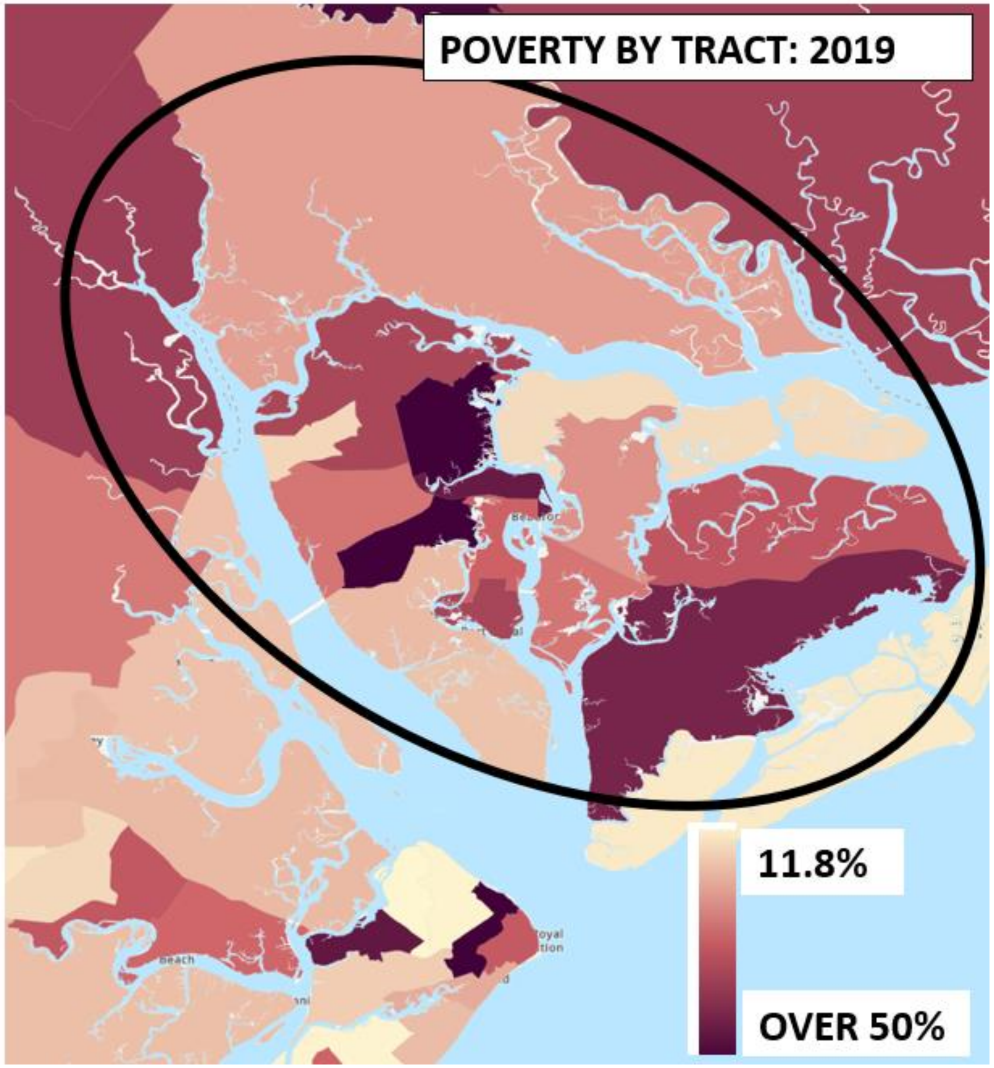
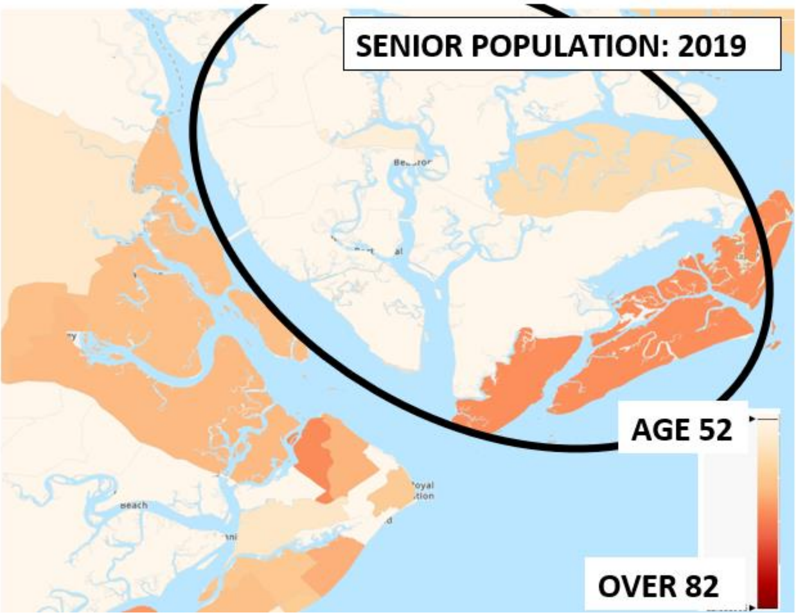
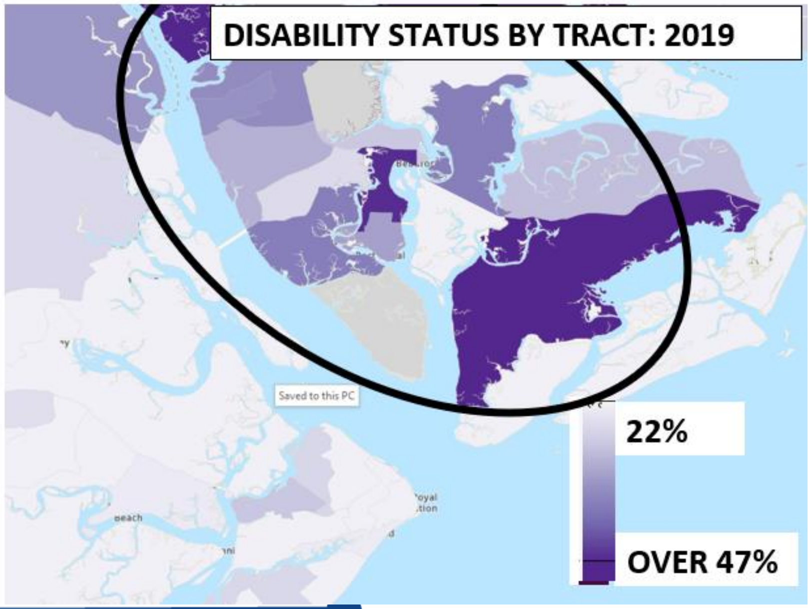


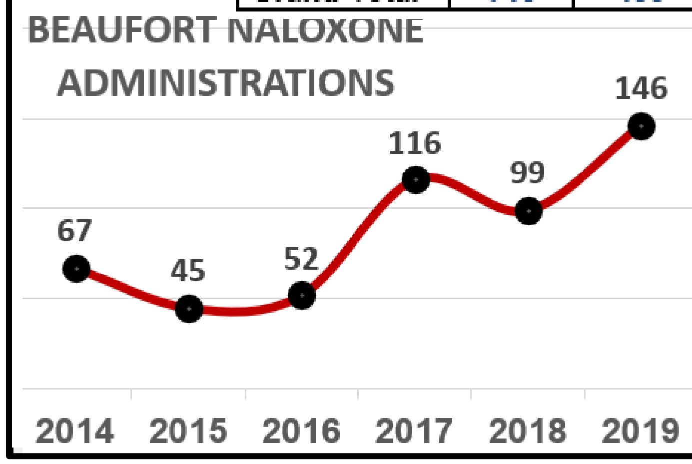


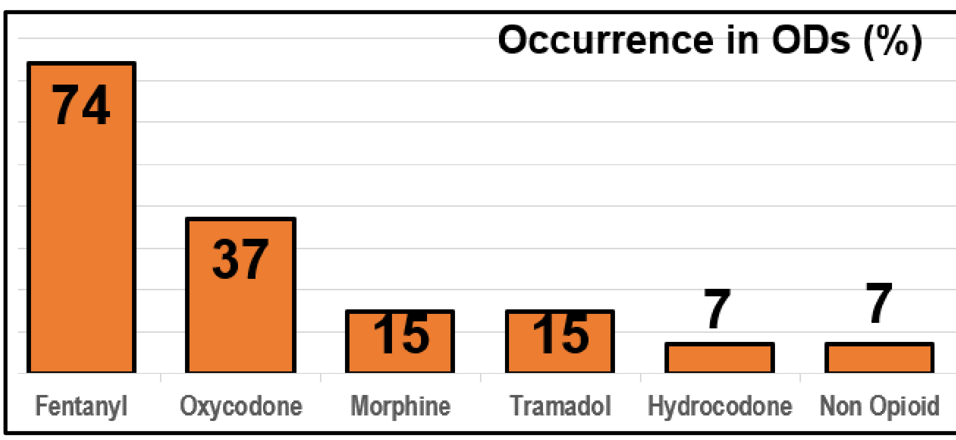


Finally, data from the applicant agency (Beaufort County Alcohol and Drug Abuse Department) documents the incidence of individuals seeking treatment and perceived covid suppression. Over the past five years, opioids and psychostimulants represents a disturbing trend. One result, an explosion in the administration of **opioid antagonists**, such as **Naloxone.**

	2019	2020
Alcohol	424	260
Opioid	41	50
Cannabis	185	108
Sedative	4	3
Cocaine	43	27
Amphetamine	14	2
Tobacco	8	5
Grand Total	**719**	**455**

The data in this narrative, which represents but a **small portion collected**, was employed to assess the overall efficacy and capacity of current resources related to **prevention, treatment, and recovery** of substance use disorders, especially opioid. **Critical service gaps** were then prioritized and formulated into a **three-year work plan**, with careful attention on strategies to **sustain the overall effort once federal grant funding has lapsed.**





B. Applicant Clearly and Succinctly Summarizes Goals of Project, Approach and Capacity, Including History of Collaborating to Address SUD/OUD

The proposed project brings to culmination, over one-year of data collection, planning, discussion with consortium members and staff, gap analysis, identification of evidence-based intervention strategies, and devise a detailed workplan. The following provides a brief summary of the project goals and objectives:

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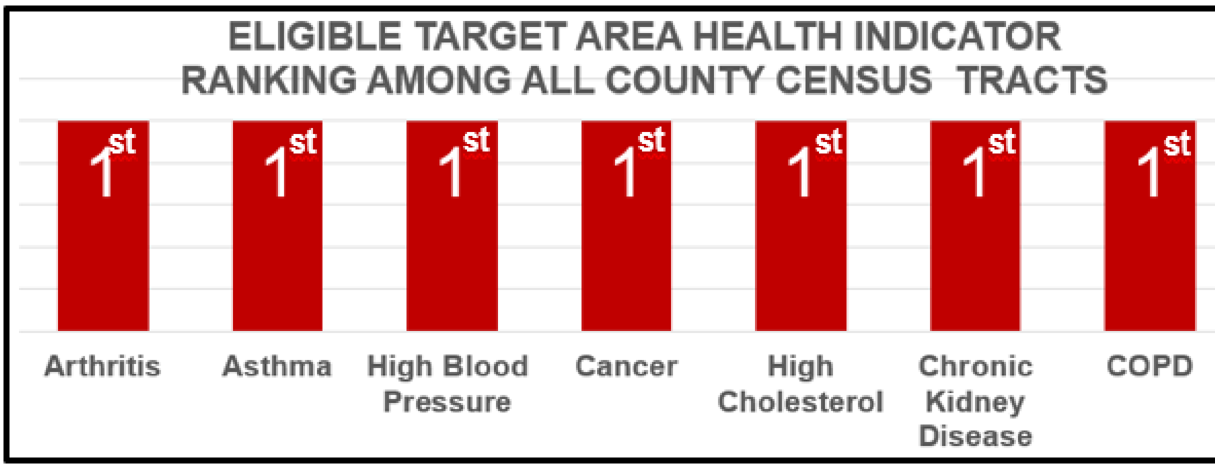
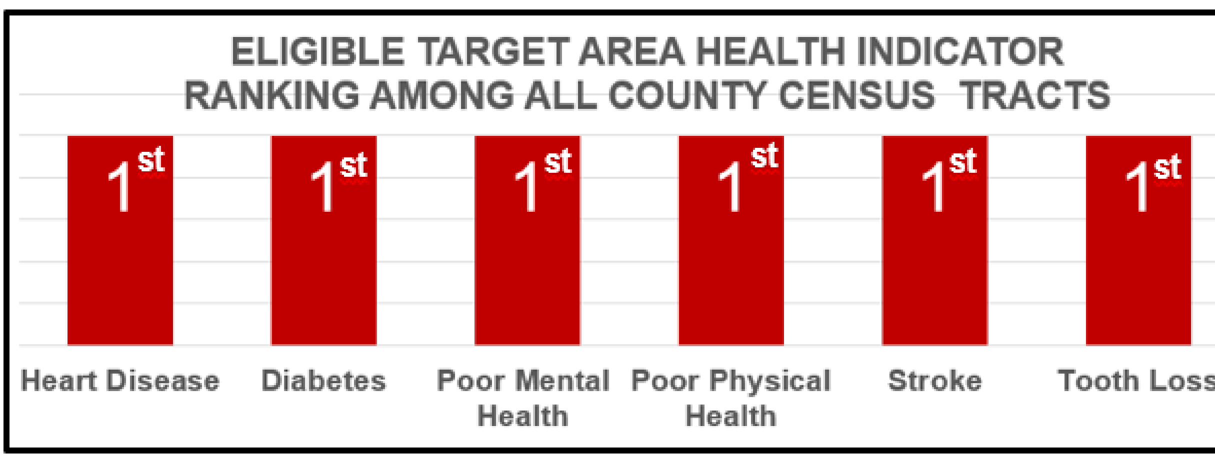
GOAL 1: Increase Local Capacity & Infrastructure Necessary to Reduce Opioid Misuse By 20% by 2023 Through Enhanced Service Delivery Network of Prevention, Treatment & Recovery Conducted by a Consortium of Key Members.
OBJECTIVE 1: Within four months of grant award, the proposed staffing expansion plan will be fully complete, as outlined in project narrative and budget as measured by signed and executed employment contracts.
OBJECTIVE 2: All new and existing direct service staff will complete all proposed professional development (1. electronic health record training; 2. Clinical Assessment; 3. Treatment Planning; and 4. Mental Health First Aid) within the first month of employment, as measured by attendance logs collected at the beginning of each training session.
OBJECTIVE 3: Execute subcontract .40 FTE Advanced Practice Registered Nurse (APRN) provider to increase the current service delivery capacity to prescribe/administer MAT
OBJECTIVE 4: The APRN will complete Buprenorphine Waiver Management Training within 30 days of employment and submit commensurate application to prescribe MAT through SAMHSA and the DEA, as required under Drug Addiction Treatment Act of 2000 (DATA 2000), as measured by approved waiver status award notice.
OBJECTIVE 5: Recruit 1.0 FTE Peer Support Specialist to work with law enforcement and EMS to transition individuals into treatment in a timely and efficacious manner.
OBJECTIVE 6: Recruit 1.0 FTE Social Worker to provide case management and clinical supports from treatment through recovery and including support to the county detention facility.
OBJECTIVE 7: Execute .25 FTE Clinical Supervisor to oversee expanded service delivery and staffing as per licensure standards, including support to the county detention center
OBJECTIVE 8: A range of community awareness and engagement resources will be developed for distribution and include traditional and social media, public transport advertising, flyers, brochures, and town hall meetings.
OBJECTIVE 9: The number of individuals served through Medically Assisted Treatment and commensurate individual, group, and/or family counseling sessions will be 50 unduplicated cases in a calendar year, including both regular and intensive outpatient treatment, as measured by the DAODAS Clinical Services Log.
OBJECTIVE 10: Project staff will conduct a clinical screening and assessment of clients within 48 hours of referral, using state mandated tools (psychosocial history, addiction severity index, client strengths analysis, interview) for presence of SUD and occurring disorders, use the information in treatment planning, as measured by completed intake battery.
OBJECTIVE 11: Participant clients will devise a recovery support plan that details adjunct services required to improve access and retention in clinical services, including vocational, education, transportation, childcare, and enrollment in the affordable care act program, within 48 hours of enrollment, as measured by completed case management plan.

C. Extent to Which Applicant Demonstrates Population has Historically Suffered from Poorer Health Outcomes, Disparities, and Other Inequities.

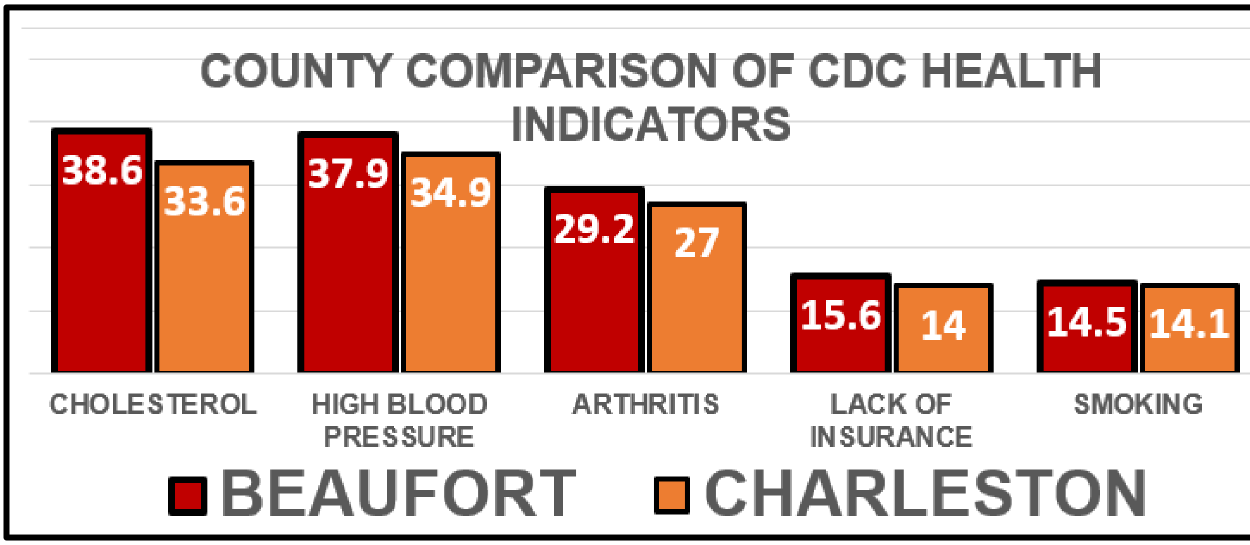
During the needs assessment process data was collected with regards to a wide range of **health disparities throughout the entire county**. Using the **Centers for Disease Control archival database**, the top thirteen health outcomes were **analyzed for each census tract** wiithn Beaufort County. The conclusion was **nothing short of staggering**. The geographic area eligible for the proposed project **ranked number one in all thirteen of the CDC Health Outcomes.** The range of these health concerns reflet some of the most serious conditions and include **cancer, high blood pressure**, and **diabetes** to **poor mental health** and **stroke.**

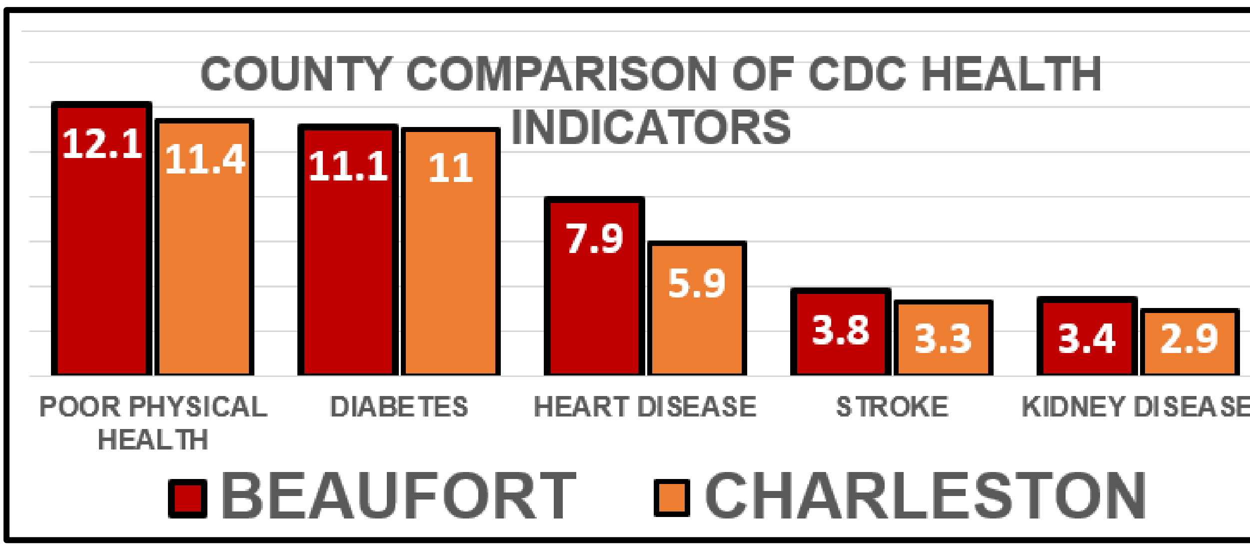




To further explore the data, a **comparison county** (Charleston) was selected to better understand if the level of problems within the target community were consonant with a **similar coastal tourist area in the state** often viewed as a “sister county.” Using the CDC archive, the same analysis was conducted for each of the aforementioned health indicators. Not surprising to health officials in Beaufort, but the level of health disparities **exceeded that of the comparison county in all but two categories**. In most cases, the problems facing residents of the proposed target community **exceed the non-**

eligible census tracts as well as Charleston County. While such a comparison lacks empirical rigor, it does further the argument that the proposed target population has historically **suffered from poorer health outcomes, disparities, and other inequities**





D. Extent to Which Applications Provides Requested Data and Information

From the outset, the proposed project was designed to be **data driven**—beginning with **identification of those populations most vulnerable** to substance use disorders, especially opioid related to ensuring that any proposed continuum of services will **track efficacy over time and budget.** That said, careful attention was taken in the collection of all required baseline data, aligned specifically to the eligible census tracts targeted by the proposed project. The pages summarize the required **Core Measures Table, Population Demographics**, and **Substance Use Disorder Prevalence**.

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REQUIRED CORE MEASURES TABLE

MEASURE	DEFINITION	BASELINE	DATA SOURCE
Core #1: Total population in the project's service area	Please report the total number of individuals in your project's service area.	The entire population of Beaufort County is 186,095 spanning 42 census tracts. Of those tracts, 17 are rural (40.5%), with a total census of 72,895, or 39.2% of the total county.	U.S. Census, 2019. Table B01003
Core #2: Number of individuals screened for SUD	Total number of individuals screened for SUD, including OUD, in the past 6-months. Include tools such as the CAGE, Michigan Alcohol Screening Test, Drug Abuse Screening Test, or screening methods such as SBIRT, or provider-developed screening questions.	299 in past six months at the Beaufort County Alcohol and Drug Abuse Services.	CSL Care Logic Database;
Core #3: Number of non-fatal opioid overdoses in the project service area	Total number of non-fatal overdoses from opioid poisoning in your project's service area in the past 6-months. Include all types (e.g., accidental, intentional, undetermined).	112, 21 involving Heroin	SC Dept of Health, February 2021.
Core #4: Number of fatal opioid overdoses in the project service area	Total number fatal overdoses from opioid poisoning in your service area in the past 6-months. Include cases where opioids are the underlying **or** contributing cause of death and include all types (e.g., accidental, intentional, undetermined).	*2020= 29 opioid deaths 2019= 16 2018= 14 2017= 17	*Beaufort County Coroner's Office, Just Plain Killers
Core #5: Number healthcare providers in the project service area with DATA waiver	Total number of healthcare providers **in the service area** who have a Data Treatment Act 2000 waiver to prescribe buprenorphine products for MAT. Total number providers **in consortium** who have a DATA Waiver.	Three practitioner levels: Family Nurse Practitioner (2) Nurse Practitioner (1) MD's (10)	SAMHSA Buprenorphine Practitioner Locater

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REQUIRED POPULATION DEMOGRAPHICS TABLE

MEASURE	TARGET RURAL POPULATION	COMPARATIVE DATA		DATA SOURCE
MEASURE 1: Percentage target rural population with health insurance	67,778 individuals **(86%)**	**South Carolina** 89.5%	**US** 91.1%	U.S Census Table PL 94-171
MEASURE 2: Breakdown of target rural population by race/ethnicity	White: 59.7% African Amer: 33.3% Hispanic: 7%	**South Carolina** White: 68.5% African Amer: 27.1% Hispanic: 5.8%	**US** White 76.5% African Amer: 13.4% Hispanic: 18.3%	2018 Census Vintage Population Estimates
MEASURE 3: Breakdown of target rural population by sex	Male (**51%**) Female (**49%**)	**South Carolina** Male 48% Female 51.4%	**US** Male 49.2% Female 50.8%	U.S. Census Table DP05
MEASURE 4: Breakdown of target rural population by age:				
Children (Ages 0-14)	15,789 individuals **(19%)**	**South Carolina** (18.5%)	**US** (18.9%)	U.S. Census Table SO101
Adolescents (Ages 15-19	6,595 Individuals **(7.9%)**	**South Carolina** (5.2%)	**US** (6.6%)	U.S. Census Table SO101
Adults (Ages 20-64)	46,626 Individuals **(56.1%)**	**South Carolina** (56.2%)	**US** (59.3%)	U.S. Census Table SO101
Elderly (Age 65 and over)	13,962 individuals **(16.8%)**	**South Carolina** (20.1%)	**US** (15.2%)	U.S. Census Table SO101
MEASURE 5: Percentage target rural population unemployed	**Target (4%)** **County (3.9%)**	**South Carolina** 3.5%	**US** 3.9%	Federal Reserve Dec 2020
MEASURE 6: Percentage of target rural population living below the federal poverty line	**Target (13.3%)** **County (10.2%)**	**South Carolina** 15.3%	**US** 11.8%	U.S. Census Table SI701 2018

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REQUIRED SUD/OUD PREVALENCE TABLE

MEASURE	TARGET RURAL POPULATION	COMPARATIVE DATA	DATA SOURCE
Number of SUD/OUD emergency room visits in the target rural service area(s).	Data for key service points show a decline for 2020, due mostly to the impact of covid on admissions. The rate is trending to previous historical growth patters thus far in 2021	South Carolina documented an Opioid Related Hospital rate of 161.2 compared to 291.5 for the U.S. National Rate (per 100,000). Comparative data is for 2018, local target data is 2019.	Beaufort Memorial Hospital Epic Patient Software System.
Prevalence of SUD in target rural population, by type:		Of 2019 patients served and 2020 data comparison. Admissions were significantly impacted, due to Covid-19.	Beaufort County Alcohol and Drug Abuse Department Care Logic Database
Prescription Volume	A total of thirteen prescription drop box collections are maintained with in the target footprint.	No comparative data is available for state. The project has reached out to state authorities with plans to collect and report this data for other counties engaged in take back strategies with state funds.	Monthly intake reports from agency and project partners.

	2019	2020
Alcohol	424	260
Opioid	41	50
Cannabis	185	108
Sedative	4	3
Cocaine	43	27
Amphetamine	14	2
Tobacco	8	5
Grand Total	**719**	**455**

Diagnosis	Unduplicated Count
Alcohol abuse	218
Opioid abuse	33
Other psychoactive abuse	127
Other psychoactive dependence	22
Grand Total	**400**

DATE	POUNDS
July 2020	3,618
Oct. 2020	253.6
Jan. 2021	135.8

E. Extent to Which Applicant Demonstrates How Funding will Increase Scope and Magnitude of Service Delivery, Beyond Baseline

A detailed project work plan has been devised that will address **every single service gap** identified during the segmentation analysis, that will allow the agency to reach and **exceed full staffing capacity**, with **all required clinical supervision** and **monitoring**, removal of barriers to providing **Medically Assisted Treatment**, and provide more individualized clinical supports complicated due to state policy limiting the use of virtual sessions for treatment. The estimated increase in service delivery capacity for this funding is between **35% and 50% increase client enrollment and care**. Most important, the project will involve new phase in relationship with county law enforcement with rigorous training related to the **efficacy of harm reduction strategies**, **Medically Assisted Treatment**, and first steps in bringing substance abuse treatment services with adults in **detention**. This last element has the potential to significantly **reduce repeat episodic treatment** for the same client in and out of detention.

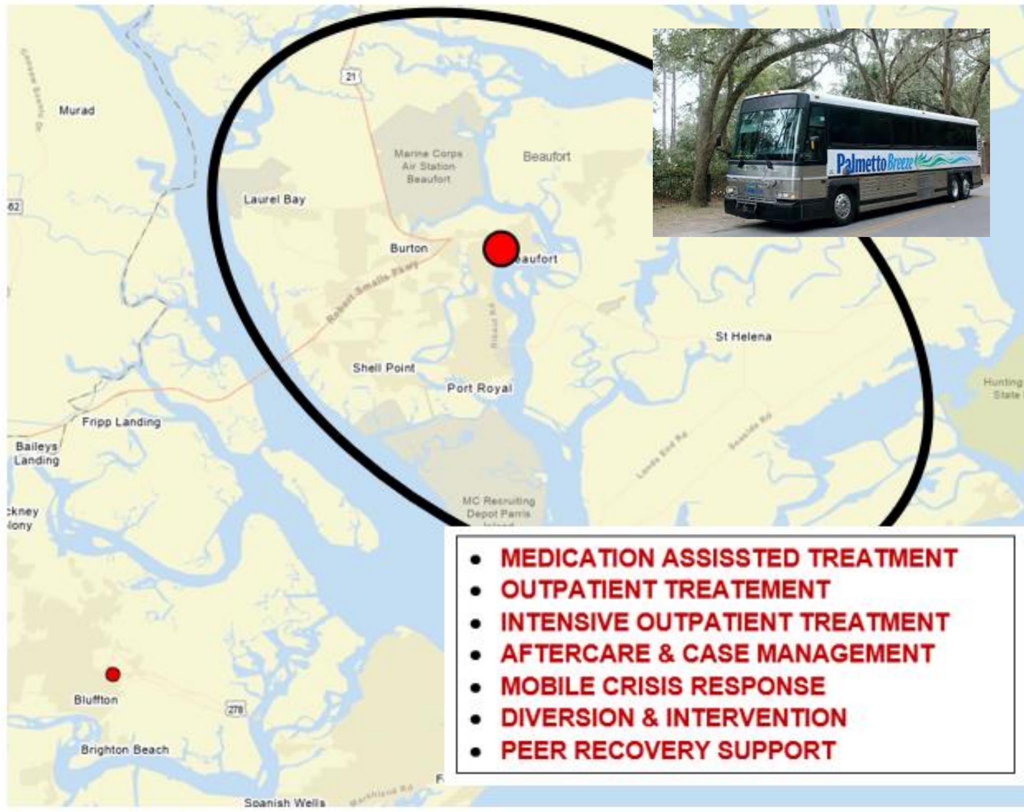
F. Quality and Appropriateness of Sources Used to Provide Data

The proposed project is based on an enormous level of local, state, and federal data collected over the past twelve six months. Key elements in the selection of data sources highlighted the **importance of recency** (data that is no older than two years, if possible), sources that will allow **disaggregation by census tract**, safeguarding of **protected information** while still allowing meaning analysis, and the use of sources that could be **employed in the future to monitor progress** towards Core Indicators. That said, the following sources were vetted and determined most accurate and dependable, and were then used in the needs assessment and segmentation analysis:

U.S. Census Bureau Data Manager
U.S. Centers for Disease Control
Robert Wood Johnson Foundation – Community Health Indicators
Anna Casey Foundation Kids Count Data Center
Environmental Systems Research Institute (ESRI) mapping shapefiles
Beaufort County Alcohol and Drug Abuse Department
Beaufort County Detention Center
Beaufort County Coroner Office Toxicology Report
South Carolina Department of Alcohol and Other Drug Addiction Services
South Carolina Revenue and Fiscal Affairs Office
SC Department of Health and Environmental Controls – SCRIPTS database
South Carolina Office of Mental Health
South Carolina Law Enforcement Division of Statistics (SLED)
Just Plain Killers Opioid Campaign: https://justplainskillers.com/data/
Law Enforcement Records Management Software (LERMS) by Municipality

G. Extent to Which Data Demonstrates Relatively High Need for RCORP Funded Prevention, Treatment and Recovery Services

EXISTING TREATMENT SERVICES / CRITICAL GAPS



The Beaufort County Alcohol and Drug Abuse Services Department (BCADAD) has been in existence since 1974 as the sole public treatment entity in the county. **The main service site,** located in the target census tracts, provides a **full continuum of evidence-based treatment services** as depicted in the map. Although 871 square miles and rural, this area is served by an affordable **public transportation system**, that significantly facilitates target client access.

The core of essential treatment services determined most relevant to the proposed project include the following:

Screening and Diagnostic Assessment (full spectrum of instrumentation)

Cognitive Behavioral Therapy

Medical Assisted Treatment **MAT**

Motivational Interviewing

Peer Recovery Support Services

The table on the next page summarizes current details with regards to these services followed by an identification of **critical gaps** that form the basis of the proposed project:

COMPONENT	SCOPE	NOTES
Outpatient	9 Hours per week; Day or Evening; M-F	A total of six master's level clinical therapists provide coverage for all levels of outpatient care.
Intensive Outpatient	20 Hours per week or more; Day or Evening; M-F	Gender specific (i.e., women) available.
Crisis and Case Management	Emergency mobile crisis response available;	
Diversion / Intervention Services	offered to patients convicted of driving or boating under the influence of alcohol or drugs.	
Aftercare	Step down services for clients in intensive outpatient.	Individual counseling sessions, peer supports, drug screening.
Clinical and Diagnostic Screening	Full range of assessments including DAST 10, AUDIT, GAIN II, Trauma and Suicide, Drug Screening, Breathalyzer, TB, HIV, Psychosocial.	Currently provided through virtual model due to Covid restrictions

The department is working to maximize services to as many patients as possible in a timely manner. The current staff in both locations collectively have a 67% productivity rate and the show rate for **patients attending services is 82%**. However, several barriers exist in the enrollment of patients into services within 6 days of the assessment:

- The COVID-19 impact on services has **reduced the group size to 5 patients** so safe social distancing can occur, resulting in a census reduction of more than 50%
- The South Carolina Department of Health and Human Service is **not allowing for virtual services for therapy** or education groups. This barrier prevents the department's ability to serve more patients efficiently. This significantly impacts both client access as well as treatment dosage.

A key concern raised during the planning involve the need for training and support among **law enforcement partners**. While the department has a good relationship with these departments, issues related to stigma persist. The Sheriff's department views Naloxone training and distribution as "**enabling**", and chronic disease language is not used. As such a comprehensive training and support plan (FAVOR model) will prioritize these partners, with assistance from other municipalities across the state that have made the **transition into a harm reduction model** in a law enforcement context.

SUMMARY OF TREATMENT SYSTEM CONCERNS

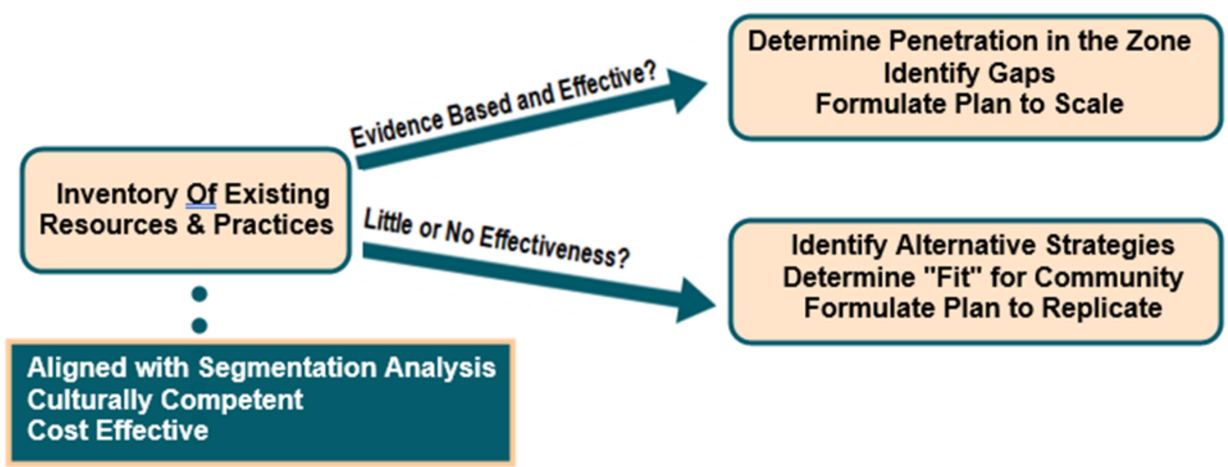
KEY SERVICE DELIVERY SYSTEM CONCERNS:

- There is only **one public treatment facility** operating in the county, providing outpatient, intensive outpatient, Medically Assisted Treatment, and recover support. The agency accepts private insurance, self-pay and sliding fee scale.
- **Current clinical capacity** is limited and represents critical concerns. With Covid, the agency has gone from serving 1,100 patients a year to less than 500. Despite the reduction in persons served, clinical staff are performing at **a 67% productivity** rate over the past the quarters.
- **Clinical Supervision** required for **licensure and accreditation** represents the greatest challenge to the expansion of new treatment staff. Current funding is available for treatment counselors, but without clinical supervision, the action would be futile.
- The explosion of **Medical Assisted Treatment (MAT)** has exhausted the current agency capacity to **meet standard**s, **issue prescriptions**, and **monitor clients**. This obstacle operates as a **bottleneck**, limiting the capacity of the agency to employ what is now known as one of the gold standards of opioid misuse treatment.
- Like many **detention centers**, the local facility can function as a "**revolving door**" to clients incarcerated with substance use disorders and receive little or no treatment to prepare for transition back into the community. The risk of overdose also represents the **leading cause of death** following detention release.

CRITERION 2: RESPONSE (METHODOLOGY/WORK PLAN CHALLENGE)

A. The Clarity and Comprehensiveness of The Applicant's Proposed Methods for Fulfilling All Core Activities, As Outlined in Section IV.2 Of The NOFO

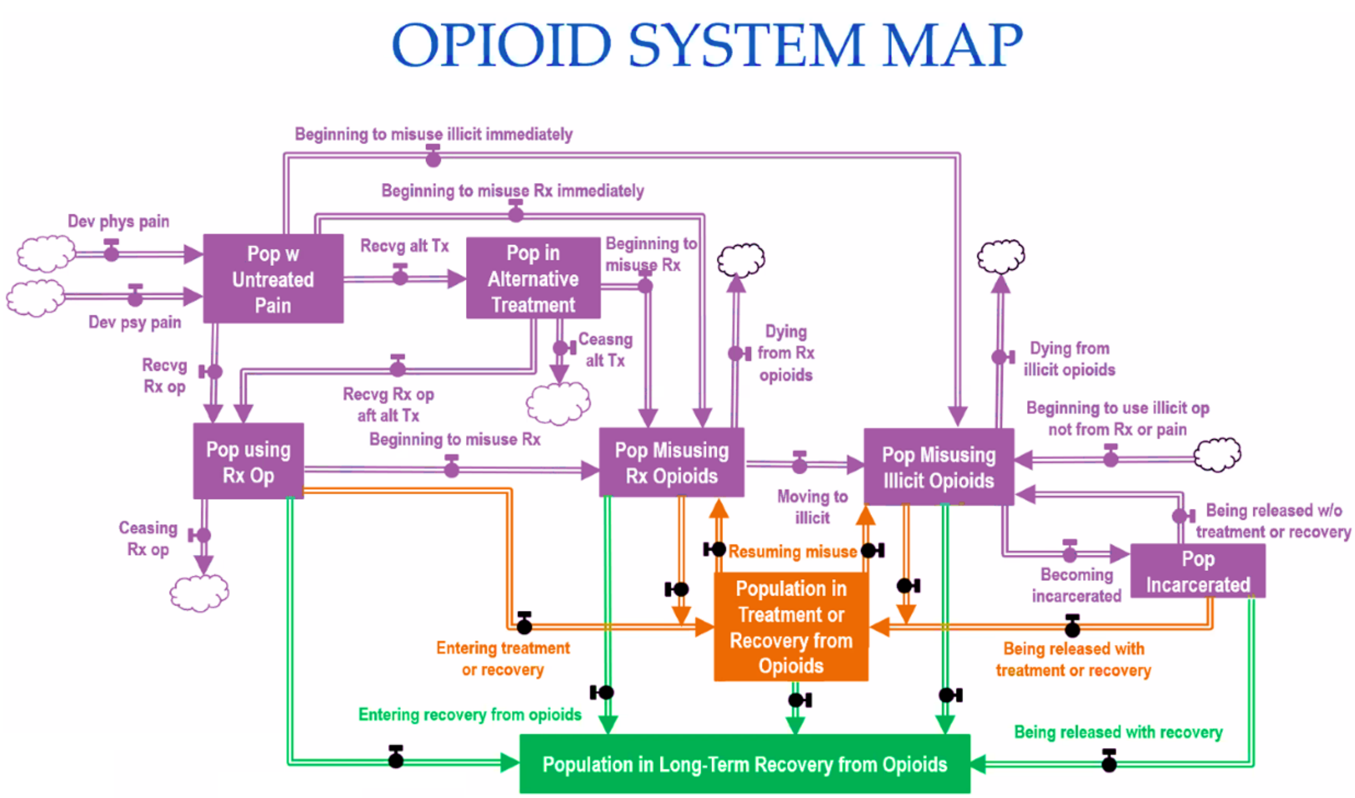
The development of the project work plan was not completed in a cavalier or adventitious manner, but based on a **rigorous community needs assessment**, input from **consortium members**, and extensive **review of empirical literature**. Project leaders reviewed the work of other states or municipalities that have been successful in reversing misuse, especially Ohio and West Virginia. As such, the proposed project has been designed to address local **service gaps** through a **coordinated network** of **evidence-based solutions**, proven effective in **communities with similar demographics** as in Beaufort. One of the first steps was a careful examination of currently available resources in **three domains: Prevention, Treatment and Recovery**. The scope and capacity of local resources were assessed to determine **alignment with research** and consonant with critical gaps identified in the needs assessment. This process is summarized in the schematic below and resulted in several key strategies that form the foundation of the work plan.



Next, the overall work was guided by several **action theories gaining prominence**, especially within South Carolina. First, there has been much discussion towards understanding health in a broader definition structured around **social determinants of health**[8], such as poverty, unemployment, and educational attainment. In this framework, individuals seeking treatment for substance use disorders are better understood when other affiliated and causal conditions related to addiction are addressed, such as family functioning, education, and employment, all of which call for a more individualized approach to service delivery and importance of high-quality case

[8] Beyond Health Care: The Role of Social Determinants in Promoting Health and Health Equity; Atiga & Hinton, Disparities Policy, May, 2018

management. Next, recent additions to the Criminal Justice literature employ a **public health model** for understanding problems such as **substance use** and **violence**[9]. This work is grounded in **general systems theory,** which emphasizes the interconnectivity of varying elements in the development, maintenance and amelioration of a behavior such as substance misuse. The system map below summarizes the complex nature of the problem with attention to **access to opioids**, the transition **from use to misuse**, **treatment and recovery process**, and interface with **public safety and enforcement**.

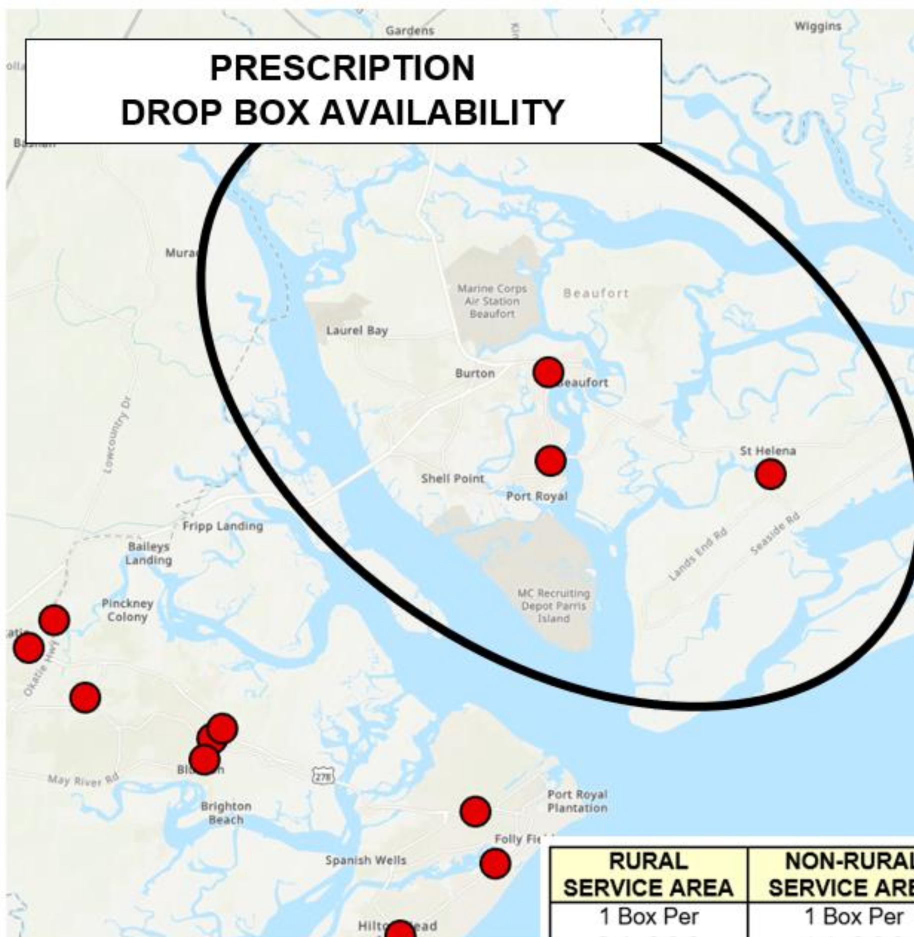


With the assistance from a consultant trained in system theory, consortium members engaged in extensive analysis of **local conditions and elements** that have helped drive the problem in Beaufort along with existing dynamics already in place to combat the problem. This process, **less static than a typical logic model**, was employed to ensure that proposed interventions **did not operate in isolation** but part of a more **complementary and collaborative** network of solutions. Specifically, to address such a complex problem, strategies must **address multiple systems levels**, with careful attention to **prevention, treatment, and recovery**. Based on these theoretical paradigms, the following summarizes proposed methods to address critical concerns identified during assessment.

[9] Centers for Disease Control, Public Health Approach to Violence Prevention, 2019

PREVENTION – MOVING UPSTEAM

While the field of prevention has evidenced an explosion in terms of both **theory and research**, specific studies that f**ocus exclusively on the prevention of opioid misuse are few.** A casual internet search for the term "Opioid Prevention" is likely to return information related to the **prevention of overdose**, **Naloxone**, or school-based curricula but **do not explicitly focus on the unique conditions** surrounding the abuse of prescription painkillers. The most common strategy supported within the field involves an attempt to remove unused medications through "**drug take back days**" or **prescription drop boxes**. Unfortunately, while the collection boxes are widely used within Beaufort County, amassing hundreds of pounds of discarded medications, the availability of these tools in the target census tracts are somewhat limited. The GIS map below illustrates the **relative scarcity of drop boxes in the eligible service area.** Given earlier data with regards to the density of **senior citizens, disabled, and veterans,** supports in this region are especially needed.



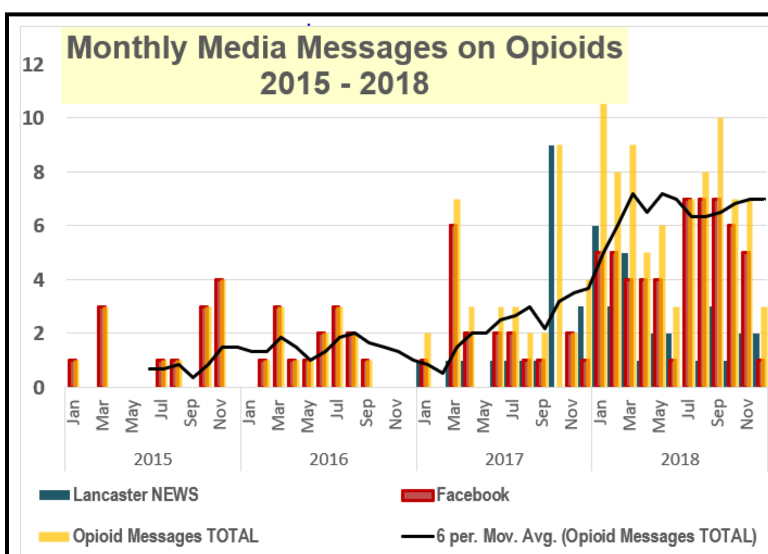
RURAL SERVICE AREA	NON-RURAL SERVICE AREA
1 Box Per 24,298 Persons	1 Box Per 11,320 Persons

GIS mapping suggests the need for at least **four more boxes**, which will be secured through the Implementation Grant. Likewise, the plan calls for a rigorous **awareness campaign to promote use** of these tools as well as other important environmental prevention elements.

During planning of the project, a **media analysis** was conducted to determine the most **common message domains** related to substance misuse, especially opioids. The results suggest a disproportionate level of attention on what is best described as "**Ain't it Awful**." With all respect and not to minimize the tragic impact that this epidemic has had across the state and nation, but news stories that decry the problem but do little to promote measurable **changes in knowledge, attitude or behavior** are unlikely to ameliorate the problem. However, within the state, there has been a shift towards solution focused media attention designed to articulate specific skills or behaviors, that if practiced, are likely to reduce the incidence of prescription drug-abuse. Key elements of this framework include:

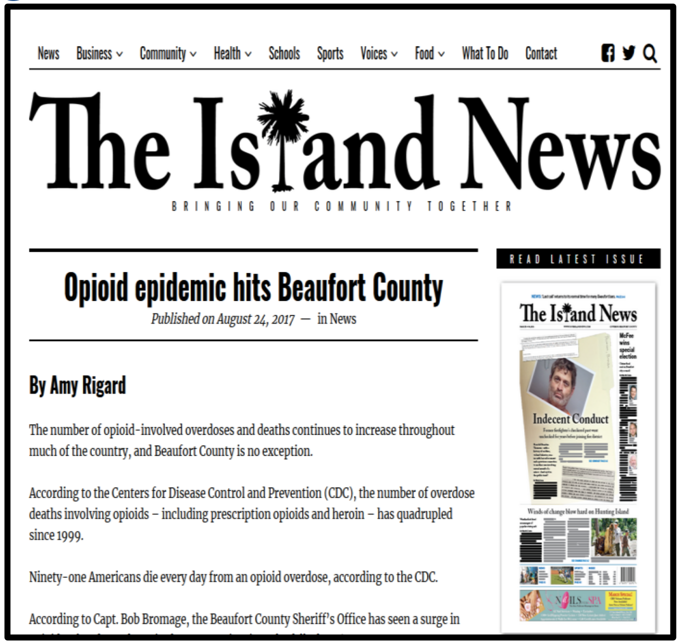
- ✓ Safe **Handling and Storage** of Prescription Medications, Especially Painkillers
- ✓ The **Dangers of Sharing** (Or Selling) Prescription Medications with Family or Friends
- ✓ **How and Why to Dispose of Unused Prescription** Medications
- ✓ The **Purpose and Proper Administration of Naloxone**
- ✓ Availability and Efficacy of **Local Community Treatment Resources**
- ✓ The **Role of Peer Recovery Supports** and How to Access Them

The Beaufort County Opioid Action Network (consortium) will design and implement a targeted **community awareness and media campaign** structured around these message domains, employing a range of tools including **social media, traditional media** sources such as **newspaper, television**, and **radio**, flyers, and bus advertising. The evaluation consultant has significant experience in the tracking of public awareness campaigns to determine saturation, message domain, and whether such attempts produce changes in public norms and behaviors. The chart to the right is from a **comparable project in the state** that has tracked media messages for **five years.** Examples of this new focus on solution focused public awareness are detailed on the next page.



BEAUFORT COUNTY CADAD
ALCOHOL & DRUG ABUSE DEPARTMENT

Voice–Vision-Leadership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Opioid epidemic hits Beaufort County

Published on August 24, 2017 — in News

By Amy Rigard

The number of opioid-involved overdoses and deaths continues to increase throughout much of the country, and Beaufort County is no exception.

According to the Centers for Disease Control and Prevention (CDC), the number of overdose deaths involving opioids – including prescription opioids and heroin – has quadrupled since 1999.

Ninety-one Americans die every day from an opioid overdose, according to the CDC.

According to Capt. Bob Bromage, the Beaufort County Sheriff's Office has seen a surge in

PROBLEM FOCUSED

SOLUTION FOCUSED

To further expand the saturation and reach of the campaign, **electronic Robo-calls** will be employed to create and broadcast messages in a more exact and targeted manner. A **consumer database of every household** in the county will be secured from a national marketing firm (e.g., Hoovers, InfoUSA, etc.) that provides a range of publicly available demographic data (e.g., **age, race, ethnicity, gender, family composition**, **socioeconomic indicators**, etc.) along with name, address, and phone number. This database will enable the consortium to develop and disseminate messages based on these criteria and provide a more individualized awareness campaign. For example, the marketing list could be employed to identify every household likely to include a **grandparent.** A **60 second Robo-Call** could then be directed to these households to take steps to safely secure medications from teen grandchildren that may visit.

Likewise, unique targeted messages can be directed to households with calls recorded by a range of stakeholders (e.g., **county council representative** to his or her constituents, the **police chiefs in different municipalities**, **sheriff, school principal**, or clergy. By individualizing message, messenger, and target recipient, community awareness strategies can have a more focused and deliberate impact. All aspects of these environmental prevention strategies have likewise been included in the evaluation methodology to track both process and outcome.

It is important to note that Beaufort County Alcohol and Drug Abuse Department has made a significant shift towards the use of environmental strategies, under guidance from state authorities. While there are numerous evidence-based prevention curricula available, the **ongoing cost of delivery** to cohorts of youth, year after year, becomes an obstacle. Environmental prevention works to alter the **physical, cultural, or governmental variables** that will lead to long-standing changes in behavior. For example, one of the most effective environmental changes has been **raising the legal drinking age to 21**. After states adopted a 21 minimum drinking age, saw a **decline of 19% in underage drinking**[10]. Other environmental strategies with demonstrated capacity to deter misuse include **high**

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[10] Serdula MK, Brewer RD, Gillespie C, Denny CH, Mokdad A. Trends in alcohol use and binge drinking, 1985-1999: results of a multi-state survey. AM J PREV MED. 2004;26(4):294-298

visibility enforcement[11], **ignition interlocks** installed in cars[12], and **lowering the blood alcohol level** required for citation for DUI[13]. The consortium is especially interested in the utilization of more environmentally informed frameworks in addressing opioid misuse in the targeted census tracts.

TREATMENT – MEETING DEMAND AND HARD TO REACH

The proposed project represents an expansion of services that the applicant organization is well experienced in which significantly enhances the overall implementation process. While a number of **high-quality services are available,** data presented earlier highlight **critical shortages facing the community**. The applicant is also well experienced in each of the proposed evidenced based services, licensure and reporting requirements, assessment protocols, and the importance of fidelity reviews. The overall implementation process for this element will be defined by five distinct steps, as outlined below, and further outlined in the **Work Plan)**:

STEP I: Clinical Supervision Capacity Expansion- Current limitations on clinical supervision necessary for licensure and monitoring will allow the agency to fill current vacant counselor positions and significantly increase treatment population base. One position will be secured. **Job descriptions** have been devised and if funded, positions will be advertised, interviewed, and selections made with careful attention to **education, experience, and understanding of local culture, language, and conditions.**

STEP II: Medically Assisted Treatment Capacity Expansion- The second obstacle involves access to an Advanced Practice Registered Nurse (APRN) able to manage new MAT patients, with special supports for the detention partnership.

STEP III: Case Management and Peer Support Capacity Expansion- Covid restrictions have resulted in a service delivery model that requires additional client supports, case management, and client monitoring. Based on the gap analysis, **two new positions** will be hired to meet the growing demands of targeted subpopulations: 1) **Clinical Social Worker**; and 2) **Peer Recovery Support Specialists**

STEP IV: Professional Development – In addition to the standard training and orientation provided for **all agency staff** and accordance with state licensure and **accreditation standards,** two key areas for additional training were identified during the assessment: 1) **Assessment and Treatment Planning**; and 2) Electronic **Health Records**.

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[11] Elder et al. 2002; Shults et al. 2001
[12] Evaluation of State Ignition Interlock Programs :Interlock Use Analyses From 28 States, 2006–2011Centers for Disease Control.
[13] James C. Fell, University of Chicago; Michael Scherer, Pacific Institute for Research and Evaluation

STEP V: Full Scale Clinical Implementation - Treatment will begin the process with a full assessment and screening comprised of **psychosocial inventory**, **social history**, **addiction severity index**, **strengths-based analysis**, standardized for state funded treatment providers. An **individualized care plan** is then formulated to outline the most appropriate continuum of care that may include one or more of the following: **Individual Counseling, Group Counseling, Family Counseling, Support Groups** and **After-Care Services**. If suitable, MAT will be prescribed as part of the treatment regime and may include **Naltrexone or Buprenorphine**.

STEP VI: Ongoing Assessment and Quality Improvement- A **Project Advisory Team** will meet weekly during the first six months of the grant to conduct an **implementation review** and monitor objectives. This will then continue monthly over the tenure of the grant as part of the **CQI process**. In addition, given the importance of ongoing professional development, funds are also allocated to allow staff to participate in **two required training events**

In addition to these activities, the applicant agency also provides a range of **client support services and case management** to monitor client participation, coordinate referrals, collect and analyze program data, oversee drug testing, and track compliance. Client monitoring may include home or workplace visits, phone-checks, and collateral contacts with employers or others involved with the client. All case management activities will be logged in the client chart and reviewed weekly by the lead clinician. A key element of this component will be to assist eligible individuals with **enrollment in the Affordable Care Act** delivery system to facilitate access to health services.

B. The Appropriateness of Methods Proposed for Fulfilling All Core and Additional Activities Given Needs and Characteristics of Target Population

It is important to note the extensive care and planning that went into the development of the proposed project. The focus throughout was **consortium driven**, with attention to the entire service continuum of **prevention, treatment** and **recovery.** Likewise, it does little good to secure needed resources, only to lose these supports once **federal grant funds have lapsed.** In addition to the rigorous community needs assessment, extensive planning effort, and aforementioned systems mapping, much time was spent in **reviewing empirical literature** related to the Opioid epidemic. Project leaders reviewed the work of other states or municipalities that have been successful in reversing misuse, especially Ohio and West Virginia. As such, the proposed project has been designed to address local **service gaps** through a **coordinated network** of **evidence-based solutions**, proven effective in **communities with similar demographics** as in Beaufort. Each prioritized intervention was selected to produce the largest contribution to programmatic capacity, especially as the impact of Covid is projected to impact local conditions for at least a year or more. The inclusion of **Clinical Supervision** and an **Advanced Practice Registered Nurse** will facilitate an expansion of caseloads, with the **current therapeutic staffing levels** available under **current local and state funding levels.** The addition of **Clinical Social Worker** and **Peer Recovery** Support position will position the consortium to provide community supports to clientele experiencing even greater economic, familial, and health related distress exacerbated by Covid. Finally, although less costly, resources directed toward **environmental prevention** activities will assist the consortium in eventually **moving upstream of the problem** and **ultimately reduce treatment demand.**

C. The Clarity and Comprehensiveness of Proposed Methods to Ensure Sustainability of Activities Beyond Period of Performance, Including:

1. Sustain Consortium Membership and Support

The Beaufort County Alcohol & Drug Abuse Department (applicant) staff have long standing relationships with community problems concerning substance abuse and misuse, as evidence by the recruitment of ten organizations recruited for the Beaufort County Opioid Consortium. The organizations represent government and the non-profit sectors. The proposed consortium membership involves local, regional, and state organizations engaged in public amenities provided in Beaufort County such as **law enforcement, emergency medical services, legal**, and **prevention, intervention**, **treatment,** and **recovery substance use services**. Since a focus of the RCORP funding is data collection and sharing, capacity for data-driven decisions will extend to other community stakeholders also addressing community issues in Beaufort County.

Specific strategies exist to ensure consortium membership and support. The strategies include:

1. Outreach to new members avoiding perceptions the group is "**closed or exclusive**"
2. Scheduling meetings at a **convenient time as determined** by membership
3. **Continuous evaluation of consortium operations** annually through an anonymous survey
4. Ensuring monthly **meetings are pertinent, deliberate, and organized** so that the meeting is mindful of the schedules of the membership
5. Ensure all consortium activities includes a rigorous evaluation methodology that allows members to **celebrate accomplishments and problem-solve when obstacles occur,** and
6. Allowing time at the meetings for members to **socialize and share both professional and personal information.**

2. Secure Target Population Support and Engagement

The Beaufort County Alcohol & Drug Abuse Department recently was awarded a small amount funding through the State Opioid Response (SOR) grant administered through the South Carolina Department of Alcohol and Other Drug Abuse Services (DAODAS). The funding establishes a collaborative prevention effort among seven Beaufort County partners called Project Stigma. Project Stigma is working to address the stigma of substance use, misuse, and treatment in Beaufort County that leads individuals to believe that their substance use concerns are a moral failing.

3. Leverage Local/Community, State, and Regional Partnerships

If the RCORP funding is awarded to the Beaufort County Opioid Consortium, **opportunities for additional membership** will exist and new potential community partners will join in the effort to reduce opioid-related issues in Beaufort County. Aside from the proposed consortium membership, the proposed Beaufort County Opioid Consortium member organizations have other community relationships, such as with the **Beaufort County School District**, Beaufort County **municipal police agencies**, **University of South Carolina Beaufort**, **Coastal Empire Mental Health** and other community **non-profits and governmental agencies**.

Other funding streams for the overall work of the Consortium will be leveraged. For instance, the Beaufort County Alcohol & Drug Abuse Department recently was awarded a small amount funding through the State Opioid Response (SOR) grant administered through the South Carolina Department of Alcohol and Other Drug Abuse Services (DAODAS). The funding establishes a collaborative prevention effort among seven Beaufort County partners called Project Stigma. Project Stigma is working to address the stigma of substance use, misuse, and treatment in Beaufort County that leads individuals to believe that their substance use concerns are a moral failing. If the RCORP funding is awarded to the Beaufort County Opioid Consortium, Project Stigma will not be supplanted by the new funding, but the goals and objectives of both projects will be combined strategically.

4. Optimize Reimbursement for Services Across Insurance Types and Facilitate the Health Insurance Process for Eligible Uninsured Patients

It is important to note that Beaufort County Alcohol & Drug Abuse Department is a county affiliate of the state addictions agency (SC Department of Alcohol and Other Drug Addiction Services) and as such, provides services throughout the county as a public entity. The agency currently accepts private insurance as well as Medicaid.

5. Leverage Other Funding Streams to Cover the Cost of Services

South Carolina currently provides funding to cover the cost of Buprenorphine to indigent individuals, such that Beaufort Alcohol & Drug Abuse Department regularly submits reimbursement claims to the state to cover these prescriptions. Likewise, the agency provides a sliding scale, in addition to the public and private pay funding streams.

6. Ensure Services Are Accessible and Affordable to Individuals Most in Need, Including the Uninsured and Underinsured.

Project leaders understand that the RCORP-Implementation Grant is **payer of last resort**. As such, service providers will bill for all services covered by reimbursement and **exhaust all possible efforts to obtain payment for services**. Likewise, agency policy also provides support to all clients without insurance coverage to **seek out and apply for any eligible reimbursement streams** (e.g., Medicaid, Affordable Care Act). At the same time, as a branch of the state treatment system, agency policy **will not deny any individual service due to inability to pay**. It is important to note that the Beaufort

County Alcohol & Drug Abuse Department is a well-established public treatment agency with an extensive record of services, especially to individuals who are either **uninsured or underinsured**.

WORK PLAN

A. Clarity and Completeness of Work Plan, Including Inclusion of Responsible Individuals And /Or Consortium Members, Timeframes, And Deliverables Associated with Each Core Activity And, If Applicable, Additional Activity

As indicated in the RFP, the complete **Work Plan** is provided as an attachment in the appendix to avoid repetition within the narrative. This lengthy document aligns project **goals and objectives**, with target strategies with includes specific tasks, **starting and end dates**, **responsible parties**, any **external partners** to be involved, the process for **tracking progress**. This document is further clarified within the narrative section, especially with regards to **tracking completion of each programmatic task on time** and in **budget.** The applicant agency furthermore commits to participate in all required **data tracking requirements**, regular **reporting as requested**, and travel related to **grantee orientation** outlined in the RFP. Work plan details, coupled with narrative supports articulate the involvement of each consortium member, especially as it relates to service on the **Project Advisory Team**, over the **three-year grant tenure** to monitor each aspects of **program implementation, management,** and **evaluation.**

B. Extent to Which the Work Plan Reflects A Three-Year Period of Performance / Timeframes are at Minimum Broken into Quarters

As per instructions detailed in the RPF, the project Work Plan summarizes tasks associated with the **entire three-year grant tenure**. Instead of projected dates, the plan is structured around specific **quarterly time segments**. This approach (As abbreviated in the Work Plan: **Y1: Q1, Q2, Q3, Q4, Y2: Q1, Q2, Q3**…) obviously involves greater actions during the onboarding of the project but provides consistent attention from project beginning to final reporting submitted to grantor.

C. Extent to Which the Plan Incorporated Processes for Reducing Health Access and Outcome Disparities in Target Population

A key element of the aforementioned **systems model,** and informed by the **social determinants of health framework**, is an emphasis on addressing a wider spectrum of **concerns beyond substance misuse disorder issues**. This is especially significant given the staggering level of poor health among the target census tracts described during the segmentation analysis of **CDC indicator data**. This was a key decision in the prioritization of **client support services and case management** to monitor client participation, coordinate referrals, collect and analyze program data, oversee drug testing, and track compliance. Client monitoring may include home or workplace visitation, phone-checks, and collateral contacts with employers or others involved with the client. All case management activities will be logged in the client chart and reviewed weekly by the lead clinician. A key element of this component will be to assist eligible

individuals with **enrollment in the Affordable Care Act** delivery system to facilitate access to health services. These strategies are likewise outlined as required in the work plan.

D. Extent Work Plan Details Process for Financial & Programmatic Sustainability Beyond Period of Performance, Including Deliverables, Responsible Parties, And /Or Consortium Members, And Timelines Associated with Processes

As indicated earlier, the work plan includes details related to the **minimization of long-term cost centers** for proposed activities and emphasizes expenditures that will **maximize currently available resources** (expanded Clinical Supervision and MAT). Likewise, elements related to sustainability are also included in the plan, and discussed in even greater detail later in the narrative.

E. Extent to Which the Work Plan Includes Activities Related to Tracking and Collection of Aggregate Data to Fulfill Reporting Requirements

Consortium members have taken significant effort during planning to ensure that systems were created to facilitate ongoing **collection, aggregation, analysis** and **reporting** of all data, **required by the RFP** as well as **part of the overall evaluation** effort. For this reason, **baseline data has already been secured** and reported in a series of tables (Section I). Likewise, a network of **local, state, and national archival databases** has been identified that will further be employed over the course of the three- year grant tenure. Discussions have taken place with regards to a series of targeted **surveys** to be employed with treatment clients (in full compliance with **participant protections including HPPA**), as well as an ongoing **community household survey** to **monitor changes in local norms** associated with the planned awareness campaign.

Assisting in the effort will be a **consultant team** to support **ongoing tracking and evaluation of the project.** This team has conducted evaluations of **over 60 state and federal projects**, with an emphasis on **substance misuse, community health**, and **public safety**. Much of the planning and discussion of each element related to tracking and collection of aggregate data has **already been positioned within the system**, which will greatly **enhance the speed in which the project can be onboarded**, if funded.

RESOLUTION OF CHALLENGES

A. Extent Applicant Describes Internal and External Challenges in Implementing Proposed Work Plan, & Quality of The Solutions Proposed to Address Them

While much planning and discussion were focused on development of the project, there are however several key challenges that present significant opportunities for the growth and effectiveness of the consortium. Throughout the state, **the adoption of a harm reduction model** related to the opioid epidemic has evolved significantly. Three years ago, **few municipalities actively encouraged law enforcement officers to carry and administer naloxone.** Concerns regarding liability, training, security, and cost were often raised. The governor then created a **state tracking system** to monitor naloxone distribution by each law enforcement agency in South Carolina, **still voluntarily** at the local level. Likewise, as **adult treatment courts** expanded across the state, local authorities often questioned the wisdom and efficacy of **Medically Assisted Treatment.** Most common objectives suggest that such actions merely **substitute one drug for another** or lead to long lines of methadone patients in blighted neighborhoods.

The grant applicant has an excellent relationship with law enforcement and first responders in the county, as these entities play a major role on the consortium, they are open to additional training and discussion surround harm risk reduction. Despite their participation, there is a **great deal of stigma** that exists with regards to understanding the **dynamics of addiction**, **treatment efficacy**, and **brain structure** as it relates to **long term participation in MAT**. The Sheriff's department views Naloxone training and distribution as "enabling", and chronic disease language is not used. The lack of using recovery-oriented language is also true for the fire rescue departments. These critical partners struggle to understand the scientific advances of the benefit for providing medication assisted treatment to offender populations. To that end, law enforcement and a variety of first responders could benefit from anti-stigma and medication assisted treatment education and training.

FAVOR LOWCOUNTRY™ Faces & Voices of Recovery

This challenge, why not unique, presents a promising opportunity for the consortium. Law enforcement members have agreed to work together on making the **transition to a harm reduction framework** and participate in a **series of training activities** and consultations to review the science and **best practice protocols.** To assist is **Face and Voices of Recovery**, one of the most prolific and effective recovery advocacy groups in the entire state. This organization well aware of stigma and especially adept at helping communities **understand current science** and discussion of **myths and misperceptions**

Next, since law enforcement credibility is enhanced when the message itself comes from other law enforcement officers, the plan calls for a series of consults to be provided by the sheriff in the upstate are who has successfully made the transition to the harm reduction framework, after much consideration and initial objection. In fact, this municipality is the **first rural sheriff's office in South Carolina** to implement the nationally recognized Law Enforcement Assisted Diversion (LEAD) model. LEAD is a **pre-booking diversion** program developed to address low-level drug and prostitution crime. The program allows law enforcement officers to **redirect low-level offenders** engaged in drug or prostitution activity to community-based services, instead of jail and prosecution. The model has been named a best practice model by the **National Institute of Corrections**, **Bureau of Justice Assistance, Ford Foundation, CrimeSolutions.Org**,, and **DrugPolicy.Org.** Numerous national evaluations of LEAD have demonstrated its capacity, with the largest study showing the model **reduced short-term recidivism by 23%, and long-term by 56%.**

LEAD
LAW ENFORCEMENT ASSISTED DIVERSION

It is probably no coincidence that the upstate sheriff was named **Sheriff of the Year** last year, due in part to his aggressive work in addressing opioid misuse within a public safety system, strongly grounded in harm reduction. He has generously agreed to assist with consultations and conduct community tour of local programs in the upstate. In addition, a member of the evaluation team (**Dr. Michael George**, of the Pacific Institute for Research and Evaluation, at Berkley) is a retired officer with **over 20 years law enforcement experience** in South Carolina. With an expertise in **enforcement, public health, and harm reduction**, Dr. George will play a key role in helping build local capacity and address perceived challenges related to stigma.

B. The Extent Which Applicant Details Potential Challenges and Solutions to Sustaining Services After the Period of Performance Ends

As indicated earlier, much of the organizational infrastructure and critical gaps identified during planning are **directly related to or exacerbated by the onset of Covid.** As **businesses closed, tax base decreased**, and **public funding suffered**. Given the strong tourism sector in the county, permanent business closures are unlikely, and as the Governor is easing restrictions in the near future, it is likely that previous revenue streams can be restored. In addition, the acquisition of **clinical supervision** and **Advanced Practice RN** with **MAT waiver**, will result in an immediate expansion of service delivery in the target census tracts. These priorities will greatly enhance sustainability potential to ensure continuation of efforts once federal grant funds have lapsed.

Next, project leaders understand that the RCORP-Implementation Grant is **payer of last resort**. As such, service providers will bill for all services covered by reimbursement and **exhaust all possible efforts to obtain payment** for services. Likewise, agency policy also provides support to all clients without insurance coverage to **seek out and apply for any eligible reimbursement streams** (e.g., Medicaid, Affordable Care Act). At the same time, as a branch of the state treatment system, agency policy will **not deny any individual service due to inability to pay**. It is important to note that the agency is a well-established public treatment agency with an extensive record of services, especially to individuals who are either **uninsured or underinsured**. This emphasis on existing reimbursement streams is also a key element in the sustainability plan.

Finally, importance of the consortium cannot be overstated. The process of data collection and analysis, planning, discussion, and formulation of intervention strategies has stimulated the group to **explore other potential venues for partnership**. During the next meeting the group will discuss **Adult Drug Treatment Court**, **MAT Expansion Psychostimulant Program Resources**, and the aforementioned **Law Enforcement Assisted Diversion** initiative. Similar planning efforts are likely to be adopted to strengthen overall resources for community, both **federal and state**. Project leaders that strong assessment data, combined with a prolific partnership, and high-quality service models are essential to securing highly competitive state grants, as well as federal.

EVALUATIVE MEAURES (EVALUATION& TECHNICAL SUPPORT

A. Clarity & Comprehensiveness of Processes (Staffing/Workflow) For Tracking, Collecting, Aggregating, Reporting Data from Consortium Members

The proposed project will employ the data, in addition to the required **Core Measures** outlined with **baseline data in the required chart presented earlier (Section 1D)**, to track progress towards stated goals and objectives. Partners envision the current problem with short term, mid-range, and long-term outcomes, as outlined in the graphic below, with the ultimate outcome of reducing Opioid misuse, overdose, and morbidity. To that end, all consortium activities employ a rigorous evaluation methodology to track activities throughout planning and implementation.

A significant strength of the Beaufort County Alcohol & Drug Abuse Department (BCADAD) is that over the last several years, BCADAD has adhered to data driven decision making. With support from the **Data Coordinator**, extensive data will be collected to monitor the overall incidence and prevalence of substance use disorders, especially Opioid related, changes to community norms, and progress towards implementation of all elements of the work plan. The following table describes each data element, and how and when this data will be collected.

Voice–Vision-Leadership

Data Element	Foci	Frequency & Methodology
Outcomes and Associated Harms		
Youth 30 Day Non-Medical Use of Prescription Drugs	Survey of middle and high school students on incidence of non-medical use of prescription drugs and other drugs; Perceived risk of use; Perceived parental and peer disapproval	Twice a year, based on Communities that Care Survey.
Adult 30 Day Non-Medical Use of Prescription Drugs	Community Survey of the incidence and prevalence of non-medical use of prescription drugs, perceived norms, and attitudes	Stratified random sample of 1,000 residents, Bi-annual: Monthly from treatment and recovery clients.
Overdose Deaths	Deaths from Prescription Drugs by drug class including prescription opioids Total, Fentanyl, and Heroin	Collected monthly from coroner, public health records
Hospital Admissions	Admissions for drug poisoning, overdose, etc. by drug class including Opioids Total, Fentanyl, Heroin (Not for dependency)	Collected monthly, SC Dept. of Health and Human Services
ER discharges	Discharges related to opioid overdose	Collected monthly, SC Dept. of Health and Human Services
Prescription Validity	% of Opioid overdose cases with valid prescriptions.	Monthly; Coroner and SCRIPTS records
Outcomes Related to Treatment Access		
Timeliness of Treatment	Mean length of time to enter treatment from overdose event or crises which lead to requesting or entering treatment	Patient survey conducted in inpatient and programs
Treatment Access	# of treatment admissions for prescription drug misuse recovery/dependency both outpatient and inpatient	Monthly; aggregate records from treatment partners
Treatment Duration	Average length of time for patients in opioid treatment	Monthly; aggregate records from treatment partners
Access to MAT	# of Medically Assisted Treatment (MAT) cases are active	Monthly; aggregate records from treatment partners

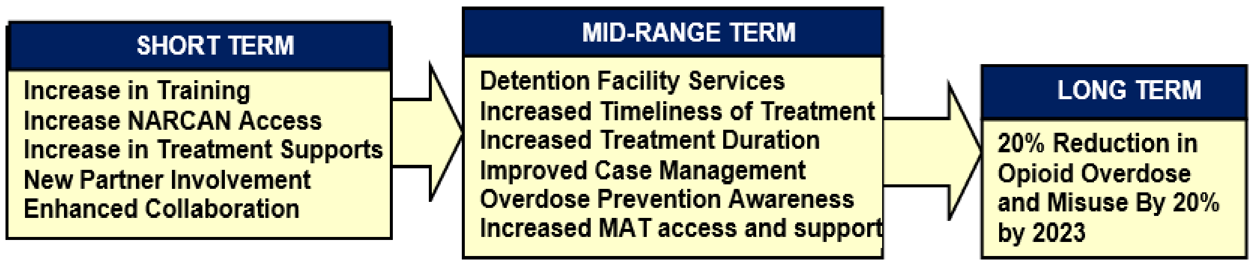
Voice–Vision-Leadership

Data Element	Foci	Frequency & Methodology
Naloxone Leve of Use to Prevent Opioid Overdoes		
NARCAN Training	Accumulative % of Police, Fire, and ER personnel Trained for proper administration of Naloxone for overdose cases	Annual; Training records from consortium partners
NARCAN Use	Number of Naloxone Administrations	Monthly: Collected by consortium partners
Social Availability		
Social Sources	% of Opioid users citing various social sources	Annually, Community survey; Patient surveys from treatment
Source by Treatment	% of Opioid users admitted for treatment citing various social sources	Monthly; ER Admissions, Treatment Admissions
Access to Disposal Tools	Number of Prescription Drop Boxes, Location, Hours of Operation	Monitored monthly
Disposal Box Content	Weight of prescription drugs in each drop box by class	Conducted by law enforcement; monthly
Retail Availability		
Source	# of Non-Medical Prescription Drug Users obtaining from retail sources including from local providers	Annual; As part of Community Survey
Source by Treatment	# of Opioid users Admitted for Treatment citing various retail sources	Monthly; ER Admissions, Treatment Admissions
Pharmacist Training	# of pharmacists trained and accumulative # registered with SCRIPTS	Monthly; Pharmacy Board; SCRIPTS
Provider Training	# of local health providers trained and accumulative # registered with SCRIPTS	Monthly; County Medical Association; SCRIPTS
Opioid Distribution	# of Opioid Prescriptions issued by local providers	Monthly; SC SCRIPT Monitoring System

Voice–Vision-Leadership

Data Element	Foci	Frequency & Methodology
Community Awareness and Environmental Prevention		
Prescription Drop Box Site Location	GIS Mapping of Drop Box Locations, aligned with Awareness Data and Utilization	Quarterly, Data from Drop Box Sites
Prescription Drop Box Promotion	Number of traditional and social media messages targeting drop box locations or events.	Quarterly, Media Analysis
Prescription Drop Box Utilization	Content by weight of each drop box by location and date.	Quarterly, Data from Drop Box Sites
Prescription Drug Storage Promotion	Number of traditional and social media messages targeting safe storage procedures or promotions	Quarterly, Media Analysis
Prescription Drug Storage Practices	Percentage of respondents reporting awareness of, and effective practice of recommended storage practices	Household survey, annual
Prescription Drug Sharing Awareness	Number of traditional and social media messages focused on reduced sharing of prescription medications	Quarterly, Media Analysis
Prescription Drug Sharing Practices	Percentages of respondents reporting awareness of dangers of, and effective practices to reduce prescription drug sharing.	Household survey, annual.
General Community Awareness	Number of traditional and social media messages content categorized around 1) general awareness and concern of the problem; 2) general awareness of local entities working toward a solution; 3) general awareness of availability of local resources; 4) general awareness of purpose and protocol for administration of Naloxone, and 5) impressions regarding efficacy of existing resources and promotions.	Household survey mirrored by community partner survey administration of within-reach populations.

Partners envision the current problem with short term, mid-range and long-term outcomes, as outlined in the graphic below, with the ultimate outcome of reducing Opioid misuse, overdose, and morbidity. To that end, all coalition activities employ a rigorous evaluation methodology to track activities throughout planning and implementation. In addition to these outcome indicators, the data monitoring plan will also address overall implementation, with the following **process indicators** employed:



PROCESS INDICATOR	PLAN FOR TRACKING
General Assessment, Analysis, and Planning Indicators	
Number of Consortium Meetings / Attendance Level	Meeting Sign-in Sheets / Documentation of Minutes
Number of new Consortium Members Engaged in Initiative.	Consortium Memorandum updated annually.
Number of GIS Maps Developed	Map Count by Project Director
Electronic Robo Calls	Number of calls made, percentage of households that listen to full message, saturation based on zip code.
Compliance with Project Timeline	Target tasks, planned dates, compared to completed tasks and dates.
Budget management over grant tenure	Monthly expenditures to date, compared to year to date, proportionate to 36 full months of funding.
Continuous Quality Improvement	Monthly meetings, documented minutes, data reviewed, and scheduled follow-up; Number of obstacles identified, addressed and timeframe.

As indicated earlier, the project will employ strategic use of **Geographic Information System (GIS) Mapping** to analyze specific target populations including **senior citizens** (most likely to suffer falls or illness requiring painkillers)**,** Imputation of **Health Insurance Coverage**, by Age and Educational Attainment**, Veteran Status** (often linked in literature as a risk factor), and **Disability Status** (likewise a potential risk factor associated with misuse. This data will be employed to monitor population changes, but no patient identifiers or protected information will be accessed, employed or mapped.

In addition to alignment with census data, the database will also be employed for **electronic telephone calls**, recorded by the Sheriff, Police Chief, Mayor, or County Administrator to inform the public of ongoing activities such as **enforcement patrols**, **community forums,** household **community surveys**, or other awareness strategies. Electronic calls will be coupled with a network of existing **digital mobile signs** that law enforcement can be **relocated throughout the county**, **strategically aligned** with any of the aforementioned shapefiles or mapping results. In this way, data collection, analysis, and awareness activities can all be more systematically conducted as opposed to a 'shotgun' approach and hoping that the most relevant target populations will be reached.

The Program Coordinator, with support from the Data Coordinators, will be responsible for collection of all process and outcome data, to be submitted quarterly to members of the consortium, as well as incorporated into a project **data dashboard** for use in monitoring performance over time. As indicated earlier, the Data Coordinators will meet bi-weekly during the first year to monitor implementation and outcome data. In cases where programmatic benchmarks or timelines are at risk, the team will devise corrective action strategies.

B. Extent Which Applicant Designates Individual in Staffing Plan (Attachment 5) To Serve as A "Data Coordinator"

The plan calls for the current Office Manager at the agency to serve in this capacity, at .25 FTE. He currently manages data systems for reporting state and fiscal reports and was involved in the planning of the effort, including support in collection of baseline data.

C. Extent Letter of Commitment Contains Explicit Commitment by Consortium Members to Sharing Aggregate Data to Fulfill Reporting Requirements.

Each member of the consortium assisted in development of a data collection plan, with strong emphasis on ensuring participant protections and to **comply with HIPAA** and other local, state and national regulations. As such, any potential concerns or obstacles have been discussed and data has been forthcoming throughout the planning process. The signed **Letter of Commitment** explicitly indicates the **willingness to share aggregate** (not patient-level or other personally identifiable information) **performance data and information with the applicant organization** to fulfill HRSA reporting requirements.

CRITERION 4: IMPACT EVALUATION & TECHNICAL SUPPORT

A. Clarity & Comprehensiveness of Plan for Updating Participating Entities, Target Area, & Public on Activities, Lessons Learned, & Success Stories

Members of the consortium have extensive experience in information dissemination. Potential platforms will include venues such as **social media**, **newspapers**, **state law enforcement networks,** and the South Carolina **Department of Alcohol and Other Drug Addiction Services** network. The consortium has also learned the importance of interfacing with local, state, and federal **legislative delegates**; and often hosts delegate tours to spotlight local issues or success stories to elected officials. This is especially important given the extensive plans involving the development of a community awareness campaign to address key norms and behaviors. Previous strategies described with regards to **tracking media message domain** and **saturation over time**, coupled with an **annual community household survey** provides an excellent opportunity for articulating **lessons learned, success stories**, and ongoing **awareness.**

Another significant resource for dissemination is the **National Rural Substance Abuse Prevention Conference**, hosted at the University of South Carolina-Lancaster. Founded through a SAMHSA grant, this conference is **now in the 13th year,** and highlights the **unique challenges of conducting prevention in a rural context.** This **three-day conference** brings national speakers to South Carolina and averages 200 in attendance, with participants from **26 states and Canada**. Project leaders have contacted conference organizers for future **Calls for Presentation**, with the hopes of participating as presenters. The plan is to theme next year's conference around Opioid misuse, with tracks for **law enforcement, physicians, pharmacists**, and **prevention specialists.** If accepted, this presents an excellent opportunity for stakeholders from Beaufort to spotlight their work and engage in discussions with other leaders from throughout the state and nation.

B. Extent Which Applicant Provides Examples of Mediums and Platforms for Disseminating This Information.

As indicated earlier, a key element of sustainability is dissemination of information to promote greater knowledge and understanding about the value of research informed practices. Consortium members are positioned to conduct a series of formal **presentations** and **town hall meetings** as a mechanism for information exchange. As such, in addition to planned presentations at **city and county council, school board**, **civic groups**, and meetings with **medical providers and hospital staff**, project leaders have prioritized **local newspaper, radio,** and **television outlets.** However, one of the most important dissemination platforms is publication in **peer reviewed journals**. The evaluation team has extensive publication experience and are most interested in exploring possible work, especially with regards to the impact of community awareness activities.

CRITERION 5: RESOURCES / CAPABILITIES

A. Extent Which Applicant Demonstrates Consortium Is Comprised Of At Least Four Separately Owned Entities, Including the Applicant Organization

As required within the RFP, **Attachment Two** provides a detailed chart listing all consortium members participating in the proposed project. This information provides all required information, including the following elements:

Consortium Member Name	Member Street Address / County
Point of Contact at Organization	Employer Identification Number (EIN)
DUNS / EIN	Service Delivery Site
Sector Represented	RCCORP Award History
NHSA Site or Eligible	Located in HRSA Rural County or Tract
Signature on Letter of Commitment	

B. Extent Which Applicant Demonstrates At Least 50% of Consortium Members Are Physically Located In HRSA-Designated Rural Area (Rural Eligibility Analyzer)

On February15, 2021 a query was conducted of the HRSA Eligibility Analyzer, for each address of every consortium member participating in the project. Every single member is **located and operates in an eligible rural tract.** Attachment Two summarizes the rural eligibility analyzer data.

C. Extent Which Consortium Members Represent Diverse Sectors & Disciplines

As indicated earlier, the proposed project is the work of consortium of local stakeholders, well familiar with each other, and comprised of the following:

Beaufort County Alcohol and Drug Abuse Department	
Beaufort County Sheriff's Office	14th Circuit Solicitor's Office
Beaufort County Detention Center	Lady's Island Internal Medicine
Lady's Island /St Helena Fire District	Burton Fire District /EMS
South Carolina Office of Rural Health	Lowcountry FAVOR
SE Center for Strategic Community Development	SC DAODAS

This group represents expertise in law enforcement, healthcare, behavioral health, community development, recovery, first responders, and community mobilization.

D. Extent Which Applicant Demonstrates All Services Provided Exclusively In HRSA-Designated Rural Areas, (Rural Health Grants Eligibility Analyzer)

As indicated earlier, the targeted census tracks are bifurcated within the county, **separated by a large body of water** (Broad River), with **all required services situated within the population center of the area.** The applicant agency and all project partners have agreed to ensure that **only eligible rural residents will be served** with grant funded resources. Since the major service providers for the partner are all located in the eligible rural area and have longstanding history of service, the ability to limit provision of grant funded strategies to only eligible residents is greatly enhanced. In fact, during project planning, the process for establishing a "**geo-fence**" around service delivery and data collection was devised. This is important, as the coalition widely employs **Geographic Information Systems (GIS) mapping** as a project planning, management and evaluation tool.

E. Extent Which Consortium Members, Including Applicant, Have Signed and Dated A Single Letter of Commitment

A Copy of a scanned, **signed and dated Letter of Commitment** have been included in the attachments. This letter identifies each organization's **roles and responsibilities** in the project, the activities in which they will be included, how the organization's **expertise is pertinent to the project**, and **length of commitment** to the project. Likewise, the letters detail each entity's understanding of the benefits that the consortium will bring to the member and to the target rural service area. Finally, **all required statements are embedded within each letter.**

F. Extent to Which 50% of Signatories are Physically Located in the Rural Area

On February15, 2021 a query was conducted of the HRSA Eligibility Analyzer, for each address of every consortium member participating in the project. Every single member is **located and operates in an eligible rural tract.** Attachment Two summarizes the rural eligibility analyzer data

G. Clarity of Organizational Chart and Extent Which It Depicts Relationships And /Or Hierarchy Among Consortium Members Participating in The Project

A detailed Organizational Chart has been included in the attachment. This chart references the proposed project in **relationship to existing services and initiatives**. It delineates new proposed staff positions and **hierarchical relationship** to designated consortium members.

H. Clarity and Completeness of Proposed Staffing Plan Including Extent to Which the Plan Includes All Elements Outlined In "Project Narrative" Section

As required within the RFP, a staffing plan table has been included (Attachment 5) that provides all elements: **Member Name, Title, Organizational Affiliation, FTE**, and **Roles and Responsibilities**. In the case of positions to be hired, the table includes a **timeline, process, and qualifications**.

I. If Staff Member Has to Be Hired, Extent Which the Applicant Details Process & Timeline for Hiring/ Onboarding Staff, Qualifications & Expertise Required

The aforementioned Staffing Plan also (**Attachment 5**) provides the required information for all positions to be hired: Advanced Practice Registered Nurse, Clinical Supervisor, Clinical Caser Manager, and Peer Recovery Support. Likewise, the plan includes a general timeline and hiring process, in additional to basic qualifications for each position. Counseling Services of Beaufort generally advertises for new or vacant positions through LinkedIn, local and regional newspapers, social media, and at universities within the state that provide clinical training in substance use disorders.

J. Extent Which Staffing Plan Directly Links to Activities Proposed in Work Plan

Following the planning process preceded development of the proposed grant, significant work was done to review service delivery trends and gap analysis. As such, five positions were prioritized within the Work Plan (**Attachment 1) and** listed within the Staffing Plan (**Attachment 5**). Likewise, the entire project follows closely to the aforementioned Opioid System Mapping and SOCI recommendations (Section 1) to ensure a comprehensive and logical approach to addressing the problem.

K. Extent to Which Applicant Demonstrates that the Project Director will devote at least 25% FTE to project

The project staffing plan calls for a 100% FTE Project Director to coordinate all aspects of program implementation, management, evaluation, and reporting. In addition, the individual will Co-Chair the Project Advisory Team and provide leadership with regards to the Community Awareness Campaign.

L. Clarity & Comprehensiveness Which Applicant Describes Project Director Will Serve as Point Person & Facilitate Collaborative Input & Engagement Among Members to Complete Work Plan During Period of Performance

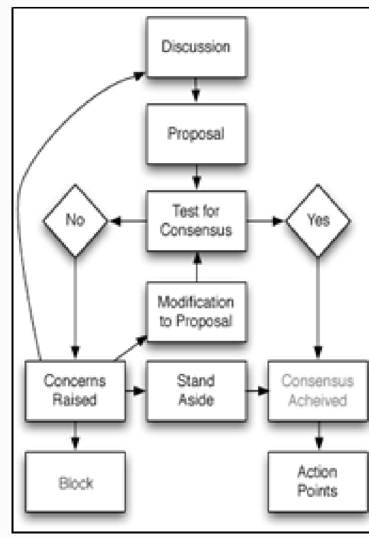
It is important to note that the applicant agency (Beaufort County Alcohol and Drug Abuse Department and consortium members are well established partners that interface regularly for years. As such, the **agency Executive Director is both comfortable and experienced** in serving as point person for the proposed project. Because the process of community mobilization often involves individuals with competing agendas, the process employed by the Coalition has greatly facilitated positive **participation, communication, and buy-in**. At onset, the consortium has adopted the **Consensus Decision-Making Framework,** a process that seeks the agreement of participants, but also mitigates the objections of the minority to achieve the most agreeable decision. Once an agenda has been set and ground rules for the meeting have been agreed upon, each item is addressed in turn. The process employed in the framework is outlined on the chart below.

Discussion of the Item: The item is discussed with the goal of identifying opinions and information. Potential proposals for action are often identified during at this time.

Formation of a Proposal: Based on discussion, a decision proposal is presented to the group.

Call for Consensus: The facilitator calls for consensus on the proposal. Each member usually must actively state their agreement with the proposal, often by using a hand gesture or raising a colored card, to avoid the group interpreting silence or inaction as agreement.

Identification and Addressing of Concerns: If consensus is not achieved, the dissenter presents the concern, potentially starting another round of discussion to address or clarify the concern.



Modification of the Proposal: The proposal is amended to address the concerns. The process returns to the call for consensus and the cycle is repeated until a satisfactory decision is made.

M. Extent Which Applicant Describes How Data Coordinator Will Track, Collect, Aggregate, & Report Data from Members to Fulfill HRSA Data Requirements

As indicated earlier in the narrative (Section: Evaluation and Technical Support: A), a team of individuals will assist the Data Coordinator with data collection, aggregation, analysis and reporting. Much of the **planning and inter-agency cooperation** needed to collect Core HRSA Indicators and other measures was completed during the one-year planning tenure. A **Memorandum of Understanding** was devised, and still in operation, that provided access to all data points listed earlier in the narrative. A **data dashboard** was devised and is still being tracked, in most cases on a **monthly basis** to facilitate a **time series analysis**.

N. Extent Which All Proposed Staff Members Have the Appropriate Qualifications and Expertise to Fulfill Their Roles and Responsibilities

The applicant and lead investigator for the project is The Beaufort County Alcohol and Drug Abuse Services Department (BCADAD), the **sole public substance abuse treatment provider in the county.** Established in 1974, the agency functions as a department under the County Council of Beaufort County, South Carolina, established under South Carolina law (Act 301 of 1973) to help individuals and families troubled by alcohol, tobacco or other drug-related problems. The department liaises with the Beaufort County Alcohol and Drug Abuse Board, which is comprised of seven members appointed by the Beaufort County Council. The Board's role is to advise County Council, staff, and other agencies in matters concerning the provisions of ongoing programs in prevention, treatment, and recovery for alcohol and drug abuse problems.

The organization is accredited by the **Commission on Accreditation of Rehabilitation Facilities** (CARF), **licensed** by the SC Department of Health and Environmental Control, and certified by the South Carolina Department of Alcohol and Other Drug Abuse Services (DAODAS). The BCADAD employs staff (and secures professional services when necessary) who are highly trained in their areas of expertise, including **person-centered care** and **evidence-based practices.** The BCADAD Treatment section is led by an experienced **Treatment Director** who has worked in the section for almost **25 years.** The BCADAD Prevention section is led by an experienced **Prevention Director** who has worked in the section for **more than 30 years**.

Key positions from the agency and consortium include:

Steve Donaldson is the Executive Director of BCADAD and will oversee the Project Director and all contracted positions in the grant during the funding period. With over 25 years of experience in roles as a Director over treatment services, Mr. Donaldson has a wealth of knowledge and expertise in running and managing treatment programs similar to the ones proposed in the grant narrative. Steve has held positions in the lowcountry area since 1998 which has bolstered his connections and vast knowledge of services available in the area and the team members running them. With his extensive experience and deep ties to the community, Steve will play a critical role in management and oversight of the proposed grant programs.

Brian Wagner - Chief Wagner is the district's Medical Training Officer overseeing the district's Basic and Advanced Life Support programs. Chief Wagner was noted for upgrading the district's medical program for both firefighters and the public. Specifically, with more than 65 percent of the emergency calls involving a medical emergency, Chief Wagner initiated the district's new Advanced Emergency Medical Technician (EMT) Program, increasing the skills of district EMTs and enabling them to deliver more advanced medical treatment to citizens. His peers universally applaud him for taking the Burton Fire District "to the next level" and he was awarded Officer of the Year in 2018.

Sara Goldsby – Sara Goldsby was confirmed as Director of DAODAS by the South Carolina Senate on February 8, 2018, after being appointed Acting Director by Governor Nikki Haley in August 2016, then nominated as Director by Governor Henry McMaster in May 2017. As Director, she has led the states response to the opioid crisis and currently serves as co-chair of the State Opioid Emergency Response Team. Under her leadership, DAODAS has been instrumental in helping local law enforcement agencies employ the use of the emergency overdose antidote naloxone. With passion around social determinants of health and access to care, Director Goldsby has worked in legal and dental practices, and hospital case management. She earned her Master of Social Work and Master of Public Health degrees – with an emphasis on health services, policy, and management – from the University of South Carolina in 2015.

Duffie Stone - Duffie Stone became the 14th Circuit Solicitor in 2006, after nearly two decades split between private practice and his work as a prosecutor in South Carolina's 14th and 5th judicial circuits. He was appointed by then Governor Mark Sanford. Stone's time as Solicitor has been marked by several innovations. Among them is intelligence-led prosecution, which uses technology and information-sharing to better understand and more effectively combat criminal elements that operate within the 14th Circuit's various communities. In 2015, he was appointed to Gov. Nikki Haley's Domestic Violence Task Force, and he currently serves as chair of the S.C. Domestic Violence Advisory Committee. Applying the lessons of those endeavors, his office launched a Special Victims Unit to prosecute rapists, domestic batterers and child abusers; and it opened the 14th Circuit Victims Center, a partnership of various nonprofit agencies that assist victims of those crimes.

Isaac Waters – Isaac Waters has made it his life's mission to support others as they build a life in recovery. He believes that the power of recovery has given him a unique opportunity to help individuals attempting to recover from substance use disorder. He has worked in many different capacities with many of the recovery organizations in the lowcountry. From founding the Collegiate Recovery Program at CofC to volunteering with WakeUp Carolina. Today, his work as Executive Director with FAVOR Lowcountry provides a platform for him to support other individuals in learning how to advocate for policy change, how to stand up and speak publicly and proudly about their recovery, and to put a face on what recovery looks like.

Col. Quandara Grant - Quandara Grant was named Director of the Beaufort County Detention Center, taking over responsibility for the jail in 2014. Prior to being named Director, Quandara served as the detention center's Security Lieutenant since 2009 and has had a tenure at the jail spanning over 25 years.

Captain Kyle Blackmon - In 2000, Captain Blackmon began his law enforcement career with the South Carolina Highway Patrol and was assigned to Beaufort County. In 2002, he transferred to the State Transport Police and worked in seven counties encompassing the low country of South Carolina. Captain Blackmon began his career with the Beaufort County Sheriff's office in March of 2004. Blackmon has attended many specialized schools and has acquired multiple instructor certifications to give him a well-rounded approach to leadership at the sheriff's office.

Captain Bruce Kline – Captain Kline has dedicated career to firefighting in Beaufort County. His tenure started in 1984 with the City of Beaufort as a firefighter and now Captain Kline has served as Lady's Island / St. Helena Fire Chief since 2005. Due to his dedication to his craft and Beaufort County, Captain Kline has extensive knowledge and connections within the county and the lowcountry.

Dr. Graham Adams - Dr. Graham Adams serves as the CEO of the South Carolina Office of Rural Health, a statewide non-profit organization striving to improve access to care, quality of life and health outcomes in rural and under-served communities. Since joining SCORH in 1995 and his appointment as CEO in 2002, Dr. Adams continues to provide technical assistance regarding strategic planning, grant development, funding opportunities, infrastructure development and resource allocation. He holds adjunct faculty positions at several universities, as well as serving on the board of trustees for numerous national and statewide organizations.

Dr. Michael D George holds a Ph.D. in Public Policy & Administration and a Master's in Justice & Public Safety with a Bachelor's in Political Science. He is employed full-time with the Pacific Institute for Research & Evaluation (PIRE) in the South Carolina office. He coordinates the evaluation of several state and county-level projects that involve collaboration among stakeholders to improve public health and public safety problems. His research and expertise areas are in high visibility enforcement, law enforcement, traffic safety, media campaigns related to traffic safety issues, underage drinking enforcement and education, qualitative research, community assessment, data collection related to substance abuse and traffic safety issues, community policing, trend analysis, community, and state collaboration, and occupant protection issues.

Dr. Paul N. McKenzie is a social scientist and proposed evaluator with 30 years of experience. He is the founder of the Institute for Adolescent Addictions, selected as a model program by the Texas Commission on Alcohol Abuse, and Euphrasia Center, named a promising program by Office of Juvenile Justice and Delinquency Prevention. He is the author of two books and numerous journal articles, and has served as evaluator for 30 federal grant projects.

O. Extent Which Applicant Clearly Links Staff Qualifications and Experience to Their Designated RCORP-Implementation Project Activities (Attachment 6).

As required within the RFP, a detailed staffing plan (Attachment 6), outlines the biographical summaries for each key position in the proposed project. This includes professional and educational backgrounds, any relevant licensure or certification, and other important qualifications for serving in the proposed project.

CRITERION 6: SUPPORT REQUESTED

A. Degree Which Estimated Cost to The Government for Proposed Grant-Funded Activities Is Reasonable Given the Scope of Work

Although an actual estimate of clients to be served within the proposed project was not required within the RFP, a general and conservative projection of direct service clients is 300 per year, or 900 over the course of the grant. This amounts to approximately $1,110 per client. Likewise, funding allocated to prevention is positioned to significantly reduce the incidence of substance misuse within the rural target area and could represent a substantial savings to the community.

B. Extent to Which Applicant Includes A Budget and Budget Narrative for Each of The Three Years of The Grant

The budget and budget narrative in the attachments includes three full years of detailed budget allocations, broken out by year.

C. Extent Which Applicant Allocates Award Across Three-Year Period of Performance

Due to the nature of the grant funding period, the awarded grant funds in the budget are split across three 12-month periods. This aligns with the project Work Plan (Attachment 1), which details three full years of activities.

D. Clarity and Comprehensiveness of The Budget Narrative, Including The Extent To Which The Applicant Logically Documents How And Why Each Line Item Request (Such As Personnel, Travel, Equipment, Supplies, And Contractual Services) Supports The Goals And Activities Of The Proposed Work Plan And Project.

Each line item and cost center within the budget narrative has been carefully justified as to its use, and the calculations behind each expenditure have been broken out. Beaufort County Alcohol and Drug Abuse Department is well experienced with grants management, especially with regards to fiscal oversight. As such, the agency **Operations Manager** will conduct **quarterly budget reviews** with project leadership to ensure that the proposed line items will **cover the entire three year project tenure.**

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

APPROVAL OF APPOINTMENT

MEETING NAME AND DATE:

NATURAL RESOURCES COMMITTEE MEETING

- NOVEMBER 1, 2021

PRESENTER INFORMATION:

COMMITTEE CHAIRMAN HOWARD

ITEM BACKGROUND:

PLANNING COMMISSION ON OCTOBER 4, 2021

PARTIAL 1st TERM -NORTHERN BEAUFORT COUNTY

PROJECT / ITEM NARRATIVE:

APPOINTMENT FOR GAIL MURRAY WITH A PARTIAL 1st TERM TO PLANNING COMMISSION WITH AN EXPIRATION DATE OF 2024

FISCAL IMPACT:

N/A

STAFF RECOMMENDATIONS TO COUNCIL:

APPROVE, MODIFY OR REJECT

OPTIONS FOR COUNCIL MOTION:

MOTION TO (APPROVE, MODIFY, REJECT) REFER APPOINTMENT OF GAIL MURRAY TO PLANNING COMMISSION (NORTHERN BEAUFORT COUNTY) TO COUNTY COUNCIL FOR FINAL APPROVAL.

APPLICATION

Beaufort County Boards/Commissions Application

Date
10/19/2021

Name
Gail Murray

Beaufort County Voter Registration Number
SC

Occupation
Community Support Specialist

Phone (Home)

Phone (Office)

Email

Home Address

City
YEMASSEE

State
SC

Zip Code
29945

Mailing Address

City
YEMASSEE

State
SC

Zip Code
29945

District
1

Ethnicity
African American

Presently Serving on a Board/Agency/Commission/Authority or Committee?

○ Yes ◉ No

BOARDS AND COMMISSIONS

Top Three Priorities: Please indicate by placing a "1", "2", or "3" alongside your choices.

[ ] Accomodations Tax (2% State)

[ ] Airports

[ ] Alcohol and Drug Abuse

3 Assessment Appeals

Beaufort County Transportation

Beaufort -Jasper Economic Opportunity

Beaufort -Jasper Water & Sewer

Beaufort Memorial Hospital

Bluffton Township Fire

Burton Fire

Coastal Zone Management Appellate (inactive)

Construction Adjustments and Appeals

Daufuskie Fire

Design Review

DSN

Economic Development Corporation

Forestry (inactive)

Historic Preservation Review

Keep Beafort County Beautiful

Lady's Island / St. Helena Island Fire

Library

Lowcountry Council of Governments

2

Lowcountry Regional Transportation Authority

Parks and Recreation

Planning *

1

Rural and Critical Lands Preservation

Sheldon Fire

Social Services (inactive)

Solid Waste and Recycling

Southern Beaufort County Corridor Beautification

Stormwater Management Utility

Zoning

0

Beaufort County Planning Commission

Supplemental Application Questionnaire

This questionnaire will assist the County Council in assessing your qualifications and experience for the Planning Commission vacancy.

Please explain why you want to serve on the Planning Commission.

As a lifelong resident of Beaufort County, I am very interested in the growth and development of the county while preserving our rich history.

What qualifications, experience and expertise make you a good candidate for the Planning Commission?

I have been very active in various groups in the Sheldon Township area and feel that I would be able to bring a voice to their concerns as it relates to growth and development.

What role do you feel the Planning Commission plays in making Beaufort County a desirable community in which to live and work?

The Planning Commission is instrumental in developing long range plans to ensure that the growth and development of the County is in keeping with the historic charm of Beaufort while meeting the needs of the residents now and in the future.

What do you believe are the most important planning issues facing the County during the next five years?

During the next five years, I feel it is very important that the County addresses affordable housing and improve infrastructure in the more rural parts of the county.

What previous experience have you had in serving on a Planning Commission? Give some examples of the items typically handled by the Planning Commission.

My previous experience does not directly corelate to the Planning Commission however in a previous role, I was involved in developing programming to make resources available the community. The most notable example of work done by the Planning Commission, in my mind, is developing the Comprehensive Plan and making sure it is a living and breathing document.

Attachments

Gail Murray resume.docx

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Item 3.

GAIL MURRAY

[redacted]

Provide leadership and accountability in providing case management coordination services to include assessing, counseling, monitoring, planning, advocacy, and direct intervention to enable persons with disabilities to achieve and maintain competitive employment.

EDUCATION

OCTOBER 2005

MASTER OF ARTS, WEBSTER UNIVERSITY

Rehabilitation Counseling

MAY 2003

BACHELOR OF ARTS, UNIVERSITY OF SOUTH CAROLINA – BEAUFORT

Interdisciplinary Studies

CERTIFICATIONS AND ACTIVITIES

05/2007 Completed a Professional Development Leadership Program (PDLP) certification
06/2017 Nonviolent Crisis Prevention Intervention (CPI) certification

2017 Chairperson for the Vocational Assessment work group appointed to streamline and restructure the assessment procedures statewide for SC Vocational Rehabilitation.

2017 Wrote new job descriptions for several positions at the request of the Vocational Rehabilitation's Commissioner.

REFERENCES

- Carol Anderson - PO Box 15 West Columbia, SC 29170 – 843-230-4933 – canderson@SCVRD.net
- Felicia Johnson – PO Box 15 West Columbia, SC 29170 – 803-361-8711 – fjohnson@SCVRD.net
- Allison Kitler – 919 Thunderbolt Dr. Walterboro, SC 29488 – 843-908-1179 – akitler@SCVRD.net

GAIL MURRAY

[redacted]

SKILLS

- Proficient in SCEIS and Covey
- Proficient in Microsoft Office (Outlook, Word, PowerPoint, Excel)
- Ability to analyze and evaluate complex issues
- Case Management
- Presenting information and negotiating resolutions
- Ability to lead and direct others

EXPERIENCE

10/2019- PRESENT
COMMUNITY SUPPORT SPECIALIST, BEAUFORT-JASPER EOC, INC.

Provide intake assistance to individuals following policies, procedures, case management procedures, administrative guideline and oral and written instructions. Make appropriate referrals for individuals to receive services from other agencies, programs, organizations, etc.

07/2015 – 06/2018
AREA DEVELOPMENT DIRECTOR, SC VOCATIONAL REHABILITATION DEPT.
Provide advanced planning, direction, and management to area/client services, supervisors, and agency officials towards the achievement of the agency mission of employment for eligible individuals with disabilities. Serve as an advanced resource in advising agency leadership and staff members on complex programmatic issues.

07/2008 – 06/2015
AREA SUPERVISOR, SC VOCATIONAL REHABILITATION DEPT.
Provided general/specific supervision of programmatic and administrative functioning of the assigned local area office operations in its mission to assist eligible clients to prepare for, achieve, and maintain competitive employment.

07/2007 – 06/2008
AREA CLIENT SERVICES MANAGER, SC VOCATIONAL REHABILITATION DEPT.
Serve as primary trainer for all staff regarding client service delivery and the rehabilitation process. Identify area trends and follow up on findings from QA. Develop training to address areas of concern to educate the staff on new initiatives, processes, policy changes, etc.

03/2006 – 06/2007
COUNSELOR, SC VOCATIONAL REHABILITATION DEPT.

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

APPROVAL OF APPOINTMENT

MEETING NAME AND DATE:

COUNTY COUNCIL MEETING

- NOVEMBER 1, 2021

PRESENTER INFORMATION:

COMMITTEE CHAIRMAN HOWARD

ITEM BACKGROUND:

APPOINTMENT OF JANE FREDERICK FILL THE NORTHERN BEAUFORT COUNTY OPENING ON THE ZONING BOARD OF APPEALS.

PROJECT / ITEM NARRATIVE:

CONSIDERATION OF APPOINTMENT FOR JANE FREDERICK TO ZONING BOARD WITH AN EXPIRATION DATE OF 2024

FISCAL IMPACT:

N/A

STAFF RECOMMENDATIONS TO COUNCIL:

APPROVE, MODIFY OR REJECT

OPTIONS FOR COUNCIL MOTION:

MOTION TO (APPROVE, MODIFY, REJECT) APPOINTMENT JANE FREDERICK TO ZONING BOARD OF APPEALS FOR FINAL APPROVAL .

Beaufort County Boards/Commissions Application

Field	Value
Date	10/25/2021
Name	Jane Frederick
Beaufort County Voter Registration Number	
Occupation	Architect
Phone (Home)	
Phone (Office)	
Email	
Home Address	
City	Beaufort
State	SC
Zip Code	29907
Mailing Address	
City	Beaufort
State	SC
Zip Code	29907
District	
Ethnicity	Caucasian

Presently Serving on a Board/Agency/Commission/Authority or Committee?

○ Yes ● No

BOARDS AND COMMISSIONS

Top Three Priorities: Please indicate by placing a "1", "2", or "3" alongside your choices.

Priority	Board
	Accomodations Tax (2% State)
	Airports
	Alcohol and Drug Abuse

Assessment Appeals

Beaufort County Transportation

Beaufort -Jasper Economic Opportunity

Beaufort -Jasper Water & Sewer

Beaufort Memorial Hospital

Bluffton Township Fire

Burton Fire

Coastal Zone Management Appellate (inactive)

Construction Adjustments and Appeals

Daufuskie Fire

Design Review

3

DSN

Economic Development Corporation

Forestry (inactive)

Historic Preservation Review

Keep Beafort County Beautiful

Lady's Island / St. Helena Island Fire

Library

Lowcountry Council of Governments

Lowcountry Regional Transportation Authority

Parks and Recreation

Planning *

1

Rural and Critical Lands Preservation

Sheldon Fire

Social Services (inactive)

Solid Waste and Recycling

Southern Beaufort County Corridor Beautification

Stormwater Management Utility

Zoning

2

Beaufort County Planning Commission

Supplemental Application Questionnaire

This questionnaire will assist the County Council in assessing your qualifications and experience for the Planning Commission vacancy.

Please explain why you want to serve on the Planning Commission.

Comprehensive planning and adhering to the the adopted plan is essential to maintaining a healthy, vibrant community while protecting our natural resources. We also must provide the necessary infrastructure for a resilient community. I want to serve to help Beaufort County grow in the most sustainable, resilient way possible.

What qualifications, experience and expertise make you a good candidate for the Planning Commission?

I am an architect who has lived in Beaufort County for over 32 years. During that time I have served on many County and City planning committees and design review boards. I have participated in the comprehensive planning meetings as an citizen. I was the 2020 President of The American Institute of Architects. In my national service, I learned best planning practices from around the world. In 2019, I participated in the Union of International Architects forum on planning for cultural tourism, which focused on the delicate balance of welcoming tourist while maintaining the quality of life for locals.

What role do you feel the Planning Commission plays in making Beaufort County a desirable community in which to live and work?

The Planning Commission is the most important body in adhering to the vision that our community has established through the comprehensive plan. The Planning Commission must recognize that the comprehensive plan is a living documents and work with staff to make sure the plan remains relevant. The members of the planning commission have to be both pragmatic and strong when reviewing zoning map amendments to make the best decision for the citizens of the county and not an individual.

What do you believe are the most important planning issues facing the County during the next five years?

I agree with the 2040 Comprehensive Plan that our greatest challenge and opportunity is to create a community that is resilient and equitable while maintaining our unique place.

What previous experience have you had in serving on a Planning Commission? Give some examples of the items typically handled by the Planning Commission.

I served on the Beaufort County Lady's Island Planning Committee form 1999-2009. I also served on the Beaufort County 170 Design Review Board from 1995-2001. The majority of items handled by the Planning Commission are revisions to the Zoning Map and/or Zoning Code. These changes generally come to the Commission in two ways. One is from the zoning staff who recommend changes to the code from experience in working with the code. The second is from property owners who want to change the zoning of their property to benefit their development plans. The Planning Commission also participates in developing and reviewing the Comprehensive Plan and other plans such as Beaufort County Connects: Bicycle and Pedestrian Plan.

Attachments

Jane 7.21.pdf

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Education:
Bachelor of Architecture,
Auburn University, 1982

Professional Registration:
Registered Architect; South Carolina,
North Carolina, Alabama, Florida, Georgia,
& Mississippi

Qualifications Certified by the National Council of Architectural Registration Boards

LEED Accredited Professional

Safety Assessment Program

FREDERICK + FREDERICK
Residential Architects

Jane Frederick, FAIA, LEED AP
Managing Principal

Experience:

Jane Frederick is an accomplished, knowledgeable, experienced architect who combines a natural talent for leadership with the ability to conceive and coordinate multiple projects simultaneously, with proven success in interior space planning and detailing. Since arriving in Beaufort in 1989 her leadership abilities have been engaged in numerous community and government boards.

Professional Affiliations:
American Institute of Architects/ National Component,
- President, 2020, 1st Vice President, 2019
- EVP/CEO Search Committee, Chair, 2021
- Architectural Firm Search Committee, 2020
- Board of Directors, 2016 -2018,
- South Atlantic Regional Director, 2012-2015
- Practice & Prosperity Committee, 2014-2015
- Board Knowledge Committee, 2012-2013
- Small Firm Round Table, Chairman, 2012-2013

American Institute of Architects/ South Carolina Chapter
- Board of Directors, 2005 - 2011 President - 2010, Secretary/Treasurer 2008-2009
- Lowcountry Director 2006-2007

SC State Board of Architectural Examiners, 1999-2004 , Chair 2001-2003

Southern Conference/National Council of Architectural Registration Boards,
- Secretary, 2001-2003; Vice-Chair 2003-2004; Chair 2004-2005

National Council of Architectural Registration Boards
- Architectural Registration Examination Committees; Stair Task Force 2008, Grading Committee, 2003-2007, Graphic test writing committee 2001-2003

National Architectural Accrediting Board Accreditation Visiting Teams 2004-present
- New York Institute of Technology*, 2016, Lebanese American University*, 2015, Academy of Art University*, 2014, Universidaad Europea de Madrid, 2013, Universidad Politecnica de Madrid, 2013, University of Maine*, Augusta, 2013, Clemson University, 2011, University of Wisconsin*, Milwaukee, 2011, Syracuse University*, 2010, University of Oklahoma, 2009, Lawrence Technological University, 2008, University of Philadelphia, 2006, Kansas State University, 2005
- *denotes team chair

Clemson University School of Architecture – Professional Advisory Board Member 2010-2014

Jury Service:

The Architect Foundation, Richard Morris Hunt Prize, November 2020
Marvin Window Corporation, 2018
AIA DC Residential Awards, 2015
AIA Gold Medal Advisory Jury, 2013-2014, Chair 2014
AIA Rhode Island, Design Awards, 2013
AIA North Carolina, 2013

Honors & Awards:

Southern Living Magazine, Best Renovation of the Year, 2009, Frederick Residence, Lady's Island, South Carolina

Metropolitan Home Magazine, Home of the Year, 1991, Frederick Residence, Beaufort, South Carolina

American Institute of Architects/ National, *CRAN Houses for all Regions*, 2014, Crosby Residence

American Institute of Architects/ South Carolina

Firm Award, 2019

Robert Mills Honor Award;

2016 Shrimp Pond Studio, Spring Island, SC
2002 Ackerman Residence, Brays Island, South Carolina
2004 Lowcountry River House, Colleton County, SC;
2004 Mays Residence, Spring Island, South Carolina

Robert Mills Merit Award;

2012 Crosby Residence, Beaufort County, South Carolina
2011 Frederick Residence, Lady's Island, South Carolina
2010 Coles Residence, Bluffton, South Carolina

Robert Mills Award – Citation;

2010 - Fienning Residence, Beaufort, South Carolina
2008 Jones Residence, Daufuskie Island, South Carolina

Historic Preservation Award

2019 – Thomas Rhodes House, Beaufort, South Carolina
2014 – Fienning Residence, Beaufort, South Carolina

Beaufort 3 Century Design Competition, 2010

Best Neighborhood Plan
Best Infill House
People's Choice Award

American Institute of Architects/ Hilton Head

Merit Award; 2006 Kirkland Residence, Hilton Head Island,

Historic Beaufort Foundation Award, 1992

Potter Residence, Beaufort, South Carolina

Main Street Beaufort, Best Exterior Renovation, Heads Up Salon, 2002

American Institute of Architects South Carolina

Presidential Citation, 2020

Past President's Medal, 2011

Certificate of Recognition, 2010, *Serving on the Fall Conference Planning Committee*

Certificate of Recognition, 2008-2009, *Service as Secretary/Treasurer*

Certificate of Recognition, 2009, *Serving on the SAR Conference Planning Committee*

Certificate of Recognition, 2005-2007, *Service as Lowcountry Director*

Award of Recognition, 2007, *Serving on the Spring Conference Planning Committee*

Presentations:

Panel Member, Moody Nolan Architects, May 19, 2021

Keynote, Recognition Day, Mississippi State, School of Architecture, April 25, 2021

The Year in Review, AIA Podcast, December 2020

President's Panel, NOMA annual Meeting Oct. 17, 2020

Speaker, 2020 World Habitat Day Conference by UN-Habitat, Consortium for sustainable Urbanization and AIA NY, Oct. 5, 2020

Keynote, Gulf Coast Green, AIA Houston, July 2, 2020

Speaker, Carbon Positive Summit, Architecture 2030, March 1, 2020

RIBA Presidential Round Table, Feb. 2, 2020

President's Panel, AIAS Forum, Dec. 29, 2019

Inaugural Address, AIA Dec. 13, 2019

Resiliency, Sea Island Rotary, Beaufort, SC, November 26, 2019

Women's Leadership, Perkins Eastmam, Washington, DC, November 6, 2019

Women's Leadership Summit, Minneapolis, MN, September 12, 2019

Resiliency, Twin States Conference, American Society of Landscape Architects, Huntsville, AL, April 4, 2019

Aspire Conference, South Atlantic Region, Asheville, NC, March 1, 2019

AIA Leadership Summit, Washington, DC November 9, 2018

New Architects Luncheon, AIA South Carolina, Columbia, SC, October 16, 2018

Social Media for Architects, AIA National Convention, New Orleans, May 12, 2011

Architects as Leaders, AIAS Grassroots Leadership Conference, Washington, DC,1999

Social Media for Architects, AIA Georgia Convention, Athens, October, 2011

Leadership, if not us…WHO? AIA Charlotte, Architecture Week, Charlotte, NC, Sept, 1997

Downtown as a Classroom, South Carolina Middle School Conference, Myrtle Beach, SC, February, 1996

*Sustainable Strategies for the Lowcount*ry, Lowcountry Chapter USGBC, Beaufort, June 28, 2011.

Making your house work for you, VanLandingham Rotary, Hilton Head Island, March 2009

Green Building 101, Beaufort Rotary, Beaufort, June 2009

Favorite Buildings, Pecha Kucha, Charleston, June 2009

Favorite Buildings, Pecha Kucha, Beaufort, September 2009

Publications by Jane Frederick

"Building the Future" *Architect*, Nov./Dec. 2020 p.116.

"Energy Modeling is Pivotal" *Architect,* Oct. 2020 p.78

"A Different Kind of Fall" *Architect*, Sept. 2020, .72

"Healthy, Safe and Equitable" *Architect,* August 2020, p.68

"A Tipping Point for Systemic Injustice" *Architect,* July 2020, p. 46.

"Envisioning the Future" *Architect*, June 2020

"Growing from Adversity" *Architect* , May 2020, p. 130

" A Year of climate Action" *Architect*, April 2020

"Leading from Behind No More" *Architect,* March 2020, p 52.

"Strength in Numbers" *Architect,* Feb. 2020, p 56

"Being What Happens" *Architect,* Jan. 2020, p.18.

"Pass capital bond bill ASAP" *The Statehouse Report*, August 13, 2010

"Stock school plans are a bad idea" *The Statehouse Report*, August 27, 2010

"Bond Bill would put people to work, serve public," *The State*, February 9, 2010

"Pass capital bond bill ASAP" *The Statehouse Report,* August 12, 2010

"Beaufort County's Stormwater Ordinance is good for all of us"

The Beaufort Gazette, June 26, 2011

"Social Media: Making it Work" *AIA Small Practice Practitioners Journal 53*, Summer 2011

"A Woman's View" *South Carolina Architecture*, 2009 page 134

Media about Jane Frederick

Responsive Leadership, Madam Architect, by Amy Stone, March 2, 2021

Jane Frederick, Care by Design Podcast, by Eve Blossom, August, 2020.

The New State of Architecture with Jane Frederick, The Culture Design Show, by Steve Chapparo, Podcast, May 5, 2020

Publications about Frederick + Frederick Architects:

AIA Small Project Practitioners 2015 Review, Shrimp Pond Studio

Houses for All Regions, CRAN Residential Collection, Images publishing, 2014

Andersen Corporation 2019 Calender, T-House on the cover

The Rush of Waterfront Living, Alina Dizak, The Wall Street Journal, May 17, 2018

Suited to a T, Claire Conroy, Residential Design, Vol. 2, 2017 pp52-56

Building Character, This Old House, March 2014

Great Kitchens for Hanging Out, Kristen Sitter, Cabin Life, April, 2012

History Restored, Blake Miller House to Home, Oct/Nov. 2011

Hot to Trot, by Mary Katherine Quinlan, Southern Living October 2011, pp. 87-93.

Cook up a great outdoor kitchen, This Old House, June 2011pp. 95-117 and front cover.

Lowcountry Landmark, Renovation Style Fall 2010

The Little Hut That Could, Southern Living, May 2009

Designs That Grow from the Land, American Lifestyles Magazine, Dec/Jan 2007

Hearts of Palm, Metropolitan Home, February 1991

Marshfront Magic, Waterfront Home & Design, Fall 2005

Off the Beaten Path, Residential Architect, November/December 2009

Before & After: Returning the Charm to a Southern Landmark, Haskell Harris, Garden & Gun, July 14, 2016

Expert Talk: Porch Swings Say into Sweet Life, Lawrence Karol, HOUZZ, May 31, 2012

Regional Design: Charleston & SC Lowcountry, Becky Harris, HOUZZ, August 18, 2012

Houzz Tour: Rustic & Traditional in South Carolina, Vanessa Brunner, HOUZZ, Sept. 9, 2012

Outdoor Design: Save that Tree, John Hill, HOUZZ, May 11, 2011

Great Designs for Summer Lounging, Margaret Everton, HOUZZ, April 25, 2011

Fabulous, Must Have Features for Fall & Winter Outdoor Spaces, HOUZZ, Sept. 7, 2010

Cool off this summer in a screened-in porch, Becky Harris, HOUZZ, May 22, 2010

13 Welcoming Front Porches, Jeff Stafford, HGTV

18 Back Porch Design Ideas, Jeff Stafford, HGTV

8 Marvelously Functional Mudrooms, Lisa Frederick, HGTV, Dec. 22, 2014

Exterior Design Trends and Ideas, Buildapedia, December 2010

2009 Southern Home Awards, Apartment Therapy, July 7, 2009

Architects use Creativity to Build Business, AIA Architect, May 1, 2009

Choosing between old and new houses, Cyber Homes, April 16, 2009

Eco Architecture, Lowcountry Healthy Homes, August 27, 2009

Modern dogtrot South Carolina lowcountry, www.homebuilderdigest.com

A Hilton Head Sanctuary, From House to Home, April/May 2007

All things old are new again in this lowcountry design, AIA South Carolina Architecture Magazine, 2011

In Beaufort, you don't renovate, you restore, AIA South Carolina Architecture Magazine, 2011

Remodeling Handbook, Charleston Home Magazine, Fall/Winter 2009

Island Magic, South Carolina Homes & Gardens, 2005

Honor Award, Frederick & Frederick Architects, South Carolina Homes & Gardens, 2004

Building on the Past, Indigo Coast, 2004

Honor Award, Frederick + Frederick, South Carolina Homes & Gardens, November December 2002

Contemporary architecture struggles to a find place in area, Beaufort Gazette, July 31, 2006

A Gift for Detail & Design, Hilton Head Monthly, June 2005

Modern Magic, Lowcountry Weekly, March 4, 2009

Nature's Home, Hilton Head Monthly, May 2003

Marine Living: Redesign of Quonset Wins Fredericks Southern Living Award, by Gail Westerfield, Island Packet, August 11, 2009

Community Service:

Disaster Service Worker
City of Beaufort Review Board, 2015-2018, Vice-Chair, 2015-16 Chair 2017-18
Liberty Fellowship Inaugural Class 2006,
Friends of the Spanish Moss Trail - 2010-2014, Secretary, 2012-2014
Town of Port Royal Historic Preservation Commission, 2008- 2011, Chair, 2008 - 2011
Beaufort County Zoning Ordinance Technical Advisory Committee, 2012
Beaufort County, Lady's Island Planning Committee, 1999 – 2009
Beaufort County Highway 170 Corridor Review Board, Chair, 1995-2001
Candidate, SC 2nd Congressional District, 1998, 2000
Leadership South Carolina, 1998
Historic Beaufort Foundation, Trustee 1991-94,
Preservation Committee, Chair 2002-2004
Beaufort Chamber of Commerce, Leadership Beaufort, 1991

BEAUFORT COUNTY COUNCIL
AGENDA ITEM SUMMARY

ITEM TITLE:

APPROVAL OF APPOINTMENT

MEETING NAME AND DATE:

COUNTY COUNCIL MEETING

- NO EMBER , 202

PRESENTER INFORMATION:

COMMITTEE CHAIRMAN HOWARD

ITEM BACKGROUND:

A OINTMENT OF WILLIAM BEDINGFIELD TO SOUTHERN BEAUFOT COUNTY CORRIDOR BEAUTIFICAN BOARD

PROJECT / ITEM NARRATIVE:

CONSIDERATION OF APPOINTMENT FOR WILLIAM BEDINGFIELD TO SOUTHERN BEAUFOT COUNTY CORRIDOR BEAUTIFICAN BOARD WITH AN E IRATION DATE OF

FISCAL IMPACT:

N/A

STAFF RECOMMENDATIONS TO COUNCIL:

APPROVE, MODIFY OR REJECT

OPTIONS FOR COUNCIL MOTION:

MOTION TO (APPROVE, MODIFY, REJECT) A OINTMENT WILLIAM BEDINGFIELD TO SOUTHERN BEAUFOT COUNTY CORRIDOR BEAUTIFICAN BOARD TO COUNTY COUNCIL FOR FINAL A RO AL

Beaufort County Boards/Commissions Application

Date	Name
10/14/2021	William Bedingfield

Beaufort County Voter Registration Number	Occupation
	Arborist - Self employed

Phone (Home)	Phone (Office)	Email

Home Address

City	State	Zip Code
Bluffton	South Carolina	29910

Mailing Address

City	State	Zip Code
Bluffton	SC	29910

District	Ethnicity
	Caucasian

Presently Serving on a Board/Agency/Commission/Authority or Committee?

○ Yes ● No

BOARDS AND COMMISSIONS

Top Three Priorities: Please indicate by placing a "1", "2", or "3" alongside your choices.

	Accomodations Tax (2% State)
	Airports
	Alcohol and Drug Abuse

Assessment Appeals

Beaufort County Transportation

Beaufort -Jasper Economic Opportunity

Beaufort -Jasper Water & Sewer

Beaufort Memorial Hospital

1 Bluffton Township Fire

Burton Fire

Coastal Zone Management Appellate (inactive)

Construction Adjustments and Appeals

2 Daufuskie Fire

Design Review

DSN

Economic Development Corporation

Forestry (inactive)

Historic Preservation Review

Keep Beafort County Beautiful

Lady's Island / St. Helena Island Fire

Library

Lowcountry Council of Governments

Lowcountry Regional Transportation Authority

Parks and Recreation

Planning *

Rural and Critical Lands Preservation

Sheldon Fire

Social Services (inactive)

Solid Waste and Recycling

3 Southern Beaufort County Corridor Beautification

Stormwater Management Utility

Zoning

Beaufort County Planning Commission

Supplemental Application Questionnaire

This questionnaire will assist the County Council in assessing your qualifications and experience for the Planning Commission vacancy.

Please explain why you want to serve on the Planning Commission.

What qualifications, experience and expertise make you a good candidate for the Planning Commission?

What role do you feel the Planning Commission plays in making Beaufort County a desirable community in which to live and work?

What do you believe are the most important planning issues facing the County during the next five years?

What previous experience have you had in serving on a Planning Commission? Give some examples of the items typically handled by the Planning Commission.

Attachments

Drew Resume.doc

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