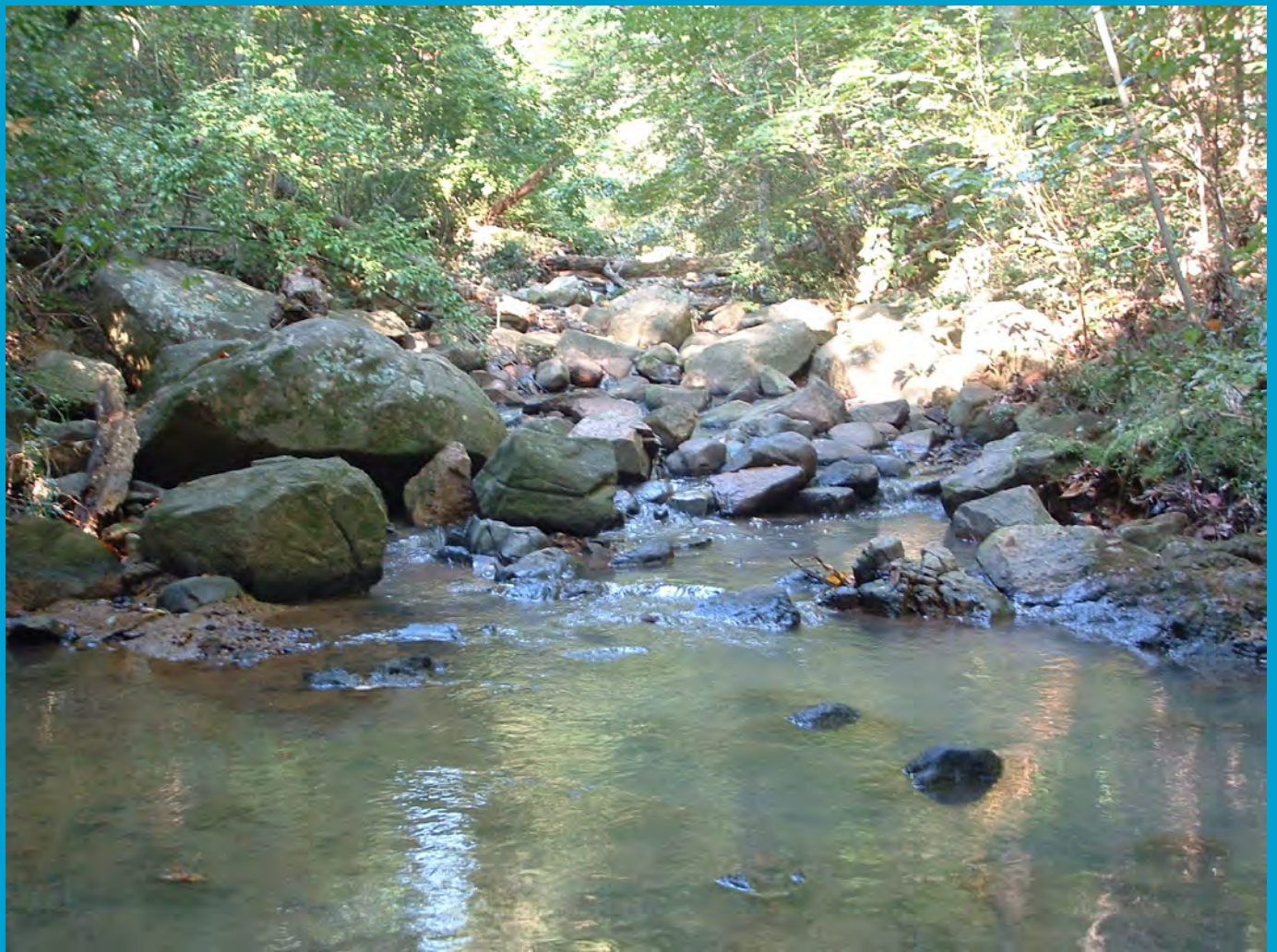


TOWN OF CHAPEL HILL STORMWATER MANAGEMENT PROGRAM MASTER PLAN



PHASE 2 FINAL REPORT





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Table of Contents

Executive Summary	ES-1
Introduction	1
Stormwater Management Program Master Planning Process	3
Section 1 – Strategic Operating Plan	7
Program Goals and Strategic Objectives	8
Goal 1 Master Plan	8
Goal 2 Water Quantity	10
Goal 3 Water Quality	12
Goal 4 Streams	15
Goal 5 Public Education	18
Goal 6 Levels of Service / Measures	20
Goal 7 Regulatory Compliance	22
Goal 8 Stormwater Leadership	25
Goal 9 Program Integration	27
Goal 10 Stormwater Utility	30
Strategic Initiative Summaries	32
Key Strategic Measures	35
Measure 1 Improved Stream Conditions	39
Measure 2 Reduced Nutrient Exports	39
Measure 3 Fewer Violations of Environmental Regulations Related to Water Resources ..	41
Measure 4 Reduced Flooding Risks	42
Measure 5 Reduced Reactive Maintenance and Repairs	42
Measure 6 Increased Positive Stormwater Practices	43
Measure 7 Benchmarking Against Best Practices	44
Implementation Schedules and Funding Plans	49
Comprehensive Strategic Initiative Implementation Schedule	50
Extended Strategic Initiative Implementation Schedule	52
Additional Funding Considerations	54
Strategic Plan Summary and Conclusions	55
Section 2 – Operational Plan for Master Plan Implementation	57
Enhanced Infrastructure Capital Improvement Program	58
Introduction	58
Stormwater Problem Classification	61
Conveyance System Remediation CIP Prioritization	62
Flood Mitigation CIP Prioritization	64
Targets and Budget	66
Drainage Partnership Program	67
Drainage Assistance Programs in Other Cities	67
Qualifying Projects	68
Project Prioritization	69
Project Procedures	69
Targets and Budget	70



Water Quality Capital Improvement Program	72
Jordan Retrofits	72
Bolin Creek Watershed Restoration	73
Summary of Next Steps for Retrofit Prioritization	75
Targets and Budget	75
LUMO and Engineering Design Manual Updates	77
LUMO Update	77
Engineering Design Manual Update	77
Targets and Budget	78
Continued Development of Subwatershed Plans	80
Subwatershed Delineations	80
Subwatershed Planning Tasks	84
Targets and Budget	84
Transition to Proactive Maintenance Program	85
Database Development and Inspections	85
Planned Maintenance and Repair Program	87
Targets and Budget	87
Expansion of Small Maintenance Projects Program	88
Targets and Budget	88
Comprehensive Monitoring Program	89
Streamflow Monitoring	89
Precipitation Monitoring	91
Chemical Monitoring	92
Biological Monitoring	93
Geomorphological Monitoring	95
Volunteer Monitoring	96
Targets and Budget	96
Long-Term BMP Inspection and Enforcement Program	98
Jordan Lake Nutrient Management Strategy	98
Chapel Hill's Land Use Management Ordinance	100
Program Enhancements	101
Targets and Budget	102
IDDE Program Enhancement	103
IDDE Ordinance	103
Targeting Business Groups	104
Municipal Good Housekeeping	104
Identifying and Eliminating Sewage Discharges	104
Targets and Budget	105
Public Education Program Expansion	106
Municipal Good Housekeeping	106
Programs for Target Audiences	106
Facilitation of Bolin Creek Watershed Stakeholder Visioning Process	107
Electronic Publication of Annual Stormwater Management Program Report	107
Targets and Budget	107



Memorandum of Understanding with OWASA	108
Utility Pipeline Leaks Impacting Streams	108
Utility Easement Crossings and Corridors.....	109
Stream Monitoring/Nutrient Management.....	111
Stormwater as Potential Special Purpose Water Supply.....	111
Summary	112
Fee Credit Policy and Program	113
History of Stormwater Utility Fee	113
Development of Fee Credit Policy.....	113
Fee Credit Overview	116
Targets and Budget	120
Community Rating System Program	121
CRS Schedule and Activities	121
Targets and Budget	123
Flood Hazard Mitigation Program.....	124
FEMA Hazard Mitigation Program	124
Chapel Hill FHMP History and Proposed Development.....	125
Targets and Budget	127
Glossary of Abbreviations and Technical Terms.....	128

Appendix A - Tables for Program Goals: Strategic Objectives, Initiatives and Measures

Appendix B - Stormwater Utility Fee Credit Survey

Appendix C - Pilot Basin Study Report - Ephesus Subwatershed

Appendix D - Pilot Basin Study Report - Booker Headwaters Subwatershed



List of Tables

Table ES-1. Strategic Objectives, Initiatives and Measures for Program Goal 2	ES-3
Table ES-2. Strategic Objectives, Initiatives and Measures for Program Goal 3	ES-4
Table ES-3. Strategic Objectives, Initiatives and Measures for Program Goal 4	ES-5
Table ES-4. Strategic Objectives, Initiatives and Measures for Program Goal 7	ES-6
Table ES-5. Seven Key Strategic Measures	ES-8
Table 1-1. Strategic Objectives, Initiatives and Measures for Program Goal 1	9
Table 1-2. Strategic Objectives, Initiatives and Measures for Program Goal 2	11
Table 1-3. Strategic Objectives, Initiatives and Measures for Program Goal 3	14
Table 1-4. Strategic Objectives, Initiatives and Measures for Program Goal 4	17
Table 1-5. Strategic Objectives, Initiatives and Measures for Program Goal 5	19
Table 1-6. Strategic Objectives, Initiatives and Measures for Program Goal 6	21
Table 1-7. Strategic Objectives, Initiatives and Measures for Program Goal 7	24
Table 1-8. Strategic Objectives, Initiatives and Measures for Program Goal 8	26
Table 1-9. Strategic Objectives, Initiatives and Measures for Program Goal 9	29
Table 1-10. Strategic Objectives, Initiatives and Measures for Program Goal 10	31
Table 1-11. Key Strategic Measures	37
Table 1-12. Status of Stormwater Master Plan Integration with Municipal Planning Efforts.....	45
Table 1-13. Levels of Stormwater Inventory Completion Reported in 2013 SESWA Survey	46
Table 1-14. Stormwater Program Components Reported in 2013 SESWA Survey	46
Table 1-15. Reported Stormwater Revenue Adequacy in 2013 SESWA Survey.....	47
Table 1-16. Stormwater Fees in Selected NC Municipalities.....	48
Table 1-17. Model A Summary of Strategic Initiative Implementation Costs	51
Table 1-18. Model B Summary of Strategic Initiative Implementation Costs	53
Table 2-1. Stormwater Problem Classification Table.....	61
Table 2-2. Erosion Rating Table	62
Table 2-3. Culvert Condition Rating Table	63
Table 2-4. Flood Risk Rating Table.....	65
Table 2-5. Implementation Costs for Enhanced Infrastructure CIP	66
Table 2-6. Drainage Partnership Project Rankings/Prioritization.....	70
Table 2-7. Implementation Costs for Drainage Partnership Program	71
Table 2-8. Implementation Costs for Water Quality Capital Improvement Program	76
Table 2-9. Implementation Costs for LUMO and Engineering Design Manual Updates	78
Table 2-10. Grouping and Prioritization for Subwatershed Plans	83
Table 2-11. Implementation Costs for Continued Development of Subwatershed Plans	84
Table 2-12. Procedures for Prioritization of Culvert Inspections	86
Table 2-13. Implementation Costs for Transition to Proactive Maintenance Program	87
Table 2-14. Implementation Costs for Expansion of Small Maintenance Projects Program	88
Table 2-15. Implementation Costs for Comprehensive Monitoring Program	97
Table 2-16. Implementation Costs for Enhanced BMP Inspection and Maintenance Program .	102
Table 2-17. Implementation Costs for IDDE Program Enhancement	105
Table 2-18. Chapel Hill Fiscal Year 2014 Stormwater Budget Breakdown.....	115
Table 2-19. Chapel Hill Stormwater Control Requirements	116
Table 2-20. Fee Credits for New & Re-Development Stormwater Controls.....	117



Table 2-21. Fee Credits for Retrofit Stormwater Controls Exceeding Requirements	118
Table 2-22. 2013 CRS Schedule Activities	122
Table 2-23. Implementation Costs for CRS Program	123
Table 2-24. Implementation Costs for Flood Hazard Mitigation Program.....	127

List of Figures

Figure 1-1. Stormwater Management Program Master Planning Framework.....	4
Figure 2-1. Flowchart for Stormwater Problem Classification and Prioritization.....	59
Figure 2-2. Photos of Culverts Observed in Pilot Basins	79
Figure 2-3. Chapel Hill Subwatersheds	81
Figure 2-4. Chapel Hill Subwatershed Planning Prioritization	82
Figure 2-5. Impaired Waters and Monitoring Sites	90
Figure 2-6. Chapel Hill 2013 Benthic Monitoring Results.....	94
Figure 2-7. Photos of OWASA Sanitary Sewer Crossings at Stream Channels	110



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Executive Summary

The Stormwater Management Program Master Plan (Master Plan) is the strategic and operational guidance document for the Town of Chapel Hill's Stormwater Management Program. Developed through a collaborative, stakeholder-inclusive process, the Master Plan builds upon the program mission and stakeholder-defined goals to articulate strategic objectives. The objectives translate into manageable and measurable [stormwater](#) initiatives, services, activities, and projects.

The mission of the Town's Stormwater Management Program is to protect the health and safety of both the public and the ecosystem, to address both stormwater quality and stormwater quantity concerns, and to meet or exceed federal and state mandates regarding stormwater. The Town of Chapel Hill is responsible for managing the drainage network, including the natural streams. Further, it is responsible for maintaining those system components within the Town's rights-of-way and on Town-owned property. It is estimated that there are over 100 miles of streams and open channels, 63 miles of culverts and pipelines, and approximately 5600 storm drain inlets within the Town's corporate limits.

In order to manage stormwater [runoff](#) such that public safety isn't endangered, adequate inlet and pipe capacities have to be developed and maintained so that the road network remains functional during storm events. Bridges, culverts, and pipelines deteriorate over time and eventually need to be rehabilitated or replaced so that a washout or failure doesn't occur that may endanger motorists and pedestrians. The Federal Emergency Management Agency (FEMA)-mapped [1% annual chance floodplains](#) cover almost two square miles within the Town. University Mall and Eastgate Shopping Center, as well as a number of residences and other businesses, are within the [FEMA](#)-mapped floodplains.

Protecting the health of ecosystems and addressing water quality concerns are important aspects of stormwater management. Natural streams provide important biological habitat and functions. The Chapel Hill 2020 Comprehensive Plan, as well as federal and state regulations, aim to protect and/or restore the ecological functions of streams. Approximately 11 miles of the Town's perennial streams are listed by the Environmental Protection Agency (EPA) as impaired for aquatic life.

Several major regulatory programs developed under the [Clean Water Act](#) significantly affect stormwater management in the Town of Chapel Hill. The two most significant ones are the [EPA](#)'s National Pollutant Discharge Elimination System ([NPDES](#)) permitting program for Municipal Separate Storm Sewer Systems ([MS4s](#)) and the Jordan Lake Nutrient Management Strategy ([Jordan Lake Rules](#)). Phase I of the NPDES MS4 program affected only large cities and was implemented in the 1990s. Phase II broadened the program to include smaller cities and towns, including Chapel Hill. The Town's initial NPDES permit was issued in 2005 and renewed in 2011.

The Jordan Lake Rules were developed under the EPA [Total Maximum Daily Load \(TMDL\)](#) regulatory program to reduce the level of [eutrophication](#) in Jordan Lake. The program increases



the requirements of post-construction runoff controls for new development projects by establishing upper limits for levels of nitrogen and phosphorus in stormwater runoff from a site. Additionally, later phases of the [Jordan Lake Rules](#) include requirements for local governments to mitigate nitrogen and phosphorus exported from areas of existing development by constructing stormwater control facilities, often termed “retrofits,” to treat runoff so that the [nutrient](#) levels in streams flowing to Jordan Lake will be reduced. Cost estimates for constructing stormwater retrofits to meet anticipated nutrient reduction goals for the Jordan Lake existing development rule run in the tens of millions of dollars.

Town Council established the following ten (10) Goals for the Stormwater Management Program:

Program Goal 1 – Develop and implement a comprehensive Stormwater Program Master Plan that supports all of the stormwater program priorities.

Program Goal 2 – Address stormwater quantity (flooding) as an integral component within the program.

Program Goal 3 – Address stormwater quality as an integral function within the program.

Program Goal 4 – Protect and restore natural stream corridors.

Program Goal 5 – Develop a formal public education and public involvement program.

Program Goal 6 – Define the level of service and performance standards for the stormwater program.

Program Goal 7 – Ensure compliance with federal and state regulatory mandates.

Program Goal 8 – Establish clear stormwater program leadership that the public recognizes.

Program Goal 9 – Integrate programs to utilize resources efficiently.

Program Goal 10 – Establish an understanding of the stormwater system as a utility.

To implement the program goals, strategic objectives have been developed to further characterize, direct, and define each goal. Strategic initiatives to address each objective are proposed, many of them contributing to multiple objectives. Program Goals 2, 3, 4 and 7 are the goals most directly related to the Stormwater Management Program mission, and Tables ES-1, ES-2, ES-3 and ES-4 provide summaries of the proposed objectives and strategic initiatives for those goals. Key measures for each of the objectives are also noted in the tables. The objectives and initiatives proposed for Goals 1, 5, 6, 7, 8, 9, and 10 also reflect important components of the master plan, but the impacts to key program measures are less direct.



Table ES-1. Strategic Objectives, Initiatives and Measures for Program Goal 2

Program Goal 2 <i>Address stormwater quantity (flooding) as an integral function within the program</i>		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O2.1	Regulate and guide new development and re-development such that post-development flow rates and volumes of runoff emulate natural undeveloped conditions to the extent practicable, and do not create adverse flooding conditions.	Development Plan Reviews Public Education Program	LUMO and Engineering Design Manual Updates Fee Credit Policy/Program	Reduced flood risk for roads and structures
O2.2	Mitigate cumulative flooding impacts of historically uncontrolled runoff from existing development including public roadways.	Limited Infrastructure CIP	Continued Development of Subwatershed Plans Enhanced Infrastructure CIP Fee Credit Policy/Program	Reduced flood risk for roads and structures
O2.3	Proactively maintain and improve the drainage system to help minimize drainage and flooding problems while protecting receiving waters and other natural resources.	Small Maintenance Projects Program Drainage Partnership Program Ongoing Maintenance Operations	Small Maintenance Projects Program Expansion Drainage Partnership Program Expansion Transition to Proactive Drainage Maintenance Program	Reduced flood risk for roads and structures Reduced reactive maintenance activities and repairs
O2.4	Manage floodplains to minimize public safety hazards while preserving natural floodplain processes to the extent practicable.	Development Plan Reviews Coordination with FEMA Floodplain Management Program Annual Updates of Hazard Mitigation Plan	Continued Development of Subwatershed Plans CRS program Flood Hazard Mitigation Program Flood Warning System** Enhanced Infrastructure CIP	Reduced flood risk for roads and structures Fewer violations of environmental regulations related to water resources (specifically riparian buffers)
O2.5	Increase public awareness of community flood hazards, flood safety and protection measures, and the natural and beneficial functions of floodplains.	Public Education Program	Comprehensive Monitoring Program Stormwater Utility Annual Report	More residents, businesses and staff adopting positive stormwater practices

*[Link to Key Strategic Measures Table](#)

**future initiative beyond initial five-year planning window



Table ES-2. Strategic Objectives, Initiatives and Measures for Program Goal 3

Program Goal 3 <i>Address stormwater quality as an integral function within the program</i>		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O3.1	Regulate and guide new development and re-development such that post-development pollutant discharges emulate natural undeveloped conditions to the extent practicable.	Development Plan Reviews Public Education Program	LUMO and Engineering Design Manual Updates Fee Credit Policy/Program	Improved physical, chemical and biological stream conditions
O3.2	Mitigate cumulative water quality and erosion impacts of historically uncontrolled runoff from existing development including public roadways.	Bolin Creek Watershed Initiative Street Sweeping Program	Continued Development of Subwatershed Plans Water Quality CIP Fee Credit Policy/Program	Reduced export of nutrients to Jordan Lake
O3.3	Enforce strong erosion and sediment control programs during construction and land disturbance activities to reduce impacts to surface waters.	Development Plan Reviews Pollutant Report Responses Partnership with Orange County ESC Program		Improved physical, chemical and biological stream conditions
O3.4	Identify and eliminate illicit discharges into the stormwater system, with a balanced approach of general and targeted public education efforts combined with effective enforcement measures.	Public Education Program Illicit Discharge Detection and Elimination IDDE Program	IDDE Program Enhancement OWASA MOU	Fewer violations of environmental regulations related to water resources
O3.5	Perform comprehensive, watershed-based monitoring to assess effectiveness of stormwater control measures and track the biological, chemical and physical health of receiving waters.	Bolin Creek Watershed Initiative Biological Monitoring Program	Comprehensive Monitoring Program Continued Development of Subwatershed Plans	Benchmarking against best practices among municipal stormwater programs
O3.6	Ensure proper long-term maintenance and functionality of stormwater control measures.	Post-Construction Inspections of New BMPs	Long Term BMP Inspection and Enforcement Program	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake

*[Link to Key Strategic Measures Table](#)



Table ES-3. Strategic Objectives, Initiatives and Measures for Program Goal 4

Program Goal 4 <i>Protect and restore natural stream corridors</i>		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O4.1	Protect streams from further impacts due to urbanization by appropriately regulating development impacts within stream buffers.	Development Plan Reviews Stream Determinations	LUMO and Engineering Design Manual Updates	Improved physical, chemical and biological stream conditions
O4.2	Maximize natural continuity of intermittent and perennial stream corridors by minimizing impacts from manmade infrastructure and maintenance activities.	Development Plan Reviews	Continued Development of Subwatershed Plans LUMO and Engineering Design Manual Updates OWASA MOU	
O4.3	Restore natural streams and stream buffers in concert with watershed management and restoration.	Bolin Creek Watershed Initiative	Continued Development of Subwatershed Plans Water Quality CIP	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake
O4.4	Identify, and work with OWASA to reduce sanitary sewage leaks within and along streams, as well as problems with sanitary sewer overflows.	IDDE Program	OWASA MOU Comprehensive Monitoring Program IDDE Program Enhancement	Improved physical, chemical and biological stream conditions Fewer violations of environmental regulations related to water resources
O4.5	Educate and involve the community with protection, restoration, and stewardship of natural streams.	Public Education Program	Comprehensive Monitoring Program	More residents, businesses and staff adopting positive stormwater practices

*[Link to Key Strategic Measures Table](#)



Table ES-4. Strategic Objectives, Initiatives and Measures for Program Goal 7

Program Goal 7 <i>Ensure compliance with federal and state regulatory mandates</i>		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
07.1	Maintain participation in the National Flood Insurance Program.	Development Plan Reviews Coordination with FEMA Floodplain Management Program	CRS program Flood Hazard Mitigation Program Flood Warning System**	Reduced flood risk for roads and structures Benchmarking against best practices among municipal stormwater programs
07.2	Comply with requirements of the NPDES Phase II Permit, Water Supply Watershed Rules and the Jordan Lake Nutrient Strategy.	Development Plan Reviews IDDE Program Public Education Program Street Sweeping Operations	Water Quality CIP Long-Term BMP Inspection and Enforcement Program IDDE Program Enhancement	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake Benchmarking against best practices among municipal stormwater programs
07.3	Regulate and guide new development and re-development such that projects comply with all applicable federal and state stormwater requirements (e.g., 401/404, Dam Safety).	Development Plan Reviews		Fewer violations of environmental regulations related to water resources Benchmarking against best practices among municipal stormwater programs
07.4	Ensure that municipal projects and operations comply with all applicable federal and state stormwater requirements.	Ongoing Interactions with Other Municipal Departments		Fewer violations of environmental regulations related to water resources Benchmarking against best practices among municipal stormwater programs
07.5	Proactively implement Bolin Creek watershed restoration initiatives in order to forestall a Bolin Creek TMDL from EPA/NC DWR .	Bolin Creek Watershed Initiative	Water Quality CIP	Improved physical, chemical and biological stream conditions

**Link to Key Strategic Measures Table*

***future initiative beyond initial five-year planning window*



Specific budgets and operational plans have also been proposed for the planned strategic initiatives. Some major components are listed as follows:

- **Enhanced Infrastructure Capital Improvement Program (CIP)** - The Enhanced Infrastructure [CIP](#) will fund improvements to address flooding problems and failing stormwater conveyance components, which include pipe networks, culvert crossings and natural channels. The proposed funding level is \$500,000 per year and an additional 0.5 full-time employee to manage the projects.
- **Water Quality Capital Improvement Program (CIP)** - The installation of [BMP](#) retrofits, required to meet the Jordan Lake existing development rule and to address problems with impaired streams, will be funded, planned and constructed under the Water Quality [CIP](#). The proposed funding level is \$500,000 per year plus one additional full-time employee to manage the program.
- **Transition to Proactive Drainage Maintenance Program** - The dual objectives of transitioning to a more proactive, integrated drainage maintenance program are long-term cost savings and higher levels of service for the drainage conveyance system, both in terms of infrastructure condition and system performance. A comprehensive and effective database for managing asset information will be developed as an initial step in the transition. An additional four-man crew will facilitate inspection-based maintenance of the drainage system.
- **Comprehensive Monitoring Program** - A comprehensive monitoring program will provide baseline data to assess pollutant loads in the Town's streams, as well as estimating the Town's contribution to pollutant loads downstream at Jordan Lake. The proposed monitoring plan includes precipitation and stream flow monitoring; chemical and biological analyses of streams; and various ongoing [geomorphological](#) assessments of stream conditions. A volunteer monitoring program will also be established. The comprehensive monitoring program is proposed to require an additional 0.5 full-time employee. Proposed annual budgets for the first five years average \$90,000, with variations dependent on the timing of installations for USGS gages.

Other proposed initiatives include upgrading the **BMP Inspection and Enforcement** and **Illicit Discharge Detection and Elimination (IDDE)** programs, requiring one additional full-time employee with approximately ½ time devoted to each program. Updates for the **Land Use Management Ordinance (LUMO)**, in regard to stormwater management requirements, and the **Engineering Design Manual** are proposed. Proposals for establishment of a stormwater utility **Fee Credit Program/Policy** and a **Memorandum of Understanding (MOU) with the Orange Water and Sewer Authority (OWASA)** have also been developed as part of the Master Plan.

Seven key strategic measures have been selected for tracking program success and are listed and described in Table ES-5. Each of the measures is linked to specific program goals and objectives, creating a feedback loop to facilitate future program adjustments and adaptive management.



Table ES-5. Seven Key Strategic Measures

Measures		Brief Description
1	Improved physical, chemical and biological stream conditions	Stream conditions will be tracked as part of the comprehensive monitoring program, which may also include supplemental volunteer monitoring. Changes can be tracked for specific locations, specific watersheds and overall Town averages.
2	Reduced export of nutrients to Jordan Lake	Nutrient exports will be tracked as part of the comprehensive monitoring program with sampling data at import/export sites, combined with flow monitoring data to facilitate computations.
3	Fewer violations of environmental regulations related to water resources	Violations (reported and/or from inspections) will be tracked in a database.
4	Reduced flooding risk for roads and structures	Flooding risk for roads and structures will be quantified as subwatershed plans are developed; reductions will be quantified as repair, Drainage Partnership Program (DPP) projects, and CIP projects and/or buyouts are completed.
5	Reduced reactive maintenance activities and repairs	Part of the transition to a proactive maintenance program will involve tracking of time and expenses as “reactive” or “proactive.”
6	More residents, businesses and staff adopting positive stormwater practices	Periodic community surveys will include questions on changed behaviors regarding stormwater management. Follow up on public education programs to target audiences will survey changed behaviors. IDDE and other investigation follow-ups will also note changed behaviors. Some of the tracking may also be anecdotal.
7	Benchmarking against best practices among municipal stormwater programs	The Town’s program can be compared to other programs by using the bi-annual SESWA surveys or other comparable information. Although limited in scope, the comparisons will provide some measure of program effectiveness and costs relative to best practices among other programs.

To meet the stated mission of protecting the health and safety of both the public and the ecosystem; addressing both stormwater quality and stormwater quantity concerns; and meeting or exceeding state and federal mandates, the Town established a stormwater management utility and stormwater management enterprise fund. The stormwater utility is an organizational structure that is responsible for funding, administering, and operating the Town’s stormwater management program. The stormwater utility is funded entirely by the stormwater management enterprise fund through a rate structure based on the amount of [impervious area](#) on a property. The Engineering and Design Services and Stormwater Management Division, within the Town’s Public Works Department, is charged with management of the stormwater utility. The stormwater management utility fee was established in 2004 with the [ERU](#) set at 2,000 s.f. of impervious area. The fee was set at \$39.00 per ERU per year.



Two alternative Master Plan implementation and funding scenarios are proposed for consideration. The [Stormwater Advisory Board](#) recommended that the scenarios also incorporate a change in the Town of Chapel Hill Equivalent Rate Unit (ERU) basis from 2,000 square feet to 1,000 square feet. Model A represents a comprehensive but not full implementation of the Master Plan within a five-year timeframe and would require an initial fee of about \$38 per 1,000 s.f. [ERU](#), followed by annual increases of 10% per year. Model B significantly delays implementation of major components of the strategic initiatives and would require 12 to 15 years for implementation. The initial stormwater fee would be \$24 per 1,000 s.f. ERU and the proposed ongoing annual fee increases are \$3 per ERU. Based on this analysis and the recommendations from the Stormwater Advisory Board, in 2013 Town Council approved changing the ERU to 1,000 s.f. and increasing the annual fee to \$24.00 per ERU, effective with the 2014 budget.

The Master Plan comprises the essential guidance document for the range of services, activities and functions of the Stormwater Management Program. It is intended to be reviewed and updated annually. The ongoing implementation schedule for the Master Plan will be dependent on the levels of funding for the stormwater utility. A significant increase in the stormwater utility funding is warranted in light of the impending requirements of the Jordan Lake rules, as well as ongoing needs to address issues associated with deteriorating infrastructure and flooding concerns.



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Introduction

Town of Chapel Hill Stormwater Program Mission

The mission of the comprehensive Stormwater Management Program is to:

- Protect the health and safety of both the public and the ecosystem
- Address both stormwater quality and stormwater quantity concerns, and
- Meet or exceed federal and state mandates regarding stormwater

The Town of Chapel Hill is responsible for managing the drainage network, including the natural streams. Further, it is responsible for maintaining those system components within the Town's rights-of-way and on Town-owned property. It is estimated that there are over 100 miles of streams and open channels, 63 miles of culverts and pipelines, and approximately 5600 storm drain inlets within the Town's corporate limits.

In order to manage stormwater [runoff](#) such that public safety isn't endangered, adequate inlet and pipe capacities have to be developed and maintained so that the road network remains functional during storm events. Bridges, culverts, and pipelines deteriorate over time and eventually need to be rehabilitated or replaced so that a washout or failure doesn't occur that may endanger motorists and pedestrians. Particularly in the older parts of Chapel Hill, the condition of aging drainage infrastructure is an increasingly critical concern. Maintenance of the drainage network includes regular cleanouts of drainage inlets and ongoing repair and upkeep of system components. Street sweeping is also a stormwater maintenance activity, collecting trash and pollutants from street surfaces so that they don't block the pipes or drain into the streams, thus minimizing flooding and maintaining stream water quality.

Addressing stormwater quantity concerns is another part of the stormwater program mission. The Town participates in the National Flood Insurance Program (NFIP) so that residents are able to purchase flood insurance. The Federal Emergency Management Agency (FEMA)-mapped [1% annual chance floodplains](#) cover almost two square miles within the Town. University Mall and Eastgate Shopping Center, as well as a number of residences and other businesses, are within the FEMA-mapped [SFHAs](#). In addition to flooding which occurs along natural stream channels, parts of Town such as West Franklin Street and surrounding areas are subject to flooding due to undersized and/or poorly functioning drainage pipe systems. According to FEMA records, total NFIP payments in Chapel Hill as of September 30, 2013 have totaled over \$7 million since the program began in 1968. These various flooding concerns need to be addressed through a combination of buyouts/relocations, floodproofing, and drainage system improvements.

Protecting the health of ecosystems and addressing water quality concerns are important aspects of stormwater management. For regulatory purposes, streams are classified as [perennial](#), [intermittent](#) or [ephemeral](#) based on biology, geomorphology, and hydrology (e.g., whether the



stream has flow all year, only for a part of the year or only during rainfall events). About 63 miles of the streams in Chapel Hill have been classified as perennial and another 15 miles as intermittent. These streams provide important biological habitat and functions. The Chapel Hill 2020 Comprehensive Plan, as well as federal and state regulations, aim to protect and/or restore the ecological functions of streams. In addition to stream classification, the State of North Carolina assigns uses to surface waters (i.e., rivers, streams, lakes, swamps, ocean and coastal waterways) based on human use and ecological/biological factors. Water quality standards are based on these use groups. Monitoring results determine whether the waterbodies either meet water quality standards or are considered to be [impaired](#). If impaired, the sections of waterway are placed on a [303\(d\)](#) list and requirements will be placed on the governing jurisdiction for improving the water quality. Approximately 11 miles of the Town's perennial streams are listed as impaired for aquatic life. The state's [monitoring](#) tests include surveys of [benthos](#) (bugs living on the bottom of the stream) as an assessment of the aquatic life in the stream.

The third component of the mission of the stormwater program is to meet or exceed state and federal mandates related to stormwater management. Several major regulatory programs developed under the [Clean Water Act](#) significantly affect stormwater management in the Town of Chapel Hill. The two most significant ones are the Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System ([NPDES](#)) permitting program for Municipal Separate Storm Sewer Systems ([MS4s](#)) and the Jordan Lake Nutrient Management Strategy ([Jordan Lake Rules](#)). Phase I of the NPDES MS4 program affected only large cities and was implemented in the 1990s. Phase II broadened the program to include smaller cities and towns, including Chapel Hill. The Town's initial [NPDES](#) permit was issued in 2005 and renewed in 2011. Ongoing compliance with the permit requires a stormwater management program covering the following "six minimum measures":

- construction site [runoff](#) control
- post-construction runoff control
- good housekeeping/pollution prevention for municipal operations
- public education
- public participation and involvement
- illicit discharge detection and elimination (IDDE)

The Jordan Lake Rules were developed under the [EPA Total Maximum Daily Load \(TMDL\)](#) regulatory program to reduce the level of [eutrophication](#) in Jordan Lake. The program increases the requirements of post-construction runoff controls for new development projects by establishing upper limits for levels of nitrogen and phosphorus in stormwater runoff from a site. Additionally, later phases of the Jordan Lake Rules include requirements for local governments to mitigate nitrogen and phosphorus exported from areas of existing development by constructing stormwater control facilities, often termed "retrofits," to treat runoff so that the [nutrient](#) levels in streams flowing to Jordan Lake will be reduced.

Stormwater management within the Town is also impacted by several other public agencies and local governments. North Carolina Department of Transportation (NC DOT) is separately regulated by North Carolina Division of Water Resources (NC DWR) and NC DOT is also



responsible for maintaining inlets, pipes and culverts within its rights-of-way. Likewise, the University of North Carolina at Chapel Hill (UNC) is responsible for portions of the drainage network on its campus, and operates under a separate [NPDES MS4](#) permit. The [watersheds](#) of Town streams extend west into the Town of Carrboro and unincorporated Orange County, so stream conditions are affected by stormwater runoff from those areas as well as within Chapel Hill. The Orange Water and Sewer Authority ([OWASA](#)) is another key agency in relation to the Town's stormwater infrastructure, since many of the OWASA sewer lines parallel and cross natural streams. An ongoing challenge of the Town's stormwater program is developing and maintaining mutually beneficial partnerships with all of these entities whose jurisdictions and operations influence the management and impacts of stormwater in Chapel Hill.

Stormwater Management Program Master Planning Process

In order for the stormwater program to comprehensively address the multi-faceted issues and concerns associated with stormwater management in Chapel Hill, the Town undertook development of a Stormwater Management Program Master Plan (Master Plan). The Master Plan has been developed as the strategic and operational guidance document for the Town of Chapel Hill's Stormwater Management Program. Developed through a collaborative, stakeholder-inclusive process, the Master Plan builds upon the program mission and stakeholder-defined goals to articulate strategic objectives. The objectives translate into manageable and measurable stormwater initiatives, services, activities, and projects. Stormwater utility resources are aligned, prioritized, budgeted, and utilized to implement program goals and objectives.

Phase 1 of the master planning process included stakeholder interviews and surveys; review of regulatory-based programs and local ordinances; analysis of current stormwater service levels, program funding, and resources; an assessment of surface water quality and stormwater-related data and information; and defining the scope and requirements for the plan. Phase 2 of the project and process builds upon and leverages the significant discovery findings and stakeholder feedback from Phase 1 of the Master Plan. A series of targeted Master Plan workshops were performed with stormwater staff and the Stormwater Management Utility Advisory Board, as part of the Phase 2 planning process, to help further define the objectives, measures, and preliminary targets for Chapel Hill's Stormwater Management Program. The Master Plan framework utilized and implemented in Phase 2 is conceptualized in Figure 1-1.

To implement the program goals, strategic objectives are needed to further characterize, direct, and define the goal(s), i.e., what does it mean to “develop and implement a comprehensive Stormwater Program Master Plan?” What does it mean to “address stormwater quantity,” “address stormwater quality,” etc.?

Moving down the strategic planning triangle in Figure 1-1 (the program mission and major goals are at the top followed by the strategic objectives) the plan becomes even more specific, measurable, tactical, and also provides a timeframe for accomplishing the various activities in support of the program goals and objectives. Linkages in stormwater services and activities across multiple program goals and objectives are also identified and help guide the Town's prioritization of the stormwater utility's resources.



Council Adopted Mission + Goals

It is the mission of the comprehensive stormwater management program to:

- protect the health and safety of both the public and the ecosystem
- address both stormwater quality and stormwater quantity concerns, and
- meet or exceed federal and state mandates concerning stormwater.

-
- G1 - Develop and implement a comprehensive Stormwater Program Master Plan that supports all of the stormwater program priorities.
 - G2 - Address stormwater quantity (flooding) as an integral component within the program.
 - G3 - Address stormwater quality as an integral function within the program.
 - G4 - Protect and restore natural stream corridors.
 - G5 - Develop a formal public education and involvement program.
 - G6 - Define the level of service and performance standards for the Town's Stormwater Program.
 - G7 - Ensure compliance with the federal and state regulatory mandates.
 - G8 - Establish clear stormwater program leadership that the public recognizes.
 - G9 - Integrate programs to utilize resources efficiently.
 - G10 - Establish an understanding of the stormwater system as a "utility".

Master Plan Framework



Figure 1-1. Stormwater Management Program Master Planning Framework



Seven key strategic measures are established and will be regularly tracked to assess progress of the stormwater program. As part of the Town's annual budgeting process, the Master Plan will be reviewed and updated to ensure that stormwater utility resource and service priorities are aligned with and/or adapted to current program goals, objectives, and strategic measures.

Section 1 of this report describes each component of the strategic plan and Section 2 outlines operational plans for each of the strategic initiatives.



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Section 1 – Strategic Operating Plan

Town Council has established the following ten (10) Goals for the Stormwater Management Program:

Program Goal 1 – Develop and implement a comprehensive Stormwater Program Master Plan that supports all of the stormwater program priorities.

Program Goal 2 – Address stormwater quantity (flooding) as an integral component within the program.

Program Goal 3 – Address stormwater quality as an integral function within the program.

Program Goal 4 – Protect and restore natural stream corridors.

Program Goal 5 – Develop a formal public education and public involvement program.

Program Goal 6 – Define the level of service and performance standards for the stormwater program.

Program Goal 7 – Ensure compliance with federal and state regulatory mandates.

Program Goal 8 – Establish clear stormwater program leadership that the public recognizes.

Program Goal 9 – Integrate programs to utilize resources efficiently.

Program Goal 10 – Establish an understanding of the stormwater system as a utility.

This section describes the program goals and strategic objectives; summarizes the strategic initiatives and measures associated with each objective; describes the use of strategic measures for tracking program performance; and details two proposed alternatives for implementation schedules and budgets.

For each of the strategic objectives described within a program goal, the existing program functions and proposed strategic initiatives contributing to the objectives are listed. A summary table is provided for each goal, outlining the strategic objectives, existing program functions, and proposed strategic initiatives. (These summary tables are also provided as Appendix A.) The proposed strategic initiatives are briefly described. Seven key strategic measures have been selected for tracking program success. The measures applicable to each objective are noted in the summary tables and a full description of the measures is included following the listing of strategic initiatives. The last part of Section 1 describes the master plan implementation schedule and stormwater program budget.



Program Goals and Strategic Objectives

Program Goal 1

G1. Develop and implement a comprehensive Stormwater Program Master Plan that supports all of the stormwater program priorities.

The Stormwater Master Plan has been developed based on the mission and the ten goals for the Stormwater Management Program. The Master Plan outlines the activities to be undertaken, with the priorities, schedule and resources needed to accomplish the various elements of the Stormwater Management Program. The Master Plan will also serve as the guideline for the implementation of the stormwater program over the long-term. This Master Plan detailed herein completes the “develop” portion of Goal 1. Below are strategic objectives for the implementation of the Master Plan.

An annual review of the master plan will be the focus of the Stormwater Advisory Board meeting each January. A detailed review of the master plan and an assessment of the stormwater program will be conducted by the Town staff every five years.

Strategic Objectives for Program Goal 1

01.1. *The Master Plan will provide strategic guidance for the range of services, activities, programs, and projects performed utilizing the Town’s Stormwater Utility resources.*

01.2. *The Master Plan will be regularly reviewed, updated, and adapted within an open and collaborative process consistent with the Town’s governance policy.*

01.3. *The performance measures and targets in the Master Plan, both regulatory and non-regulatory, will be used to help track implementation of the Town’s Stormwater Program.*

01.4. *Annual budgeting recommendations for the Stormwater Program will be developed based on the Master Plan, as it continues to be updated and modified.*



Table 1-1. Strategic Objectives, Initiatives and Measures for Program Goal 1

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O1.1	The Master Plan will provide strategic guidance for the range of services, activities, programs, and projects performed utilizing Town Stormwater Utility resources.		Completion of Master Plan Annual Review and Updating of Master Plan at January Stormwater Advisory Board Meeting	Benchmarking against best practices among municipal stormwater programs
O1.2	The Master Plan will be regularly reviewed and updated as needed.		Annual Review and Updating of Master Plan at January Stormwater Advisory Board Meeting Detailed Master Plan Review and Program Assessment Every Five Years	
O1.3	The performance measures and targets in the Master Plan, both regulatory and non-regulatory, will be used to help track implementation of the Town's Stormwater Program.		Annual Review and Updating of Master Plan at January Stormwater Advisory Board Meeting Detailed Master Plan Review and Program Assessment Every Five Years Stormwater Utility Annual Report	
O1.4	Annual budgeting recommendations for the Stormwater Program will be based on the Master Plan, as it continues to be updated and modified.		Use of Master Plan during Town's Annual Budgeting Process	

[*Link to Key Strategic Measures Table](#)



Program Goal 2

G2. Address stormwater quantity (flooding) as an integral function within the program.

A number of property owners in Chapel Hill have experienced significant damages and costs due to flood impacts. Eastgate Shopping Center and University Mall are both located within regulatory [floodplains](#), as are a number of other commercial and residential structures. Other areas, such as West Franklin Street, are outside of mapped floodplains but are nevertheless subject to flooding due to inadequacies in the stormwater system intake and conveyance capacity.

The Stormwater Management Program will be enhanced to include comprehensive long-range management efforts to minimize flood risks and the negative effects of flooding. These efforts include prioritizing and addressing stormwater infrastructure needs such as maintenance, repair, replacement, upgrades, and capital improvements.

Strategic Objectives for Program Goal 2

02.1. *Regulate and guide new development and redevelopment such that post-development flow rates and volumes of runoff emulate natural pre-development conditions to the extent practicable, and do not create adverse flooding and/or erosion impacts.*

02.2. *Mitigate cumulative flooding impacts of historically uncontrolled runoff from existing development including public roadways.*

02.3. *Proactively maintain and improve the drainage system to help minimize drainage and flooding problems while protecting receiving waters and other natural resources.*

02.4. *Manage [floodplains](#) to minimize public safety hazards while facilitating natural floodplain processes to the extent practicable.*

02.5. *Increase public awareness of community flood hazards, flood safety and protection measures, and the natural and beneficial functions of floodplains.*



Table 1-2. Strategic Objectives, Initiatives and Measures for Program Goal 2

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O2.1	Regulate and guide new development and re-development such that post-development flow rates and volumes of runoff emulate natural undeveloped conditions to the extent practicable, and do not create adverse flooding conditions.	Development Plan Reviews Public Education Program	LUMO and Engineering Design Manual Updates Fee Credit Policy/Program	Reduced flood risk for roads and structures
O2.2	Mitigate cumulative flooding impacts of historically uncontrolled runoff from existing development including public roadways.	Limited Infrastructure CIP	Continued Development of Subwatershed Plans Enhanced Infrastructure CIP Fee Credit Policy/Program	Reduced flood risk for roads and structures
O2.3	Proactively maintain and improve the drainage system to help minimize drainage and flooding problems while protecting receiving waters and other natural resources.	Small Maintenance Projects Program Drainage Partnership Program Ongoing Maintenance Operations	Small Maintenance Projects Program Expansion Drainage Partnership Program Expansion Transition to Proactive Drainage Maintenance Program	Reduced flood risk for roads and structures Reduced reactive maintenance activities and repairs
O2.4	Manage floodplains to minimize public safety hazards while preserving natural floodplain processes to the extent practicable.	Development Plan Reviews Coordination with FEMA Floodplain Management Program Annual Updates of Hazard Mitigation Plan	Continued Development of Subwatershed Plans CRS program Flood Hazard Mitigation Program Flood Warning System** Enhanced Infrastructure CIP	Reduced flood risk for roads and structures Fewer violations of environmental regulations related to water resources (specifically riparian buffers)
O2.5	Increase public awareness of community flood hazards, flood safety and protection measures, and the natural and beneficial functions of floodplains .	Public Education Program	Comprehensive Monitoring Program Stormwater Utility Annual Report	More residents, businesses and staff adopting positive stormwater practices

*[Link to Key Strategic Measures Table](#)

**future initiative beyond initial five-year planning window



Program Goal 3

G3. Address stormwater quality as an integral function within the program.

The Stormwater Management Program will continue to address stormwater quality. This applies to water quality regulatory demands as well as to erosion and sediment controls and to stream and aquatic system health. The Stormwater Management Program will also recognize and move toward the goals of the Town's 2020 Comprehensive Plan.

State and federal regulatory mandates establish minimum acceptable standards and practices for controlling and managing the quality of stormwater runoff in Chapel Hill. New development sites are required to manage stormwater runoff such that total suspended solids (TSS) are reduced by 85%, and exported nitrogen and phosphorus loads do not exceed 2.2 lbs/yr and 0.78 lbs/yr, respectively, per acre of the site being developed. To address stormwater quality as an integral function within its Stormwater Management Program, the Town recognizes it must progressively satisfy regulations while pursuing a comprehensive strategy to reduce and treat urban stormwater pollutant discharges, thereby helping improve local and regional surface water quality and aquatic ecosystem health.

An important component of the regulatory enforcement for water quality protection is the erosion and sediment control (ESC) program on construction sites. Through an inter-local agreement, Orange County administers and enforces the Town's Soil Erosion and Sedimentation Control Ordinance. The Town's land disturbance threshold of 20,000 square feet necessitating an erosion control permit is lower than the state's threshold of one acre. While an erosion control permit is not required for smaller sites, the Town checks that erosion and sediment control measures are shown for projects involving land disturbance.

The Town also realizes the importance of maintaining a balanced, longer-term vision of program success while performing and measuring the effectiveness of current and near-term priority stormwater services, activities, and improvement projects. The decline in water quality and ecosystem health within streams and lakes in Chapel Hill today is the result of generations of local growth and urbanization including point and non-point source pollutant impacts, as well as factors beyond the Town's control such as regional growth and increased atmospheric deposition of pollutants.

Measurable improvements in stormwater quality and surface water quality will require dedicated and highly targeted municipal stormwater utility resources, adaptive implementation of stormwater best management practices, strong erosion and sediment control programs, sustainable low-impact development and re-development, practicable system-wide stormwater retrofit and restoration projects, and comprehensive watershed management plans and practices



grounded in community stakeholder partnerships, active local citizen stewardship, and public-private cost sharing.

Strategic Objectives for Program Goal 3

03.1. Regulate and guide new development and redevelopment such that post-development flow constituent discharges in runoff emulate natural pre-development conditions to the extent practicable.

03.2. Mitigate cumulative water quality and erosion impacts of historically uncontrolled runoff from existing development including public roadways.

03.3. Enforce strong erosion and sediment control programs during construction and land disturbance activities to reduce impacts to surface waters.

03.4. Identify and eliminate illicit discharges into the stormwater system, with a balanced approach of general and targeted public education efforts combined with effective enforcement measures.

03.5. Perform comprehensive, watershed-based monitoring to assess effectiveness of stormwater control measures and track the biological, chemical, and physical health of receiving waters.

03.6. Ensure proper long-term maintenance and functionality of stormwater control measures.



Table 1-3. Strategic Objectives, Initiatives and Measures for Program Goal 3

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O3.1	Regulate and guide new development and re-development such that post-development pollutant discharges emulate natural undeveloped conditions to the extent practicable.	Development Plan Reviews Public Education Program	LUMO and Engineering Design Manual Updates Fee Credit Policy/Program	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake
O3.2	Mitigate cumulative water quality and erosion impacts of historically uncontrolled runoff from existing development including public roadways.	Bolin Creek Watershed Initiative Street Sweeping Program	Continued Development of Subwatershed Plans Water Quality CIP Fee Credit Policy/Program	
O3.3	Enforce strong erosion and sediment control programs during construction and land disturbance activities to reduce impacts to surface waters.	Development Plan Reviews Pollutant Report Responses Partnership with Orange County ESC Program		Improved physical, chemical and biological stream conditions Fewer violations of environmental regulations related to water resources
O3.4	Identify and eliminate illicit discharges into the stormwater system, with a balanced approach of general and targeted public education efforts combined with effective enforcement measures.	Public Education Program Illicit Discharge Detection and Elimination IDDE Program	IDDE Program Enhancement OWASA MOU	
O3.5	Perform comprehensive, watershed-based monitoring to assess effectiveness of stormwater control measures and track the biological, chemical and physical health of receiving waters.	Bolin Creek Watershed Initiative Biological Monitoring Program	Comprehensive Monitoring Program Continued Development of Subwatershed Plans	Benchmarking against best practices among municipal stormwater programs
O3.6	Ensure proper long-term maintenance and functionality of stormwater control measures.	Post-Construction Inspections of New BMPs	Long Term BMP Inspection and Enforcement Program	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake

*[Link to Key Strategic Measures Table](#)



Program Goal 4

G4. Protect and restore natural stream corridors.

The health of the aquatic ecosystem is dependent on both water quality and quantity management. The Town's Stormwater Management Program addresses both infrastructure concerns and aquatic habitat health.

Natural streams effectively represent the arteries and lifelines of watersheds. The protection and restoration of natural streams and riparian corridors are integral to reaching the mission and goals of the Town's Stormwater Management Program. First, the Town desires to protect natural streams from additional harmful impacts. Protection includes establishing stream buffers, controlling increased runoff from upstream development, and eliminating illicit discharges. Second, minimum stream restoration standards include physical stability of the channel, habitat enhancements for aquatic life, and beneficial re-connections to riparian [floodplains](#), where practicable. More comprehensive stream restorations may include re-introduction of natural stream meanders, restored habitat, reforested buffers, upstream watershed Best Management Practices ([BMPs](#), also sometimes referred to as Stormwater Control Measures or SCMs), and relocation or mitigation of infrastructure encroachments within the stream corridor. Third, recognizing many constraints exist within the built urban environment, the Town realizes that the extent and level of potential stream restoration must be determined on a case-by-case basis.

Formal urban stream restoration is also an expensive proposition. Stream restoration projects will require dedicated public stormwater utility funding in close cooperation with private owners and external agencies sharing a stake in stream restoration programs and projects. There are over 100 miles of streams in Chapel Hill. Many miles of streams could benefit from increased protection and/or formal stabilization or restoration. Millions of dollars will be required over a number of years to restore streams within the community. For example, it is preliminarily estimated that restoring a modest 10% of the most degraded streams in Chapel Hill may cost more than \$30 million.

Natural streams in Chapel Hill have been impacted from decades of community growth corresponding to changing watershed and runoff conditions. As a result, public education will be critical in setting realistic stream restoration expectations within the community. Education will help establish reasonable timeframes for improvements and an understanding of resources required to make progress towards the important goal of stream restoration. Education will also help private property owners understand what they can do to protect natural streams and stream corridors. Stream protection and restoration will ultimately require understanding and active participation and stewardship from the entire Chapel Hill community.



Strategic Objectives for Program Goal 4

04.1. Protect streams from further impacts due to urbanization by appropriately regulating development impacts within stream buffers.

04.2. Maximize the natural continuity of intermittent and perennial stream corridors by minimizing impacts from manmade infrastructure and maintenance activities.

04.3. Restore natural streams based upon findings, priorities, and standards from stream restorability evaluations in concert with watershed management and restoration.

04.4. Work with [OWASA](#) to identify and reduce sanitary sewage leaks within and along streams, as well as problems with sanitary sewer overflows.

04.5. Educate and involve the community with protection, restoration, and stewardship of natural streams.



Table 1-4. Strategic Objectives, Initiatives and Measures for Program Goal 4

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O4.1	Protect streams from further impacts due to urbanization by appropriately regulating development impacts within stream buffers.	Development Plan Reviews Stream Determinations	LUMO and Engineering Design Manual Updates	Improved physical, chemical and biological stream conditions
O4.2	Maximize natural continuity of intermittent and perennial stream corridors by minimizing impacts from manmade infrastructure and maintenance activities.	Development Plan Reviews	Continued Development of Subwatershed Plans LUMO and Engineering Design Manual Updates OWASA MOU	
O4.3	Restore natural streams and stream buffers in concert with watershed management and restoration.	Bolin Creek Watershed Initiative	Continued Development of Subwatershed Plans Water Quality CIP	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake
O4.4	Work with OWASA to identify and reduce sanitary sewage leaks within and along streams, as well as problems with sanitary sewer overflows.	IDDE Program	OWASA MOU Comprehensive Monitoring Program IDDE Program Enhancement	Improved physical, chemical and biological stream conditions Fewer violations of environmental regulations related to water resources
O4.5	Educate and involve the community with protection, restoration, and stewardship of natural streams.	Public Education Program	Comprehensive Monitoring Program	More residents, businesses and staff adopting positive stormwater practices

*[Link to Key Strategic Measures Table](#)



Program Goal 5

G5. Develop a formal public education and involvement program.

The Town's existing Stormwater Management Program includes a well-developed public education and involvement program that exceeds the [NPDES](#) requirements. The program maintains and periodically updates a calendar and webpages within the Town of Chapel Hill's website. Presentations, workshops, collaborative efforts, and watershed project assistance are regularly given to schools and civic groups. Stormwater staff attend and often help to plan events and festivals. Staff administers a vibrant volunteer program that includes activities such as the annual fall NC Big Sweep and other litter clean-ups, storm drain marking, stream monitoring, and community outreach and education. Town staff also design and write ads and articles for various publications. Outreach to special target audiences over the past few years have included low-income housing residents, real estate agents, Boy Scouts and Cub Scouts, summer campers, churches, riparian buffer property owners, pet owners, and restaurant owners and workers. Stormwater Management staff has actively participated in Triangle J Council of Governments' Clean Water Education Partnership (CWEP) to develop a regional website (www.nccleanwater.org), to produce radio, movie theater, and television Public Service Announcements, and to develop outreach materials and exhibit booths.

Continuing improvements and expansion of education efforts will focus on both causes and solutions for stormwater problems, including possible regulatory remedies. The goal is to establish a clear understanding that stormwater and surface waters are a public resource to be protected and managed in the public interest, and that every resident can contribute to improving the quality of our waterways. Note that many of the Strategic Initiatives listed in Table 1-5 are collectively a part of the proposed the Public Education Program Enhancement.

Strategic Objectives for Program Goal 5

05.1. Increase general public knowledge and awareness of stormwater, flooding, and surface water quality within the community.

05.2. Encourage and enable citizens and the community to make informed environmental decisions through integrated and targeted education and outreach activities.

05.3. Maximize citizen and community involvement in stormwater pollution prevention activities and encourage behavioral changes that benefit surface water management.

05.4. Satisfy public education, outreach, and involvement requirements of [NPDES](#) Phase II permit.

05.5. Seek to partner, coordinate, and leverage education, outreach, and involvement programs with community and regional stakeholders.



Table 1-5. Strategic Objectives, Initiatives and Measures for Program Goal 5

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O5.1	Increase general public knowledge and awareness of stormwater, flooding, and surface water quality within the community.	Public Education Program Technical Assistance	Comprehensive Monitoring Program Publication of Annual Stormwater Utility Report CRS Program Flood Warning System**	Fewer violations of environmental regulations related to water resources More residents, businesses and staff adopting positive stormwater practices Benchmarking against best practices among municipal stormwater programs
O5.2	Encourage and enable citizens and the community to make informed environmental decisions through integrated and targeted education and outreach activities.	Public Education Program	Expanded Public Education Programs for Additional Target Audience Groups Collaboration with Stakeholder Groups	
O5.3	Maximize citizen and community involvement in stormwater pollution prevention activities and behavioral changes that benefit surface water management.	Public Education Program Stormwater Advisory Board	Comprehensive Monitoring Program Additional Stormwater Training for Municipal Employees and Operations IDDE Program Enhancement Fee Credit Policy/Program Collaborative Public Education Workshops and Seminars	
O5.4	Satisfy public education, outreach, and involvement requirements of NPDES Phase II permit.	Public Education Program (meets NPDES requirements)		
O5.5	Seek to partner, coordinate, and leverage education, outreach, and involvement programs with community and regional stakeholders.	Public Education Program	Stream Stewards Certification Program Facilitation of Stakeholder Involvement Plan for Bolin Creek Initiative	

*[Link to Key Strategic Measures Table](#)

**future initiative beyond initial five-year planning window



Program Goal 6

G6. Define the level of service and performance standards for the Town's stormwater program.

The Stormwater Management Program has established performance standards for the drainage conveyance system through Town ordinances, the Engineering Design Manual, and the proposed enhancement of the infrastructure Capital Improvement Program ([CIP](#)). In these ways, the appropriate performance standards in regard to flood protection and infrastructure conditions have been designated. The Stormwater Program will plan, prioritize, design and construct system improvements based on these design guidelines, infrastructure rating tables and the prioritization guidelines set up for infrastructure CIP, Drainage Partnership Program ([DPP](#)), and small maintenance repair projects. As stormwater maintenance is transitioned to a more proactive program, appropriate levels-of-service in regard to inspection and maintenance frequency will be established. Currently, the Stormwater Program is targeting to annually inspect 75% of the stormwater drainage system within the Town's rights-of-way. The enhanced infrastructure CIP, the DPP, and the Transition to Proactive Maintenance Program are key strategic initiatives under which levels-of-service have been and/or will be defined.

Initial targets and levels-of-service for program operations have also been established, for both the maintenance and office functions of the Stormwater Program. Targets may be adjusted after development of some baseline data.

- Complete at least 75% of in-house repair projects within 15 working days of receipt of work order.
- Complete development plan reviews within 15 working days of submittal.
- Initiate at least 75% of investigations of reported pollution within 24 hours of receipt.
- Initiate at least 75% of investigations within 3 working days of receiving complaint.

These service standards mostly target responsiveness to citizen concerns. Potential additional performance standards have been developed as part of the stormwater management master plan.

Strategic Objectives for Program Goal 6

06.1. Define appropriate levels of inspection and maintenance for the various components of the stormwater infrastructure system.

06.2. Complete and maintain a database of condition ratings for infrastructure components.



06.3. Utilize consistent level-of-service drainage conveyance standards as a basis for prioritization of projects.

06.4. Define timely responses to citizen complaints and/or pollution reports.

06.5. Define appropriate response times for completion of development plan reviews.

Table 1-6. Strategic Objectives, Initiatives and Measures for Program Goal 6

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
06.1	Define appropriate levels of inspection and maintenance for the various components of the stormwater infrastructure system.	Ongoing Maintenance Operations Street Sweeping Program	Transition to Proactive Drainage Maintenance Program	Reduced reactive maintenance activities and repairs
06.2	Complete and maintain a database of condition ratings for infrastructure components.	Stormwater System Database Development	Transition to Proactive Drainage Maintenance Program	Reduced reactive maintenance activities and repairs
06.3	Utilize consistent drainage conveyance system levels-of-service as a basis for prioritization of projects.		Enhanced Infrastructure CIP Small Maintenance Projects Program Expansion Drainage Partnership Program Expansion	Reduced reactive maintenance activities and repairs Reduced flood risk for roads and structures
06.4	Define timely responses to citizen complaints and/or pollution reports.	Ongoing Maintenance Operations IDDE Program Technical Assistance Drainage Partnership Program	Small Maintenance Projects Program Expansion Drainage Partnership Program Expansion Transition to Proactive Drainage Maintenance Program	Improved physical, chemical and biological stream conditions Benchmarking against best practices among municipal stormwater programs
06.5	Define appropriate response times for completion of development plan reviews.	Development Plan Reviews		Benchmarking against best practices among municipal stormwater programs

*[Link to Key Strategic Measures Table](#)



Program Goal 7

G7. Ensure compliance with federal and state regulatory mandates.

Many of the components of the existing stormwater program and several of the planned strategic initiatives were developed for the purpose of compliance with federal and state mandates.

One of the earliest stormwater-related regulatory compliance efforts for Chapel Hill, as with many cities and towns, was prohibiting development within [floodplains](#) so that town residents would be eligible to participate in the [NFIP](#).

In the early 1990s, the State established the Water Supply Watershed Protection Rules, regulating development density, establishing stream buffer protections and requiring post-construction stormwater controls in areas draining to a water supply reservoir. About half of the Town of Chapel Hill falls within the watershed protection district and is affected by these rules.

The Town's first Phase II [NPDES MS4](#) Permit in 2005 necessitated other program components, such as public education, [IDDE](#) and "good housekeeping" for municipal operations. The updated and re-issued 2011 NPDES MS4 Permit adds some additional requirements for the stormwater program, including establishment of an effective program to ensure ongoing inspection and maintenance for stormwater controls.

The Jordan Lake Nutrient Management Strategy regulations ([Jordan Lake Rules](#)) adopted by the legislature in 2008 and 2009 affect all of Chapel Hill. These rules established additional buffer requirements, set nutrient exports limits for development and redevelopment projects, and proposed a phased approach for reducing nutrient exports from areas of existing development. Initially, local governments are required to identify opportunities for siting retrofit stormwater controls. Later phases will require construction of retrofits to meet specified nutrient reduction targets.

Because several of the major streams in Chapel Hill, totaling about 11 miles, are on [NC DWR's 303\(d\)](#) list, the Town faces the possibility that [EPA](#) may require NC DWR to develop a [TMDL](#) for one or more of these streams. A TMDL would place a significant additional regulatory burden on the Town's stormwater management program. In order to prevent a future TMDL, the Town has been involved for the past several years in a joint initiative with the Town of Carrboro to implement restoration measures in the Bolin Creek watershed. Bolin Creek traverses both towns and is listed as impaired for much of its length.

The following lists the existing stormwater program functions which are required for regulatory compliance. Proposed strategic initiatives required to maintain compliance include a water quality capital improvement program, a long-term [BMP](#) inspection and enforcement program and enhancement of the IDDE program.



Existing program functions contributing to regulatory compliance:

- Development Plan Reviews
- Public Education Program
- [IDDE](#) Program
- Coordination with [FEMA](#)
- [Floodplain](#) Management Program
- Annual Updates of Hazard Mitigation Plan
- Bolin Creek Watershed Initiative
- Post Construction Inspections of [BMPs](#)
- Stream Determinations
- Stormwater System Database Development
- Ongoing Facilitation of Stormwater Advisory Board
- Ongoing Interactions with Other Town Departments
- Ongoing Interactions with External Stakeholders

Strategic Objectives for Program Goal 7

07.1. Maintain participation in the National Flood Insurance Program.

07.2. Comply with requirements of the [NPDES](#) Phase II Permit, Water Supply Watershed Rules and the [Jordan Lake Rules](#).

07.3. Regulate and guide new development and re-development such that projects comply with all applicable federal and state environmental regulations related to water resources (e.g., 401/404, Dam Safety).

07.4. Ensure that municipal projects and operations comply with all applicable federal and state environmental regulations related to water resources.

07.5. Proactively implement Bolin Creek watershed restoration initiatives to forestall a TMDL from [EPA/NC DWR](#).



Table 1-7. Strategic Objectives, Initiatives and Measures for Program Goal 7

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O7.1	Maintain participation in the National Flood Insurance Program.	Development Plan Reviews Coordination with FEMA Floodplain Management Program	CRS program Flood Hazard Mitigation Program Flood Warning System**	Reduced flood risk for roads and structures Benchmarking against best practices among municipal stormwater programs
O7.2	Comply with requirements of the NPDES Phase II Permit, Water Supply Watershed Rules and the Jordan Lake Nutrient Strategy.	Development Plan Reviews IDDE Program Public Education Program Street Sweeping Operations	Water Quality CIP Long-Term BMP Inspection and Enforcement Program IDDE Program Enhancement	Improved physical, chemical and biological stream conditions Reduced export of nutrients to Jordan Lake Benchmarking against best practices among municipal stormwater programs
O7.3	Regulate and guide new development and re-development such that projects comply with all applicable federal and state environmental regulations related to water resources (e.g., 401/404, Dam Safety).	Development Plan Reviews		Fewer violations of environmental regulations related to water resources Benchmarking against best practices among municipal stormwater programs
O7.4	Ensure that municipal projects and operations comply with all applicable federal and state environmental regulations related to water resources.	Ongoing Interactions with Other Municipal Departments		Fewer violations of environmental regulations related to water resources Benchmarking against best practices among municipal stormwater programs
O7.5	Proactively implement Bolin Creek watershed restoration initiatives in order to forestall a TMDL from EPA/NC DWR .	Bolin Creek Watershed Initiative	Water Quality CIP	Improved physical, chemical and biological stream conditions

*[Link to Key Strategic Measures Table](#)

**future initiative beyond initial five-year planning window



Program Goal 8

G8. Establish clear stormwater program leadership that the public recognizes.

Developing and retaining qualified staff is an important aspect of establishing stormwater program leadership for the Town. The Stormwater Program staff interacts with the residents of Chapel Hill in a variety of ways: handling of the billing data; the review process for proposed development projects; responding to residents' calls and providing technical assistance; public education efforts; and participation in various ongoing committees and planning efforts for the Town. Ongoing staff development efforts include in-house training sessions, as well as professional development courses and conferences. Staff continuing education accomplishments have included two engineers becoming Certified [Floodplain](#) Managers and a stormwater specialist completing several of the Rosgen stream morphology and restoration training courses. The Program has a good record of staff retention; staff members have been with the Town an average of more than seven years.

Several of the ongoing practices and functions of the Stormwater Program contribute significantly in developing stormwater program leadership that is recognized both within Chapel Hill and further afield. Stormwater staff participates and provides leadership in a number of regional, state, and national stormwater organizations and committees including the North Carolina Water Resources Association, the North Carolina Association of Floodplain Managers, the Triangle J Clean Water Education Partnership, the National Association of Flood and Stormwater Management Agencies, and the Nutrient Scientific Advisory Board. Staff also keeps abreast of proposed regulatory changes that will potentially impact the stormwater program and makes the effort to provide appropriate responses and feedback to regulatory agencies. The ongoing facilitation of the Stormwater Advisory Board is also an important part of the Program's leadership efforts.

Continuing and expanding the program function and practices described above are considered the most appropriate means of meeting Goal 8. No new initiatives are proposed for this goal. Community surveys are proposed as the best method for assessing public perspectives regarding the stormwater program leadership.

Strategic Objectives for Program Goal 8

08.1. Seek to maximize retention of qualified staff and provide ongoing training.

08.2. Encourage staff participation in regional, state and national stormwater organizations and programs.



08.3. *Provide appropriate comments and responses regarding proposed regulatory initiatives and changes.*

08.4. *Facilitate knowledgeable and beneficial support of the Stormwater Advisory Board.*

Table 1-8. Strategic Objectives, Initiatives and Measures for Program Goal 8

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
08.1	Seek to maximize retention of qualified staff and provide ongoing training.	Staff Continuing Education		Benchmarking against best practices among municipal stormwater programs
08.2	Encourage staff participation in regional/state/national stormwater organizations and programs.	Staff Participation and Leadership in NCWRA, APWA, NCAFM, NAFSMA, Nutrient Scientific Advisory Board		
08.3	Provide appropriate comments and responses regarding proposed regulatory initiatives and changes.	Ongoing Reviews of Federal Register Updates re: Stormwater Ongoing Responses to EPA/NC DWR Participation in Nutrient Scientific Advisory Board		
08.4	Staff support to the Stormwater Advisory Board .	Stormwater Advisory Board		

*[Link to Key Strategic Measures Table](#)



Program Goal 9

G9. Integrate programs to utilize resources efficiently.

The Stormwater Management Program includes numerous internal components and requires interaction and coordination with multiple municipal departments and outside agencies and organizations. Ongoing program integration efforts are especially manifested in the areas of public education and in coordination of stormwater management with other municipal operations. Another example of program integration is the Bolin Creek [EPA](#) 319 Grant Project, a cooperative effort of the Towns of Chapel Hill and Carrboro, along with the North Carolina State University (NCSU) Extension Service.

The 2009 Carolina North Development Agreement with [UNC](#) establishes an important and comprehensive partnership that contributes to advancing the Town's stormwater management goals and objectives. The agreement details open space and stream buffer requirements and standards for stormwater management. In light of the fact that the Carolina North area represents the largest remaining undeveloped area in Town, the joint agreement is an especially significant step in seeking to protect streams and downstream water quality.

The primary strategic initiatives that will be aimed at improving program efficiency and integration are the [LUMO](#) and Engineering Design Manual Updates and the Memorandum of Understanding (MOU) with [OWASA](#). The updates are intended to help clarify buffer regulations and guidelines for stormwater design, but will also involve identifying and modifying regulations and policies that are competing or contradictory to stormwater management goals. The proposed [MOU](#) with OWASA is an effort to establish a partnership with them on issues that impact streams and explore possible ways to promote the use of stormwater as a water resource asset.

The Stormwater Program will continue to seek ways to minimize duplication and inefficiencies in the management and implementation of the various stormwater programs and services in order to improve the overall cost-effectiveness of the program and to optimize the use of limited resources. The Stormwater Management Program will continue to promote integrated services and inter-jurisdictional cooperation, and to seek external funding opportunities to leverage Town stormwater funds.

Strategic Objectives for Program Goal 9

09.1. Identify and mitigate competing or contradictory factors within Town policies, ordinances, plans, and operational activities that impact stormwater goals and objectives.



09.2. *Coordinate with internal municipal departments as needed to advance stormwater management goals and objectives.*

09.3. *Establish and maintain partnerships with community and external organizations to advance stormwater management goals and objectives.*

09.4. *Utilize stormwater as a beneficial water resource asset for Chapel Hill and the region.*

09.5. *Actively seek external grant funding opportunities to leverage Town utility resources.*



Table 1-9. Strategic Objectives, Initiatives and Measures for Program Goal 9

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O9.1	Identify and mitigate competing or contradictory factors within Town policies, ordinances, plans and operational activities that impact stormwater goals and objectives.	Ongoing Interactions with Other Town Departments	LUMO and Engineering Design Manual Updates	Program integration efforts help to maximize program effectiveness and thus indirectly contribute to Key Strategic Measures.
O9.2	Coordinate with internal municipal departments as needed to advance stormwater management goals and objectives.	Ongoing Interactions with Other Town Departments		
O9.3	Establish/maintain partnerships with community and external organizations to advance stormwater management goals and objectives.	Public Education Program Bolin Creek Watershed Initiative UNC Representative on Stormwater Advisory Board UNC-TOCH Partnership on Restaurant Pollution Prevention TJCOG Membership & Participation Joint Efforts with Town of Carboro ESC Program with Orange County	Comprehensive Monitoring Program OWASA MOU	
O9.4	Utilize stormwater as a beneficial water resource asset for Chapel Hill and the region.	Public Education Program (e.g., Rain Barrels)	LUMO and Engineering Design Manual Updates Fee Credit Policy/Program OWASA MOU	
O9.5	Actively seek external grant funding opportunities to leverage Town utility resources.	Bolin Creek Watershed Initiative Ongoing Grant Applications/Awards		

*[Link to Key Strategic Measures Table](#)



Program Goal 10

G10. Establish an understanding of the stormwater system as a utility.

The Stormwater Management Program is funded by a utility fee, which provides a stable, dedicated revenue source like those in place for other services (e.g., water, sewer, gas, electricity). However, the stormwater system is not readily recognized by most citizens as a utility. Several of the strategic initiatives proposed as part of the Master Plan will play an important role in helping to improve understanding of the stormwater system as a utility.

Establishing an understanding of the stormwater utility will require that the drainage infrastructure be managed in ways that are somewhat similar to how a water and sewer utility is managed. The proposed transition to a more proactive drainage maintenance program, and the completion of the stormwater system inventory, are important Goal 10 efforts. The comprehensive monitoring program will extend the inventory and periodic “inspections” to cover the natural components of the stormwater system. Online publication of an annual stormwater utility report that includes an economic summary, [CIP](#) updates, and a compilation of monitoring results will be a key effort towards helping citizens understand the stormwater system as a utility. This initiative is proposed within the Public Education Program Enhancement.

Development and implementation of this goal will complement several other program goals including public education (G5) and establishing program leadership that is clearly recognized by the public (G8). Developing and regularly updating costs of stormwater utility services and corresponding user fee rates will also be inherent in successful implementation of this goal.

Strategic Objectives for Program Goal 10

O10.1. Develop and maintain a comprehensive database of the stormwater system, including natural streams.

O10.2. Manage the stormwater system as a utility.

O10.3. Educate officials, citizens and other municipal staff regarding the management and function of the stormwater system.



Table 1-10. Strategic Objectives, Initiatives and Measures for Program Goal 10

Strategic Objectives		Existing Program Functions	Strategic Initiatives	Key Strategic Measures*
O10.1	Develop and maintain a comprehensive database of the stormwater system, including natural streams.	Stormwater System Database Development	Comprehensive Monitoring Program Publication of Annual Stormwater Utility Report	Benchmarking against best practices among municipal stormwater programs
O10.2	Manage the stormwater system as a utility.	Technical Assistance Ongoing Maintenance Program Stormwater System Database Development Stormwater Utility Billing	Comprehensive Monitoring Program Transition to Proactive Drainage Maintenance Program Publication of Annual Stormwater Utility Report	Benchmarking against best practices among municipal stormwater programs
O10.3	Educate officials, citizens, and other municipal staff regarding the management and function of the stormwater system.	Public Education Program Technical Assistance Ongoing Maintenance Program	Comprehensive Monitoring Program Publication of Annual Stormwater Utility Report	Fewer violations of environmental regulations related to water resources More residents, businesses and staff adopting positive stormwater practices

**[Link to Key Strategic Measures Table](#)*



Strategic Initiative Summaries

A number of strategic initiatives, or action items, are proposed to be enhanced or added to the ongoing existing functions of the Stormwater Program in order to further the program goals and objectives. Following are brief summaries of the proposed initiatives to be undertaken in the initial five-year planning horizon. Additional implementation details, schedules and budgets are described in Section 2.

Enhanced Infrastructure Capital Improvement Program

The Enhanced Infrastructure Capital Improvement Program (CIP) establishes processes for addressing stormwater complaints, identifying potential improvement projects, and prioritizing expenditures for proposed improvements. The infrastructure [CIP](#) will fund improvements to address flooding problems and failing stormwater conveyance components, which include pipe networks, culvert crossings and natural channels. Projects with construction costs greater than \$30,000 to \$50,000 will generally be implemented as capital improvement projects.

Drainage Partnership Program

The Drainage Partnership Program (DPP) further defines and re-establishes the drainage assistance program originated in 1994 to facilitate limited improvements on private single-family residential property.

Water Quality Capital Improvement Program

The installation of [BMP](#) retrofits, required to meet the Jordan Lake existing development rule and to further the Bolin Creek Watershed Restoration, will be funded, planned and constructed under the Water Quality CIP. Stream restoration projects are also included within the Water Quality CIP.

Land Use Management Ordinance (LUMO) and Engineering Design Manual Updates

The planned updates are intended to improve consistency of the existing buffer and stormwater regulations, remove existing barriers to certain Low Impact Development (LID) practices, address problems with the existing rules, and add provisions to improve soil management and culvert design requirements. An example of a completed initiative is the removal of the requirement for stormwater management controls on individual single-family residential projects that disturb less than 20,000 square feet of land. The revised performance standard for these exempted residential projects is to discharge runoff in a non-erosive and diffuse manner. This can be accomplished by using measures, or some combination of measures, that include energy dissipators, grading, level spreaders, and rain barrels or chains.

Continued Development of Subwatershed Plans

The process of identifying and reviewing problems, assessing flooding and water quality issues and developing integrated plans for improvements in each drainage basin in the Town will gradually add to the master plan project lists for the infrastructure and water quality [CIPs](#) and the [DPP](#), providing a comprehensive extent and scope of potential improvements, which can then be prioritized Townwide within the individual programs.



Transition to Proactive Drainage Maintenance Program

The dual objectives of transitioning to a more proactive, integrated drainage maintenance program are long-term cost savings and higher levels of service for the drainage conveyance system, both in terms of infrastructure condition and system performance. A comprehensive and effective database for managing asset information will be developed as an initial step in the transition. An additional four-man crew will facilitate inspection-based maintenance of the drainage system.

Expansion of Small Maintenance Projects Program

As the Proactive Maintenance Program is established and drainage system components in need of repair or replacement are identified, additional funding and efforts will need to be directed towards remedial repairs in order to maintain the system at desired levels of service and in a cost-effective manner.

Comprehensive Monitoring Program

A comprehensive monitoring program will provide baseline data to assess pollutant loads in the Town's streams, as well as estimating the Town's contribution to pollutant loads downstream at Jordan Lake. Over time, the monitoring program will provide a basis for measuring trends and assessing the effectiveness of stormwater improvements, including water quality retrofits required under the Jordan Lake existing development rules. The proposed monitoring plan includes precipitation and streamflow monitoring; chemical and biological analyses of streams; and various ongoing [geomorphological](#) assessments of stream conditions. A volunteer monitoring program will also be established.

Long-Term BMP Inspection and Enforcement Program

The [BMP](#) inspection and enforcement program will help to ensure that BMPs are constructed and maintained to function in perpetuity. Locations and information for existing BMPs will be incorporated into the comprehensive database of drainage infrastructure. The Stormwater Program will develop policies and processes for BMP inspections and to facilitate corrections of BMP deficiencies when discovered.

Illicit Discharge Detection and Elimination (IDDE) Program Enhancement

The Town has established an effective [IDDE](#) program, which includes investigations of reports and ongoing identification of IDDE problems. One recent improvement for IDDE enforcement has been the Town's establishment of a Code Enforcement Team to address various enforcement concerns, including IDDE violations. Proposed enhancements include adoption of an updated IDDE ordinance, standardization of enforcement procedures, and coordination with the public education program to target businesses repeatedly identified as generators of illicit discharges. Another component of the IDDE Program Enhancement will be working with various municipal departments to eliminate some ongoing illicit discharges associated with municipal operations. Additional efforts in identifying and eliminating sewage discharges are also proposed.



Public Education Program Expansion

Several enhancements to the existing public education program are proposed in order to further extend outreach and target specific audiences. The first is a focused effort on pollution prevention and stormwater management training within the Town operations. Another added program component will be development and support of a public involvement plan for the Bolin Creek Watershed Restoration. Outreach and training for additional target audiences which have been identified by the Stormwater staff are also being planned. A new initiative will be electronic publication of an annual report of stormwater program activities. Periodic community surveys to gauge public stormwater awareness, practices, and perspectives will also be coordinated and budgeted within the public education program.

Memorandum of Understanding with OWASA

A comprehensive Memorandum of Understanding with [OWASA](#) is proposed to address the following issues:

1. Sanitary sewer leaks (illicit discharges) impacting streams
2. Utility easements crossing and/or immediately adjacent to streams
3. Stream monitoring/nutrient management
4. Stormwater as potential water supply

Fee Credit Policy/Program

A stormwater fee credit, up to a total of 50% reduction, for properties other than single and two-family residential properties will be considered by the Town Council. In all cases, credit is only offered for lots or tracts where the stormwater measures and controls exceed the requirements in place at the time that the property was developed. Property owners demonstrating exceedance in the areas of water quality or peak rate controls, or by treating offsite runoff, are potentially eligible for credit. Credit will be offered only for low impact measures and structural controls, and not for public education efforts. Credit may also be available for [NPDES](#) permit holders.

Community Rating System (CRS) Program

[FEMA](#) offers a [CRS](#) program to encourage communities to adopt sound and proactive [floodplain](#) management practices. Discounts on flood insurance rates are offered to property owners residing in communities participating in the CRS program. The Town has a floodplain management program which includes a number of the creditable activities under the CRS program. These efforts will be further upgraded and documented for CRS participation.

Flood Hazard Mitigation Program

Development of a Flood Hazard Mitigation Program (FHMP) will provide a roadmap for the Stormwater Program in addressing long-standing flooding problems. For each structure within the FEMA-mapped floodplain, plus additional properties at risk of localized flooding, benefit-cost analyses will be developed to compare estimated flood damages with the costs of a buyout or capital improvement project. The [FHMP](#) will thus lay the groundwork for leveraging federal and/or state grant monies to assist in [CIP](#) projects or buyouts.



Key Strategic Measures

Seven Key Strategic Measures have been selected as the primary means to assist the Town in tracking the success of the stormwater program. Obvious measures of success include reductions in flooding risks and improvements in water quality. Potentially less obvious but critically important measures include changes in municipal employee and resident stormwater practices and the level of residents' satisfaction with the Town's stormwater services. Key measures are listed in Table 1-1. For each measure, the directly and indirectly contributing program functions and planned strategic initiatives are listed.

The following pages provide more complete descriptions of the key program strategic measures, how they will be tracked and applied, and which program functions are considered as directly or indirectly contributing and why.



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Table 1-11. Key Strategic Measures

Measures		Brief Description	Directly Contributing Programs/Initiatives	Indirectly Contributing Programs/Initiatives
1	Improved physical, chemical and biological stream conditions	Stream conditions will be tracked as part of the comprehensive monitoring program, which may also include supplemental volunteer monitoring. Changes can be tracked for specific locations, specific watersheds and overall Town averages.	Water Quality CIP Development Reviews IDDE Program Street Sweeping Program Pollutant Report Responses Long-Term BMP Inspection and Maintenance Program	Fee Credit Policy/Program Public Education Program Comprehensive Monitoring Continued Development of Subwatershed Plans OWASA MOU LUMO and Engineering Design Manual Updates Goal 8 Leadership Efforts Goal 9 Integration Efforts Goal 10 Utility Management Efforts
2	Reduced export of nutrients to Jordan Lake	Nutrient exports will be tracked as part of the comprehensive monitoring program with sampling data at import/export sites, combined with flow monitoring data to facilitate computations.		
3	Fewer violations of environmental regulations related to water resources	Violations (reported and/or from inspections) will be tracked in a database.	IDDE Program Technical Assistance Development Reviews Partnership with Orange County ESC Program Long-Term BMP Inspection and Maintenance Program	Public Education Program Goal 8 Leadership Efforts Goal 9 Integration Efforts Goal 10 Utility Management Efforts
4	Reduced flooding risk for roads and structures	Flooding risk for roads and structures will be quantified as subwatershed plans are developed; reductions will be quantified as repair, DPP and CIP projects and/or buyouts are completed.	Development Reviews Transition to Proactive Maintenance Program Enhanced Infrastructure CIP Small Maintenance Projects Program Flood Hazard Mitigation Program Drainage Partnership Program	Continued Development of Subwatershed Plans Long-Term BMP Inspection and Enforcement Program CRS program Flood Warning System
5	Reduced reactive maintenance activities and repairs	Part of the transition to a proactive maintenance program will involve tracking of time and expenses as “reactive” or “proactive”.	Transition to Proactive Maintenance Program Enhanced Infrastructure CIP Small Maintenance Projects Program	Stormwater System Database Development Goal 8 Leadership Efforts Goal 10 Utility Management Efforts
6	More residents, businesses and staff adopting positive stormwater practices	Periodic community surveys will include questions on changed behaviors regarding stormwater management. Follow up on public education programs to target audiences will survey changed behaviors. IDDE and other investigation follow-ups will also note changed behaviors. Some of the tracking may also be anecdotal.	Technical Assistance Public Education Program IDDE Program Ongoing Interactions with Other Municipal Departments	Goal 8 Leadership Efforts Goal 9 Integration Efforts
7	Benchmarking against best practices among municipal stormwater programs	The Town’s program can be compared to other programs by using the bi-annual SESWA surveys or other comparable information. Although limited in scope, the comparisons will provide some measure of program effectiveness and costs relative to best practices among other programs.	Goal 8 Leadership Efforts Goal 10 Utility Management Efforts	Entire Stormwater Program

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Key Strategic Measure 1

Improved physical, chemical and biological stream conditions.

Changes in [benthic](#) scores, the measure used by [EPA](#) and [NC DWR](#) for assessing biological stream conditions, will serve as a key indicator for Goals 4 and 7 - protection and restoration of natural stream corridors and regulatory compliance. A number of the streams in Chapel Hill have been listed by NC DWR as impaired because they don't adequately support aquatic life. Benthic monitoring is the primary measure used to assess support of aquatic life. NC DWR has adopted specific methodology for scoring sites based on the number and diversity of macroinvertebrate [benthos](#) in a stream sample. NC DWR only monitors a few sites within Chapel Hill, with a frequency of every few years. Both the Morgan/Little Creek Local Watershed Plan and the Bolin Creek Watershed Initiative are part of the state's efforts to address impairments in these streams that were identified through past benthic monitoring.

The Town's biological monitoring program began in 2011 with eighteen sites. A few additional sites were added in 2012 and 2013. The more intensive and frequent testing provides the Town with insights on where the worst problems are and how they fluctuate relative to seasonal and cyclical stream flow conditions. Changes can be tracked at each site and also as a numerical average for particular watersheds and for the Town as a whole.

It is important to note that improvements in benthic scores are not easily achieved, even on a stream reach where a comprehensive restoration project has been completed. It is possible that even optimal implementation of the Town's stormwater program may not result in significant biological improvements. The benthic scores for streams in Chapel Hill are also influenced by upstream activities outside of the Town's jurisdiction. For these reasons, measures of physical and chemical stream conditions, such as habitat assessments and water quality analyses, may be used to supplement the benthic scores to track improvements in stream conditions.

Key Strategic Measure 2

Reduced export of nutrients to Jordan Lake.

The strongest regulatory program with which the Town's stormwater program must comply are the Jordan Lake existing development rules, which will require reductions in estimated nutrient exports from the Town. Monitored changes in nutrient exports will serve as a primary indicator for Goal 7 - regulatory compliance and Goal 3 - improving water quality.

In order to make valid estimates of nutrient exports, it will be necessary to establish continuous flow monitoring at four locations, as described in the section on Comprehensive Monitoring.



The four sites will also need to be sampled frequently enough to develop statistically valid data on nutrient concentrations relative to flows and seasons. The baseline data will determine whether the actual Town's nutrient export is comparable to the load estimated by North Carolina Department of Environment and Natural Resources (NC DENR) in the Jordan Lake [TMDL](#) model.

As the Water Quality [CIP](#) is implemented, primarily targeting nutrient reductions through [BMPs](#) and stream restoration, the ongoing monitoring will provide an objective measure of the extent to which in-stream nutrient reductions are being achieved.

For Key Measures 1 and 2, the contributing programs and initiatives are essentially the same. All of the measures targeted at nutrient reductions should also have an impact on improving stream health. Measures to restore stream health also contribute to nutrient reductions, since healthy streams, especially the [headwater](#) reaches, have been shown to be important for nitrogen processing.

- **Water Quality CIP** – The measures implemented to address stream impairments and achieve nutrient reductions from areas of existing development will be funded and prioritized through this program. The Public Education Program will indirectly contribute by informing citizens and encouraging support of proposed CIP projects. The continued development of subwatershed plans will help to facilitate planning and prioritization of water quality CIP projects.
- **Development Reviews** - Although development reviews may not directly contribute to *improvements* in [benthic](#) scores or nutrient reductions, they are critical to ensuring that construction of new projects and redevelopment projects do not cause further stream degradation and increased nutrient exports. The [LUMO](#) and Engineering Design Manual Updates indirectly influence Measures 1 and 2, as they impact development requirements. The long-term BMP inspection and enforcement program will help to ensure that the approved BMPs continue to operate as designed and approved.
- **IDDE Program** – Continuing efforts to identify and eliminate illicit discharges directly contribute to improvements in water quality and stream health. The Public Education Program indirectly contributes by informing businesses and citizens about appropriate pollution prevention efforts and encouraging changed behaviors. Developing a memorandum of understanding with [OWASA](#) would further extend IDDE efforts to address bacterial pollution.
- **Street Sweeping Program** – Street sweeping is a non-structural BMP that prevents trash and pollutants from reaching the streams.
- **Pollutant Report Responses** – The stormwater staff's prompt response to citizen reports of pollution problems can prevent further stream degradation. The Public Education Program contributes indirectly by disseminating information on what constitutes a violation and how to report it.



Key Strategic Measure 3

Fewer violations of environmental regulations related to water resources.

The Town enforces a variety of standards and requirements related to protection of water resources, including stream buffer/Resource Conservation District (RCD) requirements, erosion and sediment control requirements, and stormwater [BMP](#) requirements. In addition, the Town has responsibility for enforcing prohibitions on illicit discharges to the stormwater system. An illicit discharge or a violation of any of the afore-mentioned stormwater ordinance requirements constitutes a violation of environmental regulations related to water resources.

The Stormwater Management Program is developing a database which will facilitate tracking of all calls and emails from residents and businesses reporting stormwater issues. The reported issues will include various types of regulatory violations, which can be classified as to type of concern and tracked for annual totals. The totals will obviously fluctuate depending on rainfall patterns, flood events, particular development projects underway and other factors. Some increases in *reported* violations may be seen as a result of public education efforts making residents more aware of stormwater issues and more informed about the Town's stormwater management program. The stormwater database will also include [IDDE](#) reports of violations and inspection reports for [ESC](#) measures and post-construction BMPs. Again, the additional inspection and enforcement efforts may result in an initial increase in the *observed* number of violations, but the long-term objective of both programs is a reduction in the *actual* number of regulatory violations.

A number of core functions of the Stormwater Management Program directly contribute to efforts to reduce violations of environmental regulations. Comprehensive reviews of development plans help to head off potential problems related to development, both during and after construction. Erosion and sediment control efforts, in partnership with Orange County, are aimed at preventing sediment-related problems during construction. Continuing IDDE efforts in both education and enforcement should eventually reduce the incidence of illicit discharges.

Several other Program functions are also expected to contribute indirectly towards reducing violations of environmental regulations related to water resource protection. The public education program helps to increase public understanding about stormwater management and set appropriate expectations. The [LUMO](#) and Engineering Design Manual Updates and the Long-Term BMP Inspection and Enforcement Program are efforts to improve and clarify standards for development projects.



Key Strategic Measure 4

Reduced flooding risk for roads and structures.

As subwatershed plans are developed, the roadways and structures at risk of flooding frequency that exceeds design standards will be identified and analyzed. Similar analysis will be done with projects identified for inclusion in the Infrastructure Capital Improvement Program or Drainage Partnership Program. As Infrastructure [CIP](#) and [DPP](#) projects are implemented, reductions in flood risks for affected roadways and structures can be quantified.

Development reviews directly impact flooding risks, by requiring that potential downstream flooding impacts be analyzed prior to project approval and that appropriate flood detention be incorporated into the development. A proactive maintenance program helps ensure that stormwater conveyance will not be impeded when a storm event occurs. Repairs and improvements performed as part of Infrastructure CIP, the Small Maintenance Repair Projects Program and the Drainage Partnership Program will often directly result in a decreased flood risk. A Flood Hazard Mitigation Program, to comprehensively assess flooding problems along major streams in Town and prioritize appropriate projects, will help to maximize flood reduction efforts.

Several programs will also indirectly contribute to flood reduction efforts. Continued development of subwatershed plans will help to quantify problems and identify potential flood reduction projects. The Long-Term [BMP](#) Inspection and Enforcement Program, although aimed at the water quality component of stormwater control facilities, will also help to ensure the flood detention measures continue to function properly. [FEMA](#)'s Community Rating System program provides incentives for flood reduction measures and raises awareness of flooding issues. A Flood Warning System is proposed, as a future initiative outside the initial five-year planning window, to help to reduce public safety risks associated with floods and also raise public awareness and support for flood reduction efforts.

Key Strategic Measure 5

Reduced reactive maintenance activities and repairs.

As the Town transitions to a more proactive drainage maintenance program, a decreasing portion of maintenance and repair efforts should be in response to a resident complaint or failure of a pipe or structure following a large storm event. Instead, a greater portion of the effort should be spent on maintenance and repairs routinely scheduled and/or based on a prioritization system developed from ongoing infrastructure database updates. Part of the drainage infrastructure management program will involve development of a tracking system that includes a breakdown of reactive vs. proactive maintenance and repair efforts.



The strategic initiatives for transitioning to a Proactive Drainage Maintenance Program, implementing an Enhanced Infrastructure Capital Improvement Program and expanding the Small Maintenance Projects Program will all directly contribute to success in reducing the portion of maintenance and repair efforts that are reactive instead of proactive. The Proactive Drainage Maintenance Program is also a key component of the Goal 10 utility management efforts. The Stormwater System Database Development is an important step in transitioning to a proactive maintenance program, and thus contributes indirectly to this measure. Goal 8 program leadership efforts will also play an important role in transitioning the maintenance program.

Key Strategic Measure 6

More residents, businesses and staff adopting positive stormwater practices.

An important measure of stormwater program success is the extent to which individuals are changing their behaviors in relation to stormwater management. Efforts to inform and persuade employees, residents and businesses to improve stormwater-related practices are a cost-effective way to effect improvements in ecosystem health and water quality. In a few cases, the behavior changes can also reduce flooding risks. An example would be the proper placement of leaf piles such that they don't block gutters and storm drains. Some aspects of an [IDDE](#) program are aimed at changing the behavior of businesses and residents to incorporate pollution prevention into their standard practices. Public education measures target both reductions in practices that negatively impact streams and water quality, as well as encouraging community involvement in and support for clean-up, restoration and retrofit efforts. Residents can also be involved in actively noting and reporting stormwater problems.

The Town proposes to periodically survey the community to assess program effectiveness. This survey effort may be a stand-alone event, or can be incorporated into some other municipal survey effort. One or more questions can be specifically designed to determine whether the respondent has changed their behavior in any way that may affect stormwater. Possible changes for residents may be in areas of lawn care; car washing practices; disposal of paint/wash water/etc.; roof drain disconnections (or connections); and implementation of stormwater controls such as vegetated swales and rain gardens.

Additionally, some targeted [IDDE](#) and public education programs may be followed up with a formal or informal survey to assess success with a particular target group. For example, a follow-up survey of Town restaurants could be undertaken with that group or other indirect measures could be used, such as the number of restaurants where proper grease handling and spill clean-up equipment has been put in place. The particular indicators may vary depending on the groups being surveyed, but an important indicator of stormwater program success will be the extent to which the behavior of employees and residents can be changed in ways that help to improve the Town's streams.

The Public Education Program and the [IDDE](#) Program are directly aimed at changing the behavior of people in Chapel Hill in ways that improve stormwater management. Ongoing



interactions with other municipal departments are part of the [NPDES](#)-mandated “Good Housekeeping” effort to establish sound pollution prevention and stormwater management practices across the various Town departments. Sound stormwater management program leadership (Goal 8) and integration of Town programs with other local and regional efforts can also indirectly influence changes in the ways that employees, businesses, and residents impact stormwater management.

Key Strategic Measure 7

[Benchmarking](#) against best practices among other municipal stormwater programs.

To a large degree, the municipal stormwater program in each city or town has been uniquely developed to address concerns particular to its residents and respond to a certain set and schedule of regulatory mandates. Even within a similar geographic region, a town may differ greatly from its neighbor in regard to the extent and types of stormwater concerns and the existing state of the drainage infrastructure. Nevertheless, there are many similarities among stormwater programs and the core issues of adequate stormwater conveyance and environmental regulatory compliance are comparable for most programs, at least within a given state or region. It is a reasonable measure of program effectiveness to compare the Town’s program with best practices among other municipal programs serving similar populations and subject to comparable regulations. To a lesser degree, it may also be beneficial to periodically compare the Town’s stormwater program fees and costs relative to other North Carolina municipalities, particularly those within the Jordan Lake watershed facing regulatory requirements comparable to Chapel Hill’s.

A number of professional organizations and research institutions are also very important sources of information in regard to best practices among municipal stormwater programs. Urban stormwater management, particularly in regard to water quality concerns and retrofit [BMPs](#), is a rapidly evolving field. Research is ongoing and regulatory updates are frequent. In North Carolina, much of the research in regard to various stormwater management practices, including stream restoration and various types of BMPs, is conducted by the NCSU BioAg Extension Service. It provides workshops to disseminate information regarding case studies and research results, as well as publishing papers and reports. The NC Water Resources Research Institute is another important source of research information. The North Carolina chapter of the American Public Works Association has a Stormwater Management Division, which conducts an annual conference where stormwater management staff and consultants in the state and region share experiences on topics ranging from financial issues to specific construction projects and practices. State and national organizations, such as the North Carolina Association of Floodplain Managers, the National Association of Flood and Stormwater Management Agencies, the American Society of Civil Engineers, and the Center for Watershed Protection, also hold regular conferences and publish reports, magazines and newsletters. These organizations help to continuously re-define and update “best practices,” informally providing benchmarks which can be useful for assessing and improving the effectiveness of Chapel Hill’s program.



The UNC Environmental Finance Center and the Southeast Stormwater Association (SESWA) both survey municipal stormwater utilities biannually and publish results. SESWA’s survey, most recently published in 2013, covers [EPA](#) Region 4, encompassing Florida, Georgia, South Carolina, North Carolina, Alabama, Mississippi, Kentucky and Tennessee, and includes several questions about stormwater program functions. The UNC survey data focuses on stormwater fees and is provided on a website, the NC Stormwater Utility Fees Dashboard.

A few program comparisons can be gleaned from the [SESWA](#) survey. Table 1-12 lists the responses regarding development and use of a stormwater master plan. After the Stormwater Program Master Plan is adopted, the benchmark will be the Town’s level of integration of the Stormwater Program Master Plan with the overall comprehensive planning for the Town. Already, the key features of the Stormwater Program Master Plan have been included in the development of the Town’s 2020 comprehensive plan. The specific question asked of jurisdictions with an adopted stormwater master plan was, “Does your jurisdiction make an effort to coordinate your Local Government Comprehensive Plan with your stormwater Master Plan and [NPDES](#) Program concepts?”

Table 1-12. Status of Stormwater Master Plan Integration with Municipal Planning Efforts

Strong Coordination with Stormwater Master Plan	21%
Moderate Coordination with Stormwater Master Plan	37%
No Coordination with Stormwater Master Plan	2%
Stormwater Master Plan under Development	26%
No Stormwater Master Plan Effort	14%

There are a few other questions about the stormwater programs that provide some useful comparisons. Table 1-13 lists the reported levels of stormwater mapping and inventories. The quality of databases tends to vary significantly among municipalities, so it is difficult to draw a direct comparison between Chapel Hill’s mapping efforts and those reported. It is doubtful that 53% of jurisdictions actually have 100% of their stormwater systems definitively mapped and inventoried as to size and condition. The Town of Chapel Hill had much of its stormwater infrastructure mapped by summer interns several years ago, but the quality of the mapping is poor in some areas and infrastructure condition ratings were either not noted or are not consistent. Probably only about 10 to 25% of the system has been mapped to the standards set up to facilitate the transition to a Proactive Maintenance Program.



Table 1-13. Levels of Stormwater Inventory Completion Reported in 2013 [SESWA](#) Survey

	100%	75%	50%	25%
Reported Percentage of Stormwater Facilities Mapped & Inventoried	53%	24%	15%	8%
Chapel Hill Initial Inventory		X		
Chapel Hill Improved Inventory to Facilitate Proactive Maintenance Program				X

Table 1-14 lists the responses to several yes/no questions about stormwater programs. For the two monitoring questions, the extent and quality of the monitoring efforts are not noted and some respondents may actually have very minimal tracking of improvements. As part of the Stormwater Program Master Plan implementation, the Town proposes a comprehensive water quality monitoring program and the tracking of flood risks in conjunction with continued development of subwatershed plans and a flood hazard mitigation program. These strategic initiatives will facilitate monitoring of improvements in water quality and flood protection. Another proposed strategic initiative is participation in [FEMA](#)'s Community Rating System program. Thus, full implementation of the master plan will move the Town from the “no” (or partial) category to the “yes” category on these benchmarks. In regard to the last question, the Town is aligned with the overwhelming 93% majority, having within the past few years added more stringent requirements to assure long-term maintenance of stormwater facilities on a newly developed property.

Table 1-14. Stormwater Program Components Reported in 2013 [SESWA](#) Survey

Question	% Yes	% No	TOCH
Does your jurisdiction monitor improvements in water quality?	72%	28%	partially
Does your jurisdiction monitor improvements in flood protection?	69%	31%	partially
Does your utility manage the FEMA community rating system flood management program for your jurisdiction?	36%	64%	no
Does your utility use operation and maintenance permits (or other enforcement methods) to require private owners to maintain their on-site stormwater facilities?	93%	7%	yes

Funding adequacy for the stormwater utility to meet program objectives is also a useful benchmark. Table 1-15 lists the [SESWA](#) survey responses regarding adequacy of program funding, with comparative responses for the current level of stormwater funding in Chapel Hill.



Table 1-15. Reported Stormwater Revenue Adequacy in 2013 [SESWA](#) Survey

Level of Revenue Adequacy	Administration	TOCH	O&M	TOCH	CIP	TOCH
Adequate to meet all needs	53%		22%		13%	
Adequate to meet most needs	36%	x	37%		15%	
Adequate to meet most urgent needs	7%		36%	x	44%	
Not adequate to meet urgent needs	4%		5%		28%	x

More than half of the 75 respondents report that their stormwater [CIP](#) utilizes some non-stormwater fee funding, with 32% of those reporting use of grant funds, 19% sales tax revenues and others reporting use of loans, ad valorem and gas tax revenues. The Town used [EPA](#) 319 grant funds for construction of improvements in the Bolin Creek watershed.

A number of municipalities report that they charge a fee for stormwater permits, site plans reviews and/or inspections. However, 36% of jurisdictions reporting collection of at least one of these fees note that the stormwater utility does not receive any of the revenue. This is the case in Chapel Hill, where the planning department collects a permit fee, but none of the revenue goes to the Stormwater Program to offset the plan review or inspection costs.

In seeking to establish and maintain adequate funding for the Town’s stormwater utility, the stormwater utility fees will need to be periodically readjusted in accordance with program objectives. Although it is useful to compare the Town’s stormwater fees with those of other municipalities, there is no “best practice” in regard to a particular fee. A compilation of reported stormwater fees from the 2012 NC Stormwater Utility Fees Dashboard (beta version) is provided in Table 1-16 as background information for discussions of appropriate stormwater utility fee levels for the Town of Chapel Hill.

Comparisons are not straightforward because a number of municipalities have flat rate residential fees and those with tiered fees have different tiering levels. Chapel Hill’s recently increased fees are above average compared to reported fees in 2012, but are still below rates for the City of Durham, the only other municipality in the survey within the Upper New Hope Basin of Jordan Lake and subject to the associated nutrient reduction requirements. Cities within the Jordan Lake watershed are all facing the financial implications of required retrofits and fee increases should be expected. Greensboro and Durham have recently raised stormwater fees. Burlington, Elon and Graham have each instituted stormwater fees since the Jordan Lake rules were adopted, though at this point those are flat monthly fees of only \$1.00 to \$2.00 for both residential and non-residential properties.



Table 1-16. Stormwater Fees in Selected NC Municipalities

Municipality	Population	Residential Monthly Fee for 2,000 Square Feet Impervious Cover	Residential Monthly Fee for 4,000 Square Feet Impervious Cover	Non- Residential Monthly Fee for 10,000 SF IC
Chapel Hill	57,233	\$ 4.00	\$ 8.00	\$ 20.00
Comparably Sized North Carolina Municipalities (30,000 to 110,000)				
Greenville	84,554	\$ 2.85	\$ 5.70	\$ 14.25
Monroe	32,797	\$ 2.80	\$ 5.60	\$ 15.28
Rocky Mount	57,477	\$ 3.25	\$ 3.25	\$ 12.90
Concord	79,066	\$ 4.30	\$ 4.30	\$ 13.78
Kannapolis	42,625	\$ 4.00	\$ 5.00	\$ 12.31
Wilmington	106,476	\$ 5.75	\$ 5.75	\$ 23.00
Small City Averages	67,166	\$ 3.83	\$ 4.93	\$ 15.25
Larger North Carolina Municipalities (over 200,000)				
Charlotte	731,424	\$ 9.53	\$ 10.06	\$ 31.80
Raleigh	403,892	\$ 4.00	\$ 6.80	\$ 17.70
Greensboro	269,666	\$ 2.70	\$ 3.90	\$ 10.62
Winston-Salem	229,617	\$ 4.25	\$ 4.50	\$ 15.90
Durham	228,330	\$ 2.57	\$ 5.34	\$ 22.25
Fayetteville	200,564	\$ 3.00	\$ 3.00	\$ 13.24
Large City Averages	343,916	\$ 4.34	\$ 5.40	\$18.59
Median Rates for Municipalities in NC 2012 Database				
All municipalities		\$ 3.09	\$ 3.43	\$ 11.68
Cape Fear River Basin		\$ 3.51	\$ 3.68	\$ 12.66
Avg per household income >\$50,000		\$ 3.45	\$ 4.08	\$ 13.53

The [benchmarking](#) measures are directly impacted by the management of the stormwater utility (Goal 10 strategic objective) and by the Goal 8 leadership efforts to stay abreast of ongoing changes in stormwater management practices and regulatory trends, and facilitate informed support and input from the Stormwater Advisory Board. All of the ongoing program functions and the planned strategic initiatives indirectly contribute in some way to the standing of the Town's program in comparison to other municipal stormwater management programs.



Implementation Schedules and Funding Plans

Identification and development of Strategic Initiatives (action items) is the first part of the process to meet the overall Stormwater Program Master Plan Goals and Objectives. The next critical step is development of an implementation schedule and budget, including an analysis of the additional funding that will be required in order to implement the strategic plan.

To meet the stated mission of protecting the health and safety of both the public and the ecosystem; addressing both stormwater quality and stormwater quantity concerns; and meeting or exceeding state and federal mandates, the Town established a stormwater management utility and stormwater management enterprise fund in 2004. The stormwater utility is an organizational structure that is responsible for funding, administering, and operating the Town's stormwater management program. The stormwater utility is funded entirely by the stormwater management enterprise fund through a rate structure based on the amount of [impervious area](#) on a property. The Engineering and Design Services and Stormwater Management Division, within the Town's Public Works Department, is charged with management of the stormwater utility. The stormwater management utility fee was established in 2004 with the [ERU](#) set at 2,000 s.f. of impervious area. The fee was set at \$39.00 per ERU per year and was generating about \$1.8 million per year in FY 2011-2012, the base year from which the master plan financial forecast scenarios were generated.

Conventional wisdom recognizes that stormwater funding be: 1) sufficient to meet the needs of a defined program; 2) reliable so that a long-term plan can be implemented to address problems that have been generations in the making; and 3) equitable so that the burden of costs is shared fairly among those who contribute to the runoff. Implementation of the Stormwater Utility achieved each of these three criteria, yet even the establishment of an initial stormwater fee was done with the understanding that the initial fee would not carry the program forward very far. The recommendation to Council at that time from the Town Staff, the Stormwater Utility Consultant, and the Town's Citizen Policy Review Committee was to increase the fee by 10% each year to cover needed growth in the program. No increases were implemented from the beginning of the stormwater utility up until very recently, by which time the program was using fund balance to meet operational needs. Thus, the funding levels have not facilitated adequate provision for proactively addressing infrastructure maintenance and repairs or expanding the program to comprehensively deal with increasing regulatory requirements.

To forecast the stormwater program costs and funding needs, stormwater staff worked together with the master plan consultants to develop expense and staffing needs associated with each of the proposed strategic initiatives. A spreadsheet model was then developed to account for a projected rate of increases in current operational expenses combined with new costs of strategic initiatives. Various options for fee increases were modeled relative to specific implementation plans for the strategic initiatives. Based on feedback and input from the Stormwater Advisory Board, two potential schedule and funding plans were selected for consideration and comparison.



Comprehensive Strategic Initiative Implementation Schedule

The “Model A” implementation schedule and funding plan facilitates a comprehensive upgrade of the stormwater program within a five-year planning window to include most of the major components of the Strategic Initiatives. This timeframe allows for an aggressive, yet achievable implementation schedule. The budget funds a half-million dollars per year of water quality projects, including nutrient reduction measures required under the [Jordan Lake Rules](#) and ongoing Bolin Creek watershed restoration efforts. Although this level of funding won’t be adequate to fully address all of the stream problems or ensure that the targeted levels of nutrient reductions are achieved, it is expected to be enough to demonstrate a good faith effort on the part of the Town and keep the program in compliance with federal and state requirements. Similarly, the “Model A” plan funds a significant investment in infrastructure capital improvement projects to address flooding concerns and replace inadequate and/or failing infrastructure. At the proposed rate of implementation, it will take approximately 13 to 15 years to construct the [CIP](#) projects identified and included in program planning thus far. Other projects are expected to be proposed as subwatershed planning progresses. Overall, the plan would include ramping the program up to increase annual expenditures by about \$1.65 million plus adding three operations staff members and five maintenance staff members. Total program costs would be ramped up to an additional annual cost of around \$2.45 million, for a total stormwater program budget of about \$4.25 million. Table 1-17 provides additional details, and specific details within each strategic initiative are described in Section 2.

Stormwater staff and the [Stormwater Advisory Board](#) proposed consideration of reducing the size of the [ERU](#) from 2,000 square feet to 1,000 square feet, based on citizen feedback that a 1,000 square foot ERU would be more equitable. The Town Council adopted this change in 2013. The following analyses are based on a 1,000 s.f. ERU size at the start of fee increases to cover the costs of the Strategic Initiatives.

There are many different fee adjustment alternatives available to the Town, but the bottom line is that adequate funding of the Model A implementation plan will require a significant increase in stormwater revenue. Projections indicate that funding of this Strategic Initiative implementation plan will require the equivalent of an initial 90% fee increase, calculated based on the current number of billable ERUs. The fee adjustment selected for the Model A scenario involves the following:

1. Implement the Comprehensive Strategic Initiative implementation ramp-up in [FY](#) 13/14.
2. Reduce the ERU size from 2,000 to 1,000 square feet.
3. Set the initial fee at \$39.10 per ERU per year.
4. Begin billing the increased fee in FY 13/14.
5. Raise the fee by 10% in each of the subsequent years for at least the next four years.

If all assumptions associated with the Model A scenario are correct and the scenario is implemented as proposed, there would be a net increase in the end-of-year fund balance of \$46,674 in the six-year span.



Table 1-17. Model A Summary of Strategic Initiative Implementation Costs

	Year 1		Year 2		Year 3		Year 4		Year 5	
	Prog Exp	+FTE	Prog Exp	+FTE	Prog Exp	+FTE	Prog Exp	+FTE	Prog Exp	+FTE
Enhanced Infrastructure Capital Improvement Program	\$100,000	0.25 Ops	\$200,000	0.50 Ops	\$300,000	0.50 Ops	\$400,000	0.50 Ops	\$500,000	0.50 Ops
Drainage Assistance Program	\$50,000		\$50,000	0.50 Maint	\$50,000	0.50 Maint	\$50,000	0.50 Maint	\$50,000	0.50 Maint
Small Maintenance Projects Program	\$100,000		\$100,000	0.50 Maint	\$100,000	0.50 Maint	\$100,000	0.50 Maint	\$100,000	0.50 Maint
Water Quality Capital Improvement	\$150,000	0.25 Ops	\$450,000	1.00 Ops	\$500,000	1.00 Ops	\$500,000	1.00 Ops	\$500,000	1.00 Ops
LUMO & Design Manual Update	\$25,000		\$25,000							
Continue Watershed Plans	\$300,000		\$300,000		\$300,000		\$300,000		\$300,000	
Transition to Proactive Drainage Maintenance Program	\$0	1.00 Maint	\$35,000	2.00 Maint	\$150,000	4.00 Maint	\$150,000	4.00 Maint	\$75,000	4.00 Maint
Comprehensive Monitoring Program	\$85,000		\$70,000	0.50 Ops	\$115,000	0.50 Ops	\$90,000	0.50 Ops	\$95,000	0.50 Ops
BMP Inspection and Enforcement Program	\$2,500	0.25 Ops	\$5,000	0.50 Ops	\$5,000	0.50 Ops	\$5,000	0.50 Ops	\$5,000	0.50 Ops
IDDE Program Enhancement	\$2,500	0.25 Ops	\$5,000	0.50 Ops	\$5,000	0.50 Ops	\$5,000	0.50 Ops	\$5,000	0.50 Ops
Public Education Program Expansion			\$20,000							
Community Rating System Program					\$5,000		\$5,000		\$5,000	
Flood Hazard Mitigation Program							\$10,000		\$10,000	
Sub-Totals:	\$815,000	\$188,535	\$1,260,000	\$579,746	\$1,530,000	\$767,051	\$1,615,000	\$786,227	\$1,645,000	\$805,883
Annual Totals*:	\$1,003,535		\$1,839,746		\$2,297,051		\$2,401,227		\$2,450,883	

*Additional to \$1.8 mil/yr base budget.



Extended Strategic Initiative Implementation Schedule

An alternative implementation schedule for the Strategic Initiatives was developed as “Model B”, deferring a number of the initiatives until after the initial five-year window and allowing for more gradual increases in program funding. The funding requirements for new initiatives and program enhancements under the extended schedule are roughly 20% to 30% per annum of the comprehensive implementation schedule. Table 1-18 presents the initial five years of the extended schedule. Further analysis of the funding spreadsheet model indicates that between twelve and fifteen years would be needed to achieve the same level of program development as would be achieved in the comprehensive implementation schedule in five years. Clearly, the level of service to the citizens of Chapel Hill would be less under the extended scenario. The lack of funding for upgrading the maintenance program and the infrastructure capital improvement program is expected to result in higher long-term costs associated with drainage failures and associated emergency repairs and replacements, which often cost significantly more than similar projects carried out as part of a proactive repair and replacement program. Also, with reduced funding, the Town may not be able to implement program components required by the [Jordan Lake Rules](#), or other required programs, and may be in violation of regulatory mandates. The fee adjustment selected for this scenario involves the following:

1. Implement the Extended Strategic Initiative implementation ramp-up in [FY](#) 13/14.
2. Reduce the [ERU](#) size from 2,000 to 1,000 square feet.
3. Set the initial fee at \$24.00 per ERU per year.
4. Begin billing the increased fee in FY 13/14.
5. Raise the fee by \$3 in each of the subsequent years for twelve to fifteen years.



Table 1-18. Model B Summary of Strategic Initiative Implementation Costs

	Year 1		Year 2		Year 3		Year 4		Year 5	
	Prog Exp	+FTE	Prog Exp	+FTE	Prog Exp	+FTE	Prog Exp	+FTE	Prog Exp	+FTE
Enhanced Infrastructure Capital Improvement Program										
Drainage Assistance Program	\$50,000		\$50,000		\$50,000		\$50,000	0.25 Maint	\$50,000	0.50 Maint
Small Maintenance Projects Program	\$50,000		\$50,000		\$50,000		\$50,000	0.25 Maint	\$50,000	0.50 Maint
Water Quality Capital Improvement	\$100,000		\$150,000	0.25 Ops	\$175,000	0.50 Ops	\$225,000	0.50 Ops	\$275,000	0.50 Ops
LUMO & Design Manual Update										
Continue Watershed Plans										
Transition to Proactive Drainage Maintenance Program										
Comprehensive Monitoring Program	\$25,000		\$40,000		\$90,000		\$60,000		\$60,000	
BMP Inspection and Enforcement Program				0.25 Ops		0.50 Ops		0.50 Ops		0.50 Ops
IDDE Program Enhancement										
Public Education Program Expansion										
Community Rating System Program										
Flood Hazard Mitigation Program										
Sub-Totals:	\$225,000	\$0	\$290,000	\$54,475	\$365,000	\$111,675	\$385,000	\$158,749	\$435,000	\$208,108
Annual Totals*:	\$225,000		\$344,475		\$476,675		\$543,749		\$643,108	

*Additional to \$1.8 mil/yr base budget.



Additional Funding Considerations

The Town Staff, Stormwater Advisory Board, and project consultants consider that the funding and implementation scenarios described herein show the range of options most likely to be of interest. The actual implementation schedule and funding of that schedule will be decided by the Town Council and may be reviewed annually or as often as deemed appropriate to address unknown factors such as changing economic climate, changes in the regulatory environment, or other unknowns. In 2013, the Town Council, acting on recommendations from the Stormwater Advisory Board made subsequent to initial presentations of the Master Plan financial analysis, changed the [ERU](#) basis from 2,000 s.f. of impervious area to 1,000 s.f. of impervious area and set the fee at \$24.00 per ERU. This increase was in line with the scenario illustrated under Model B.

The initial establishment of the Stormwater Utility Fee in 2004 was a significant step forward by the Town of Chapel Hill that enabled the implementation of a program to meet the primary regulatory mandate of the time, the [NPDES](#) Phase II program. Although the NPDES program did not specifically require implementation of a Stormwater Utility, this significant regulatory driver required the Town to implement a program for which the best choice of funding turned out to be a Stormwater Utility. It is clear that the Town's current program has outgrown the existing funding level given that the Town has been forced to draw from the Stormwater Utility Fund Balance to meet operational needs. Although the newly implemented rate increase will raise funding levels enough to eliminate further drawdowns for now, this financial analysis indicates that a failure to adequately fund for long-term needs will continue to limit maintenance and capital improvements to minimal options and disallow the possibility of proactive maintenance and a realistic capital improvement program. The Town also has inadequate resources to deal with increased regulatory requirements associated with the Jordan Lake Nutrient Management Strategy rules.

Similar to the onset of the [NPDES](#) Phase II program, the Town must address another set of mandated regulations, the Jordan Lake rules. Cost estimates for constructing stormwater retrofits to meet anticipated nutrient reduction goals for the Jordan Lake existing development rule run in the tens of millions of dollars. Strong consideration should be given to implementing a long-term funding strategy in order for the stormwater program to successfully continue to fulfill its mission of protecting public health and safety, addressing flooding and water quality concerns, and meeting regulatory requirements.



Strategic Plan Summary and Conclusions

The strategic plan for the Town of Chapel Hill stormwater program has been developed based on the mission and the ten goals for the Stormwater Management Program. The strategic initiatives form a set of proposed programs and actions to be undertaken in order to meet the Stormwater Program goals and objectives. Seven key measures are designated for tracking of program success and as a basis for future program adjustments and adaptive management.

Funding requirements for implementation of the strategic initiatives have been analyzed and two potential financial scenarios have been proposed for consideration. The ongoing implementation schedule for the Master Plan will be dependent on the levels of funding for the stormwater utility. A significant increase in the stormwater utility funding is warranted in light of the impending requirements of the [Jordan Lake Rules](#), as well as ongoing needs to address issues associated deteriorating infrastructure and flooding concerns.

The Strategic Plan comprises the essential guidance document for the range of services, activities and functions of the Stormwater Management Program. It is intended to be reviewed and updated annually. The financial analysis spreadsheet tool should facilitate an annual update for the financial forecasts and serve as the basis for funding recommendations to Town Council.



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Section 2 – Operational Plan for Master Plan Implementation

In order to fulfill the Program Goals and Strategic Objectives described in Section 1, plans and groundwork for a number of strategic initiatives have been developed as part of the master planning process, based on a combination of research, data analysis, field reconnaissance, modeling, staff discussions and Stormwater Advisory Board workshops. In contrast to the Strategic Plan, the Operational Plan will continue to be further developed as the strategic initiatives are implemented and additional aspects of the strategic initiatives are detailed.

The following initiatives are proposed to be enhanced or added to the existing program functions of the Engineering and Design Services and Stormwater Management Division, at least partially within the initial five-year planning horizon. Details for implementation of these strategic initiatives are described herein. Note that additional initiatives, such as implementation of a Flood Warning System, and further enhancements to existing programs and functions are expected to be incorporated into future master plan updates.

- Enhanced Infrastructure Capital Improvement Program (CIP)
- Drainage Partnership Program
- Water Quality Capital Improvement Program (CIP)
- [LUMO](#) and Engineering Design Manual Update
- Continued Development of Subwatershed Plans
- Transition to Proactive Drainage Maintenance Program
- Expansion of Small Maintenance Projects Program
- Comprehensive Monitoring Program
- Long-Term [BMP](#) Inspection and Enforcement Program
- [IDDE](#) Program Enhancement
- Public Education Program Expansion
- Memorandum of Understanding with [OWASA](#)
- Fee Credit Policy/Program
- Community Rating System (CRS) Program
- Flood Hazard Mitigation Program



Enhanced Infrastructure Capital Improvement Program

A major initiative of the master planning process has been development of a framework for enhancing the Infrastructure Capital Improvement Program (CIP). To date, the Town's expenditures for infrastructure repairs, rehabilitation, and improvements have been limited to about \$100,000 per year, with projects prioritized by urgency due to a component failure or critical condition, or by obvious severity of an erosion and/or flooding problem. Enhancing the Infrastructure [CIP](#) is a key initiative for meeting objectives under Goals 2 and 6. Staff and the Stormwater Advisory Board have worked together to define objective, clear, and well-documented processes for addressing stormwater complaints, identifying potential capital improvement projects, and prioritizing expenditures for proposed improvements. The following CIP prioritization processes provide a structured outline for facilitating improvements related to stormwater conveyance. The primary concerns warranting capital improvement expenditures for such projects are (1) flooding problems and (2) failing stormwater conveyance components, which include pipe networks, culvert crossings, and natural channels. Residents' reports and complaints play an important role in identifying stormwater problems. Inspections of drainage infrastructure and/or development of subwatershed plans will bring other problems to light. Prioritization of capital expenditures will be based on objective observations, analyses, and procedures, without regard to the frequency or source of the complaints.

Introduction

The flowchart in Figure 2-1 outlines the process for categorizing a complaint or problem and addressing it appropriately. Often routine maintenance, such as cleanout of a [catch basin](#), may be sufficient to address the concern. In other cases, the problem may not be related to stormwater runoff from a public right-of-way (ROW) and thus would be ineligible for expenditure of public funds. Problems limited in scope to a single residential property are addressed under the Town's Drainage Partnership Program (DPP). Stormwater problems can be sorted and categorized based on the flowchart and the stormwater problem classification table (Table 2-1).

If a stormwater problem cannot be addressed by Town crews and warrants consideration for a capital improvement expenditure, it is then subjected to a more detailed scoring. Deteriorated or failing pipes and eroding channels are rated based on condition and threat to public safety. Flooding problems are scored based on the frequency and extent of flooding. Scoring is based on objective observations and measurements and, in some cases, also hydrologic and hydraulic analyses. Most stormwater problems will be addressed as a stormwater conveyance remediation project, in the case of failing infrastructure, or as a flood mitigation project. A few problems/projects will warrant scoring as both.

For each potential stormwater conveyance remediation project, a conceptual plan and an estimated budget will be developed. The same procedure will also be followed for localized flood mitigation projects. For flooding problems related to larger drainage networks where neither the causes nor solutions can be reasonably judged without extensive analysis, an

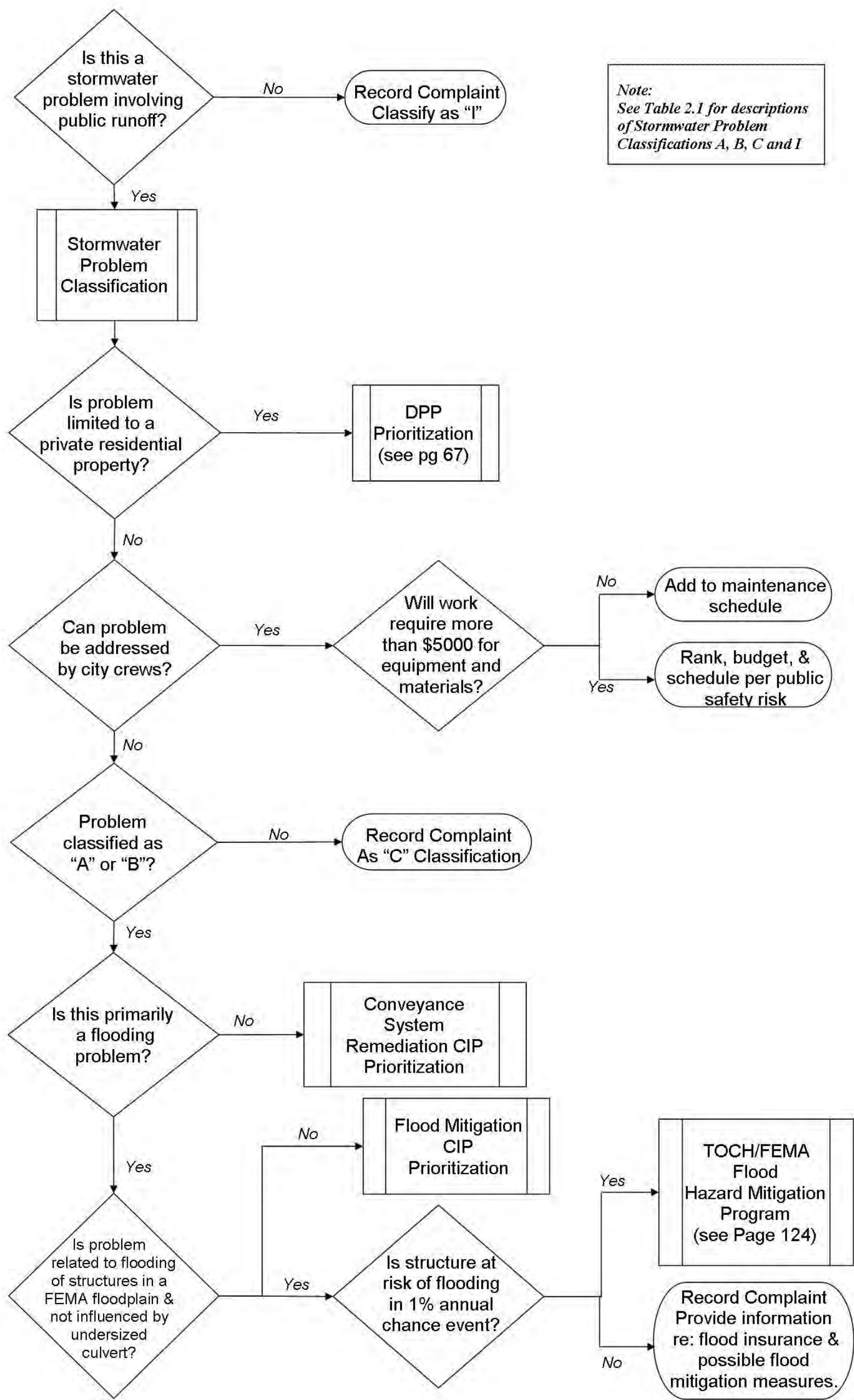


Figure 2-1. Flowchart for Stormwater Problem Classification and Prioritization



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appropriate budget for a conducting the analysis will be developed and incorporated into the Town’s program for stormwater capital improvements.

Although water quality projects will be budgeted and prioritized separately from water quantity projects (see **Water Quality Capital Improvement Plan**), as infrastructure [CIP](#) projects to address flooding or stormwater conveyance remediation concerns are developed, the Town will seek opportunities to incorporate water quality improvements and will aim to minimize any negative impacts to downstream water quality conditions. Stream bank erosion represents one area of potential overlap between infrastructure and water quality concerns. Within this CIP policy, erosion is considered problematic if it presents a threat to the integrity of a structure. However, stream degradation ranks as a very serious water quality concern regardless of proximity to structures. A potential stream stabilization and/or restoration project could rank low within this CIP policy, but warrant funding under a water quality CIP prioritization framework.

Stormwater Problem Classification

The Stormwater Problem Classification is a quick ranking system that can be used by responders to resident complaints, as well as a “first flush” classification for the backlog of historical problems. Routine maintenance may be performed in response to relatively minor complaints, but further consideration for significant repairs or a [CIP](#) project will only proceed for problems ranked as A or B.

Table 2-1. Stormwater Problem Classification Table

Problem Classification	Conditions Observed – Rate for Highest Applicable Classification
A	Finished floor space of a habitable structure has been flooded Overtopping of road(s) has been observed more frequently than applicable design criteria allow Erosion or sinkhole observed within 10 feet of a roadway or structure or otherwise presenting a public safety or property damage risk Structural integrity of drainage infrastructure is compromised and failure would affect public safety and access
B	Flooding of habitable structures inside of foundation walls has been observed Property is subject to frequent and extensive yard flooding Sinkhole over drainage pipes, but not adjacent to road or structure Erosion >10’ from roadway or structure, but in a location that may present a future threat to public safety or to structures Structure shows sign of problems that warrant an inspection/rating
C	Nuisance flooding Erosion not causing safety problem
WQ	Water quality problem (note pollutant of concern)
I	Ineligible for stormwater utility fund expenditures



Conveyance System Remediation CIP Prioritization

The Town maintains a network of stormwater pipe systems within the rights-of-way of Town streets. [NC DOT](#) is responsible for drainage infrastructure within its rights-of-way. Natural stream channels constitute another element of the stormwater conveyance system. When the structural integrity of a culvert or pipe reach is compromised such that a roadway may be threatened and/or stormwater conveyance is impeded, remediation to improve, replace or upgrade the infrastructure is required. Conveyance system remediation may also include measures to address stream bank erosion that threatens a roadway or structure. A failing [catch basin](#) or [headwall](#) would typically be addressed by the Town crew as a maintenance repair and would not warrant consideration in the [CIP](#).

Conveyance system repair and/or replacement needs will most often be manifest through inspection programs. The Town contracts with [NC DOT](#) for biannual inspections of some of the major culvert crossings on Town-maintained streets in Chapel Hill. In addition, the Town is beginning to develop an inspection monitoring program for additional culvert crossings to assess structural conditions. As the inspection program ramps up, the Town will follow the inspection prioritization plan described in the section on Transition to Proactive Maintenance Program. Some pipe or channel deterioration problems may be identified from resident reports.

Problem scores for culvert conditions or stream channel erosion problems are to be assigned based on the following tables.

Table 2-2. Erosion Rating Table

Rating	Condition Description
10 - Fair	Erosion is not within ten feet of a roadway or building, and doesn't present a threat to structural integrity at this time. Periodic inspections may be warranted to assess rate of erosion that is occurring.
20 - Poor	Erosion is within ten feet of a roadway or building and/or severity of erosion could threaten structural integrity of roadway or building.
30 - Critical	Erosion is within two to three feet of a roadway or building and/or presents a critical threat to structural integrity.
Emergency Project - pulled from CIP rating & expedited	Erosion is undercutting a roadway or building OR proximity and severity of erosion presents an urgent threat to structural integrity of roadway or building.



Table 2-3. Culvert Condition Rating Table

Rating	Condition Description
Good	No problems noted.
Fair (corresponds to NC DOT 6 or higher)	May have some deterioration or initial disintegration, cracking, or spalls on concrete or masonry walls and slabs. Local minor scouring at curtain walls, wingwalls, or pipes. Metal culverts have a smoothly curved shape but may be non-symmetrical. Some corrosion and pitting may be present.
Poor – should be rated as to extent of problem	
10 – Significantly Degraded (corresponds to NC DOT 5)	Moderate to major deterioration or disintegration, extensive cracking and leaching, or spalls on concrete or masonry walls and slabs. Minor settlement or misalignment. Noticeable scouring or erosion at curtain walls, wingwalls or pipes. Metal culverts have significant distortion and deflection in one section, significant corrosion or deep pitting.
20 – Serious (corresponds to NC DOT 4)	Large spalls, heavy scaling, wide cracks, considerable efflorescence, or opened construction joint permitting loss of backfill. Considerable settlement or misalignment. Considerable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection throughout, extensive corrosion or deep pitting. Undermining of pipe may be occurring. In open areas, small sinkholes may be present, indicating probable joint separation or other localized pipe failure.
30 – Critical (corresponds to NC DOT 3)	Any condition described under "Serious" but which is excessive in scope. Severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe erosion or scour at curtain walls, wingwalls, or pipes. Metal culverts have extreme distortion and deflection in one section, extensive corrosion, or deep pitting with scattered perforations. Evidence of severe undermining, such as significant flow observed outside of pipe at outlet. Multiple and/or large sinkholes along pipe alignment in an open area not threatening a roadway or structure (i.e., not causing an emergency situation)
Emergency Project - pulled from CIP rating & expedited (corresponds to NC DOT 2)	<i>Emergency action required (e.g., road closure).</i>



Based on the condition or erosion rating scores, the following procedure is the basis for prioritization of the proposed capital improvement project to address the problem. The prioritization is a function of the problem score, with additional consideration for roadway use, and for maintenance frequency and flooding concerns associated with the existing problem.

1. Apply factor of 100% to rating score for arterial streets and/or transit routes, 80% for collector streets and 60% for local streets. A collector or local street which is the single ingress/egress route for public facilities and/or service vehicles may also be scored at 100%. Score will range from 6 to 30.
2. Add up to five points for maintenance frequency.
 - 5 – excessive maintenance is required and/or frequent complaints received*
 - 3 – non-routine maintenance is frequently required*
 - 1 – non-routine maintenance is sometimes required*
3. Add up to five points for flooding problems.
 - 5 – road overtopping or structure flooding experienced or expected in 10% annual chance event*
 - 3 – road overtopping or structure flooding experienced or expected, but less frequently than 10% annual chance event*
 - 1 – excessive and frequent ponding on road or flooding in yard or parking area*
4. Add the values from 1, 2, and 3 to total project score.

Although the prioritization policy for conveyance system remediation ranks the worst problems as the highest priority projects, there may be situations where addressing a lower-ranked problem will result in considerable cost savings by preventing further deterioration and a more expensive future repair. In these cases, stormwater staff may opt to override the prioritization policy. Justification for doing so requires a documentation of present vs. future cost projections for required remediation.

Flood Mitigation CIP Prioritization

The flooding of homes, businesses, infrastructure and property can be related to inadequate conveyance of runoff from the immediate area into or through a pipe or channel, or it can be a result of heavy rainfall several miles away which results in a stream overtopping its bank and inundating the [floodplain](#) areas. As noted in Figure 2-1, flooding problems within [FEMA](#) 1% annual chance floodplain areas along a stream will be addressed under the Town's Flood Hazard Mitigation Program. Localized problems related to inadequately-sized drainage infrastructure will be addressed as part of the Infrastructure [CIP](#). The Town's standards for the design of roadways include measures to limit the frequency and extent of flooding on roadways. A road may frequently overtop because the culvert crossing for the stream running beneath it is too small. The outer lane of a road may pond water at the low point because the inlets and/or the pipe draining the road is/are undersized. However, it is important to note that NO drainage systems are designed to prevent ALL flooding. Instead, a defined level of flood risk is built into all design standards. Table 2-4 lists different levels of flood risk for structures and roadways, which is a predictor of how often the road or structure will be flooded. Points are assigned for flood risk levels considered undesirable, serious, or severe. For a flood-prone area, the flood risk for structures or roadways should be added to compute a total flood problem score.



Table 2-4. Flood Risk Rating Table

	Acceptable Flood Risk (Annual Chance)	10 Points- Undesirable Flood Risk (Annual Chance)	20 Points- Serious Flood Risk (Annual Chance)	30 Points- Severe Flood Risk (Annual Chance)
Habitable Structures – Finished Floor	<1%	≥1%, but <2%	≥2%, but <4%	≥4%
Habitable Structures - Damage to Equipment inside foundation walls	<2%	≥2%, but <4%	≥4%, but <10%	≥10%
Arterial/Collector Street – Overtopping at Stream Crossing	<2%	≥2%, but <10%	<3" in 10% storm	>3" or > 30 min duration in 10% storm and/or overtops in 20% storm
Local Street – Overtopping at Stream Crossing	<2%	≥2%, but <10%	<6" in 10% storm	>6" or > 1 hr duration in 10% storm and/or overtops in 20% storm
Arterial/Collector Street – Flooding encroaches into two- way travel lanes (18 foot width)	<2%	≥2%, but <4%	≥4%, but <10%	≥10%
Local Street – Flooding encroaches into one-way travel lane (9 foot width)	<2%	≥2%, but <10%	≥10%, but <20%	≥20%

Because private property owners and [NC DOT](#) also own portions of the stormwater conveyance system, not all flooding problems can be addressed by a Town-funded project. Where NC DOT owns an undersized culvert, or a portion of a drainage network requiring improvements, approvals and appropriate funding will need to be coordinated between the Town and NC DOT. Where a portion of a drainage network is on private property and in some situations, the Town may seek to develop a mutually acceptable cost-sharing arrangement for addressing flooding problems.

For flooding problems for which a straightforward solution cannot be readily identified without further study, the Town will prioritize funding for study and planning based on the flooding problem score. Conceptual plans and project budgets will be developed for the remaining



flooding problems. Potential improvement projects will lessen, but not eliminate, the risk of flooding to structures and roadways. The project area will be re-scored for post-project flood risks. Ranking of flood mitigation projects will be based on flood reduction benefit, computed as a difference between existing flooding risks and projected post-project flood risk.

The post-project flood risk for each roadway and structure associated with a [CIP](#) flood mitigation project will be scored based on Table 2-4. Projects will be prioritized based on the difference between the pre-project and post-project problem score, a measure of the projected benefit of the flood mitigation project.

Targets and Budget

A limited number of proposed infrastructure CIP projects have been identified in the initial CIP planning and the preliminary budget to implement these projects totals over 4.5 million dollars. The existing stormwater program funds about \$100K per year of infrastructure repairs, rehabilitation, and improvements. For planning purposes, that \$100K annually is designated towards the Infrastructure CIP. The target plan (Model A) for infrastructure CIP projects would initially add another \$100K per year to the existing budget, ramping up to an additional annual budget of \$500K over the following four years, for a total budget of \$600K per year. The long-term plan is to sustain funding and project implementation at that level. If stormwater funding is less than projected, the Town will lack the necessary resources to replace failing infrastructure and address long-standing flooding problems. Under Financial Analysis Model B, the infrastructure CIP budget is maintained at the current level of \$100,000 annually.

Table 2-5. Implementation Costs for Enhanced Infrastructure CIP

		Model A*	Model B
Year 1	Program Expenses (in addition to \$100K current budget)	\$100,000	
	Additional Full-Time Equivalent Operations Staff	0.25	
Year 2	Program Expenses (in addition to \$100K current budget)	\$200,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 3	Program Expenses (in addition to \$100K current budget)	\$300,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 4	Program Expenses (in addition to \$100K current budget)	\$400,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 5	Program Expenses (in addition to \$100K current budget)	\$500,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	

**Additional to current annual infrastructure improvement budget of \$100,000 per year*



Drainage Partnership Program

The Stormwater Drainage Partnership Program (DPP) is intended to provide technical and/or financial resources to persons residing and/or owning property in Chapel Hill for assistance in addressing localized drainage problems on private property. Clarification and revitalization of the DPP is a strategic initiative under Goal 2 and directly impacts Key Strategic Measure 4 (flood risk reductions).

Town Council adopted a “Drainage Assistance Policy” in 1994 to provide a cost-sharing program for addressing drainage problems on private property, which is the basis for the DPP. Participation in the Drainage Partnership Program is on a voluntary basis. Several projects have been completed under the program, but the program has never been sufficiently funded to allow for more systematic prioritization and implementation of projects. The DPP strategic initiative establishes some clarifications for the program and a project prioritization system that is consistent with the infrastructure [CIP](#).

The following provides some background information on drainage assistance programs in other North Carolina cities. The types of projects which qualify for the Chapel Hill program, the methodology for prioritizing projects, the procedures for project implementation, and the program budget are described.

Drainage Assistance Programs in Other Cities

Several cities in North Carolina have some form of a public/private joint funding of drainage projects. The programs in Raleigh and Winston-Salem are only for residential properties. The Charlotte and Cary programs are applicable to all drainage projects on private property. Greensboro previously had a drainage assistance program, but discontinued cost sharing in favor of an “all-or-nothing” funding policy for addressing drainage problems on private property.

Charlotte doesn’t separate drainage projects on private property from those on public property. It prioritizes CIP projects by neighborhood watersheds and obtains donated easements for all drainage pipes and channels when undertaking a CIP project. Smaller projects (\$30K-\$100K) are categorized and budgeted separately. If a property owner is willing to cover 50% of costs, the funding prioritization for the associated project is moved up and the project is done as soon as possible. The City expects property owners to handle day-to-day maintenance of drainage features, but the City takes on responsibility for future remediation that may be required.

Cary’s policy states that the property owner is required to pay 50% of projects on private property, and allows for payment over a five-year period for owner costs of \$11,000 or less, and a ten-year period for larger costs. Cary will consider buyouts if improvement costs approach the value of property. It will replace pipes only when “structural flooding or severe erosion which impacts the structural integrity of a habitable structure is involved.” In prioritization of projects, finished floor flooding is scored more highly than crawl space/outbuilding flooding. Cary’s policy specifically states that the “Town accepts no responsibility to maintain any storm drainage on privately owned property.” Cary requires the property owner to sign a maintenance agreement.



Winston-Salem's policy is specific to residential property owners only and specifies that the residential property must be owned by the occupants and be at least two years old. Projects must be under \$50,000, and the property owner pays 30% of project costs. In order for a project to qualify for the program, the assistant city manager for public works must determine that the drainage problem causes flooding in the dwelling or otherwise threatens the structural integrity of the dwelling, causes severe erosion of the drainageway, threatens to deny access to property that would be accessible, or impedes the flow of water due to fallen brush and vegetative debris. Projects are subject to approval by City Council.

Greensboro previously had a drainage assistance program, but later concluded that the administrative costs and the problems associated with its drainage assistance outweighed the financial benefit of the cost participation of property owners. The City now has a policy where it addresses and fully funds drainage improvements on private property, if there is public runoff and if the problem is a public safety issue or is causing property damage. The reduced interaction with property owners enables the project to be carried out more efficiently than under the previous policy.

The City of Raleigh has a detailed drainage assistance policy, updated in 2010, with separate sections for open channel problems, dredging requests, and issues related to pipes. The City covers 100% of costs for projects to relieve street flooding. If there is no street flooding, property owners pay 15% on projects to address structural flooding problems and 20% on projects to address severe erosion. A cap of \$5,000 per property owner applies. Raleigh's definition of "structural flooding" includes sheds and outbuildings on a permanent, enclosed foundation that cannot be easily moved. Raleigh requires 10% deposit which won't be refunded once City has incurred design costs, etc. Homeowners have 6 months to decide whether to proceed or the project is terminated. The homeowners have to pay their total share before construction starts or have an executed agreement to pay in installments, which puts a lien on the property. Raleigh requires the homeowner to sign a maintenance agreement and a release for the City from any liability related to the project. Project agreements are filed with the County Register of Deeds to give notice to subsequent purchasers of all conditions set forth. Raleigh is currently spending about \$750K a year on drainage assistance. About 70-80% of projects are to address severe erosion. It also provides assistance on public safety or mandated projects such as dam repairs. Raleigh has also recently begun a grant-funded homeowner assistance program for residential water quality projects, such as rain gardens.

Qualifying Projects

Although the drainage assistance policy adopted by Town Council allows for application of the program to non-residential properties, the policy has historically only been applied to single-family residential properties. Under current funding levels it is only feasible to extend assistance to residential property owners with drainage problems that can be resolved by Town crews and staff without negatively impacting ongoing stormwater operations and maintenance.

The following conditions must be met in order for a project to qualify for consideration under the Drainage Partnership Program:



- The property must receive, convey, and/or interact with public stormwater runoff.
- The property must be residential single-family or duplex.
- Property owners must be up-to-date in payment of stormwater utility fees.
- The drainage conveyance problem must be causing street flooding, structural flooding, or erosion threatening a structure, OR there is no appropriate means of conveying stormwater through the property and the situation was not caused by actions of the property owner.
- The proposed project must not create a circumstance where stormwater creates or worsens a problem on adjacent property.
- The project does not require complex analysis or design, and can be accomplished by Town staff and crews within a timeframe and budget that does not hinder ongoing stormwater operations and maintenance. Projects exceeding these resources may be considered under the Capital Improvement Program.

The scope of Town involvement in any drainage partnership project may vary from technical advice to design, construction, and maintenance of drainage improvements. As with past projects, property owners will cover the cost of materials (e.g., pipe, riprap, seed and mulch) and the Town will provide labor and equipment.

Project Prioritization

The Town will develop and regularly update a “Master [DPP](#) List” of stormwater improvement projects generated from property owner requests and/or known drainage problem areas. The costs, staff time, and other resource needs associated with proposed Drainage Partnership Program projects will generally exceed the amount of funding and resources available, thus an equitable, objective, and effective project prioritization procedure is required.

The DPP Rating System is designed for consistency with the Infrastructure Capital Improvement Project (CIP) Rating System while incorporating elements that are unique to the DPP. DPP project prioritization is based on an extension of the Stormwater Problem Classification, shown in Table 2-1, developed as part of the [CIP](#) procedures and used for initial categorization of drainage problems. Table 2-6 lists the categories for DPP prioritization, with “A-1” being the type of problems to be addressed as highest priority.

Project Procedures

In response to a resident report, staff will investigate the drainage problem and determine the appropriate action and the project prioritization. Projects to address street flooding or other public safety risks will be ranked based on the CIP scoring procedures, and there will be no cost to the homeowner.

For projects where there is no flooding or risk to public facilities, the staff will notify the property owner(s) of the proposed project to address the drainage problem, the probable cost share to be covered by the resident(s) and the likely implementation schedule. The property owner(s) must then send a written request to the Town for the proposed project to be



Table 2-6. Drainage Partnership Project Rankings/Prioritization

Problem Classification	Conditions Observed – Rate for Highest Applicable Classification
A-1	Flooding of finished floor of habitable structure has been experienced or is projected in a storm event with an annual risk of 10% or more.
A-2	Imminent risk of damage to habitable structure is posed by streambank erosion or a failing pipe.
A-3	Flooding of finished floor of habitable structure has been experienced or is projected in a storm event with an annual risk of less than 10%.
B-1	Damage to habitable structure (without flood level above finished floor) has been experienced or is projected in a storm event with an annual risk of 10% or more, OR Serious threat of damage to habitable structure is posed by streambank erosion or a failing pipe.
B-2	Damage to habitable structure (without flood level above finished floor) has been experienced or is projected in a storm event with an annual risk of less than 10%, OR Yard is extensively flooded multiple times per year due to lack of appropriate conveyance of public runoff and situation was not caused by actions of property owner, OR Severe erosion and/or pipe failure poses imminent threat to access route for a habitable structure.
B-3	Severe erosion and/or pipe failure poses serious threat to access route for a habitable structure.
C	Erosion or sinkholes are causing property damage, but not threatening habitable structure or property access.

implemented, acknowledging their cost share. The proposed project will then be added to the “Master [DPP](#) List.” Two to three months prior to project construction, approved program participants must provide written agreement to pay for their share, and must execute a right-of-entry form allowing Town forces to enter their property and holding the Town harmless from liability for the improvements and/or related construction activity. The Town will typically require that the property owner also sign a maintenance agreement. The Town may, at its discretion, accept all or part of the improved drainage facility for maintenance, subject to provision by the property owner(s) of all necessary drainage, access, and maintenance easements. All required forms and agreements must be submitted to the Town prior to initiation of project construction.

Targets and Budget

The drainage partnership program is proposed to be funded at \$50,000 per year, with a maintenance staff person available half-time for investigations, prioritization and oversight of



[DPP](#) projects. This staff member would also manage the Small Maintenance Projects Program. Under Financial Analysis Model B, the \$50,000 annual budget for projects is retained and would be managed with existing staff. The additional staffing is not funded until Year 4.

Table 2-7. Implementation Costs for Drainage Partnership Program

		Model A	Model B
Year 1	Program Expenses	\$50,000	\$50,000
	Additional Full-Time Equivalent Maintenance Staff		
Year 2	Program Expenses	\$50,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	
Year 3	Program Expenses	\$50,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	
Year 4	Program Expenses	\$50,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	0.25
Year 5	Program Expenses	\$50,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	0.5



Water Quality Capital Improvement Program

State and federal mandates have necessitated that the Town plan and construct water quality capital improvements to mitigate some of the impacts of urbanization on the Town's streams, which are tributary to Jordan Lake. Most segments of the major streams traversing through Chapel Hill have been listed by the state as being impaired for support of aquatic life, due to low [benthic](#) scores. In some streams, problems with bacteria or other pollutants have also been cited. The [Jordan Lake Rules](#) will require that local governments implement measures to reduce nitrogen and phosphorus exports from areas of existing development. The Town will be required, beginning with Stage 2 of the existing development rule, to reduce nitrogen exports by 8% and phosphorus exports by 5%. Stage 3 will increase the nitrogen reduction requirement to 35%. Stage 2 goes into effect if Jordan Lake water quality improvements are not achieved by March 2017¹ and Stage 3 is similarly tied to March 2026¹ monitoring results. Although the requirements for addressing water quality problems in local streams are not as explicit as the Jordan Lake Rules, municipal stormwater programs in areas with [303\(d\)](#) listed streams are expected to incrementally address the stream degradation problems. Failing to do so increases the likelihood that [EPA/NC DENR](#) will implement a TMDL for the impaired streams and enforce a specific schedule of improvements.

The proposed Water Quality Capital Improvement Plan ([CIP](#)) is broad in scope, intended to address the following Master Plan strategic objectives:

3.2 - Mitigate cumulative water quality and erosion impacts of historically uncontrolled runoff from existing development including public roadways.

4.3 - Restore natural streams and stream buffers in concert with watershed management and restoration.

7.2 - Comply with requirements of the [NPDES](#) Phase II Permit, Water Supply Watershed Rules and the Jordan Lake Rules.

It is expected that projects implemented under the Water Quality [CIP](#) will be the primary driver for improvements in Key Strategic Measures 1 (*stream conditions*) and 2 (*reduced exports of nutrient exports*).

Jordan Retrofits

The primary requirement for compliance with the Jordan Lake Existing Development Rule will be construction of retrofit [BMPs](#). Most stormwater BMPs have been constructed in conjunction with a commercial or residential development project. BMPs are termed "retrofit" if they are installed or re-configured to control and treat runoff from an area of existing development. Retrofits include both new facilities and upgrade or expansions of existing stormwater facilities.

¹ Session Law 2013-395 (Senate Bill 515) delayed additional implementation of the Jordan Lake Rules and Session Laws by three years. Stage 2 is delayed from March 2014 until March 2017 and Stage 3 from March 2023 until March 2026.



Siting and constructing retrofits presents a number of challenges, including utility conflicts, limited space, and limited access. In many cases, retrofits are much more expensive to install than comparable BMPs constructed at the time of site development.

Types of [BMPs](#) for which calculation methodologies for nutrient reduction credits have been partially developed include wet ponds, extended detention facilities, stormwater wetlands, vegetated filter strips, bioretention, grassed swales, green roofs, porous pavement, sand filters and water harvesting. The Nutrient Scientific Advisory Board is tasked with extending crediting guidelines to include other types of structural and non-structural BMPs, such as street sweeping, roof disconnections, stream restoration, and buffer restoration.

Based on BMP research in regard to nutrient removal effectiveness and typical costs, stormwater wetlands have been shown to be one of the more cost-effective types of retrofit BMPs. Bioretention and porous pavement are also frequently suggested as retrofit options, but cost data indicates they can be as much as 10-12 times as expensive per volume of treatment capacity as a wet pond or stormwater wetland.

Bolin Creek Watershed Restoration

Potential sites for stream restoration and stormwater BMPs have been identified in the Bolin Creek watershed. In 2004, [NC DENR](#)'s Ecosystem Enhancement Program (EEP) funded development of a local watershed plan for Morgan and Little Creeks. The Little Creek watershed includes Bolin and Booker Creeks. This study examined probability of worsening conditions and used a GIS method to identify potential sites for stream restoration or BMP installation. The BMP sites were tied to favorable technical and logistical conditions rather than identified sources of pollutants or excessive runoff that might be the causes of identified stream impairments. However, potential sites for stream restoration were identified in the *2004 Morgan Creek Local Watershed Plan Targeting of Management Report*.

The Towns of Carrboro and Chapel Hill, in partnership with [EPA](#) and NC DENR, established the Bolin Creek Restoration Team in 2006. They secured EPA 319 grant funding in 2007 for development of a *Bolin Creek Watershed Geomorphic Analysis and Potential Site Identification for Stormwater Structures and Retrofits*. This study included streamwalks of most of the Bolin Creek watershed and identification of areas appearing to suffer from geomorphic instability, with a suggested set of promising BMP retrofit projects that might address some of the identified problems.

Bank erosion was identified in the geomorphic analysis as the probable largest stressor of the biological community in streams within the Bolin Creek watershed because of the large amount of sediment that is exported through bank wasting processes. Causes of the widespread bank erosion include direct impacts through channelization, instability from poor culvert design, extensive clearing of riparian zones and direct stream crossings for sanitary sewer lines, and indirect effects in otherwise undisturbed areas from migration of instabilities created elsewhere in the watershed. The hydrologic changes associated with urban development often destabilize the dynamic geomorphic equilibrium of natural streams, triggering a predictable process of



downcutting and stream bank erosion. The stream restoration and bank stabilization projects in the report were scored based on sediment impacts (erosion prevention).

The group later obtained an additional [EPA](#) grant to facilitate implementation of a few of the recommended projects. A stream restoration effort in Baldwin Park was completed, but a second phase of the project, gully repair and bank stabilization on a tributary of Mill Race, could not be implemented because some of the surrounding property owners would not grant the needed access easements. Stormwater BMP retrofits at two Chapel Hill municipal sites and a stabilization of a much smaller tributary to Bolin Creek were substituted for the originally planned improvements. Planning and prioritization of future stream restoration and other types of water quality improvement projects will include education and involvement of affected property owners at the earliest phases and will likely favor projects that affect fewer property owners. Also, ongoing public education efforts will hopefully raise environmental awareness in regard to streams and water quality such that property owners are more cooperative.

This project also required the creation of a Bolin Creek Watershed Restoration Plan that identified stressors and sources, potential methods or projects to correct stressors, prioritization of projects and implementation steps, and monitoring and education efforts to support implementation. It identified the Middle Bolin Creek subwatershed, in particular the areas of high development density on the southern side of the creek, as the primary source of Bolin Creek's impairment in Chapel Hill. The subwatershed just upstream of this was identified as the primary source of impairment in Carrboro.

Two streams in the southern part of the Middle Bolin Creek subwatershed - Tanyard Branch and Mill Race Branch - have been found through macroinvertebrate monitoring to be the tributaries of Bolin Creek with the worst water quality. These streams drain the oldest parts of Chapel Hill, and include the highly commercialized and impervious downtown area. Small sanitary sewer leaks, cross-connections, and illicit discharges are common throughout. The plan recommends as the highest priority for Bolin Creek restoration in Chapel Hill the installation of regional stormwater retention BMPs for these two streams. Such BMPs would address the multiple water quality stressors present in these areas, and would have the added benefit of meeting Jordan Lake Rules retrofit requirements. Implementation of these projects will require considerable technical analysis to identify optimal locations and methods of stormwater management in these areas, thus Middle Bolin Creek has high priority for upcoming subwatershed studies.

All three of these efforts identified a number of potential sites for retrofit BMPs. Because retrofits installed in the Bolin Creek watershed will contribute to Bolin restoration as well as the Jordan Lake nutrient reduction goals they should be a focus of initial retrofit planning efforts. Any further planning and prioritization of stream restoration and other water quality improvement projects will include education and involvement of affected property owners at the earliest phases and will likely favor projects that affect fewer property owners. Also, ongoing public education efforts will hopefully raise environmental awareness in regard to streams and water quality such that property owners are more cooperative. Alternative incentive programs such as reverse auctions may encourage a sufficient number of property owners to participate in



smaller projects, thus increasing the visibility of the Program and encouraging further participation.

Summary of Next Steps for Retrofit Prioritization

One of the major obstacles to retrofit installations is property issues in regard to ownership, access, and project support. Locating retrofits on public property avoids the needs for purchase and can also allow for installation of public education signage and/or public art in conjunction with the project. Therefore, an initial step in retrofit planning should be a review of all municipal properties for potential retrofit sites, especially stormwater wetlands. Possible sites should be classified relative to potential BMP size, contributing drainage area, and percent impervious cover in the drainage area. In general, the cost-effectiveness of a BMP increases with the size of the BMP, the size of the contributing drainage area, and the percent of impervious cover within the drainage area.

A second step is to develop a database of existing stormwater ponds which were not constructed as BMPs (i.e., design requirements did not include post-construction water quality benefits). Where contributing drainage areas have at least 20-25% impervious cover, the feasibility of upgrading the facilities to incorporate or improve nutrient reduction should be assessed. Upgrading existing facilities is expected to be more cost effective than constructing new ones, particularly where a single property owner or a homeowners' association is involved and the Town can offer benefits such as enhanced aesthetics.

Three of the more cost-effective BMPs from the Ephesus subwatershed plan were submitted to [NC DWR](#) as potential sites in the 2011 Jordan Annual Report. For the 2012 Report, the Town submitted documentation on three of the retrofits installed under the [EPA](#) 319 grant. The 2013 report listed three additional BMPs from the Ephesus subwatershed plan. Additional BMP sites will be identified as other subwatershed plans are completed.

Subsequently, additional guidance from NC DWR is expected to be provided to local governments on development of retrofit BMPs and how they will be credited towards nutrient reduction goals. More specific retrofit prioritization criteria can be implemented accordingly.

Targets and Budget

Under Financial Analysis Model A, an additional stormwater engineer is scheduled to be added to the Stormwater staff about mid-year during Year 1 to devote ½ time to overseeing the Water Quality [CIP](#). A water quality specialist, also devoting half-time to the CIP, would be hired in Year 2. The Year 1 planning and construction budget is \$150,000, with a Year 2 budget of \$450,000 and \$500,000 per year for all subsequent years.

Financial Analysis Model B proposes hiring of the stormwater engineer to be deferred to midway into Year 2 and doesn't provide for a water quality specialist. The planning and construction budget for Year 1 is \$100,000, gradually increasing to a level of \$275,000 in Year 5. The



extended forecast for Model B would continue gradually increasing of funding up to the \$500,000 per year level over the following 5 to 8 years.

Table 2-8. Implementation Costs for Water Quality Capital Improvement Program

		Model A	Model B
Year 1	Program Expenses	\$150,000	\$100,000
	Additional Full-Time Equivalent Operations Staff	0.25	
Year 2	Program Expenses	\$450,000	\$150,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	1.0	0.25
Year 3	Program Expenses	\$500,000	\$175,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	1.0	0.5
Year 4	Program Expenses	\$500,000	\$225,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	1.0	0.5
Year 5	Program Expenses	\$500,000	\$275,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	1.0	0.5



LUMO and Engineering Design Manual Updates

As part of the Stormwater Program’s efforts to “regulate and guide new development and redevelopment” such that stormwater management is consistent with the Program Goals, the [LUMO](#) and the Engineering Design Manual both need to be updated. These updates will indirectly contribute to Key Strategic Measures 1 and 2 by providing some additional water quality and stream protections and incentives.

LUMO Update

The addition of Jordan Lake Nutrient Strategy requirements to the Town’s existing [LUMO](#) and stormwater-related ordinances and guidelines has resulted in a set of rules and guidelines that lacks adequate clarity, particular in the application of riparian buffer rules as related to Jordan Lake and LUMO requirements. The goal of updating the LUMO will be to provide a unified set of stream buffer regulations that meets or exceeds the Jordan Lake rules, while also retaining the higher restrictions of the existing LUMO requirements where advisable. One aspect of the LUMO update will be publication of reference map that includes all stream determinations which have been completed. Staff has also expressed a need to modify the LUMO’s RCD requirements with respect to base flood elevations, as the current requirement can be overly restrictive in some areas.

As part of the [LUMO](#) update, the Town may also want to consider some changes which will allow alternative street and drainage design for developers wanting to incorporate certain types of stormwater infiltration and treatment practices into their projects, such as roadside swales instead of the standard curb and gutter, or streets with a bioretention median to collect and treat runoff. These types of practices provide significant runoff reduction and help to more closely preserve the pre-project flow regime of a site.

An example of a completed initiative is the removal of the requirement for stormwater management controls on individual single-family residential projects that disturb less than 20,000 square feet of land. The revised performance standard for these exempted residential projects is to discharge runoff in a non-erosive and diffuse manner. This can be accomplished by using measures, or some combination of measures, that include energy dissipators, grading, level spreaders, and rain barrels or chains.

Engineering Design Manual Update

The current Engineering Design Manual was developed in 2005. The Jordan Lake rules have resulted in some additions to the stormwater requirements for new developments and these requirements have yet to be incorporated into the Manual. Other practices already adopted by the Town’s Stormwater Program, such as a requirement to evaluate downstream impacts, are not fully described in the Manual. As with the [LUMO](#) update, the primary goal of the Engineering Design Manual would be to improve the clarity of requirements and guidelines for new development and re-development projects.



It is recommended that the Engineering Design Manual update also include requirements aimed at improving soil management as a site is being developed. The topsoil stripping and soil compaction that often occurs as a site is being developed have long-term negative impacts for the stormwater system: more runoff occurs because the soil is compacted and the compaction and lack of topsoil make it difficult to establish and maintain vegetation. Property owners may tend to over-fertilize in a frustrated effort to establish and maintain turf in poor soil conditions. The poor ground cover can also exacerbate erosion problems. Possible requirements to be considered would be stripping and replacement of topsoil, minimization of disturbed areas, and/or re-tilling the ground before permanent seeding is done.

Another area where design guidelines could be improved is in the design of culvert crossings. Research is providing new insights on how the shape, slope and elevations of a culvert impact the geomorphic stability of a stream. [NC DWR](#) is typically requiring that a culvert carrying low flow be placed a foot below the stream grade with a downstream baffle to facilitate the build-up of sediment in the culvert bottom. The intent of this requirement is to facilitate some level of natural habitat within the culvert. Within the two watersheds where stream walks were conducted as part of the master plan was an array of different types of culvert designs. In several places there are indications of negative stream impacts related to culverts. Figure 2-2 shows examples of some of the culverts observed. It is recommended that the Engineering Design Manual update incorporates additional requirements on how culverts are placed, such that they are more consistent with the longitudinal profile and natural channel geometry of the stream.

As research continues on various stormwater management practices, the Town's design guidelines can be improved to incorporate recommendations resulting from the latest research.

Targets and Budget

Updates to the [LUMO](#) are targeted for Year 1 and the Engineering Design Manual update is scheduled to be completed in Year 2. The proposed budget includes \$50,000 for this effort, spread over two years. In Financial Analysis Model B, there is no funding designated to this initiative within the 5-year planning window.

Table 2-9. Implementation Costs for LUMO and Engineering Design Manual Updates

		Model A	Model B
Year 1	Program Expenses	\$25,000	
Year 2	Program Expenses	\$25,000	



Triple CMP Arch Pipes with Sedimentation at Tinkerbell Road



Four RCP Pipes with Excessive Sedimentation at Boxwood Drive



RCP Pipes with Tapered Invert at Northfield Drive



Double CMPs Projecting from Fill at Dixie Lane



Triple Box Culvert with Sedimentation at Parkfield Drive



RCPs with Different Sizes and Inverts at Weaver Dairy Road Extension

Figure 2-2. Photos of Culverts Observed in Pilot Basins



Continued Development of Subwatershed Plans

The Town of Chapel Hill has been developed for more than two hundred years, which has yielded a wide variety of levels of service in regard to drainage conveyance capacity and stormwater quality impacts. The oldest areas generally have failing and undersized pipes, with streets paved multiple times, sometimes almost to the top of the curb. Development in some of these areas is very dense, and there are no stormwater measures to control peak runoff or pollutants. Most of Chapel Hill has been developed as residential areas, which vary widely in regard to stream buffers, street and stormwater conveyance design, and stormwater control facilities. For these reasons, it is important to specifically assess the stormwater concerns in each area and develop appropriate subwatershed plans for infrastructure and water quality improvements.

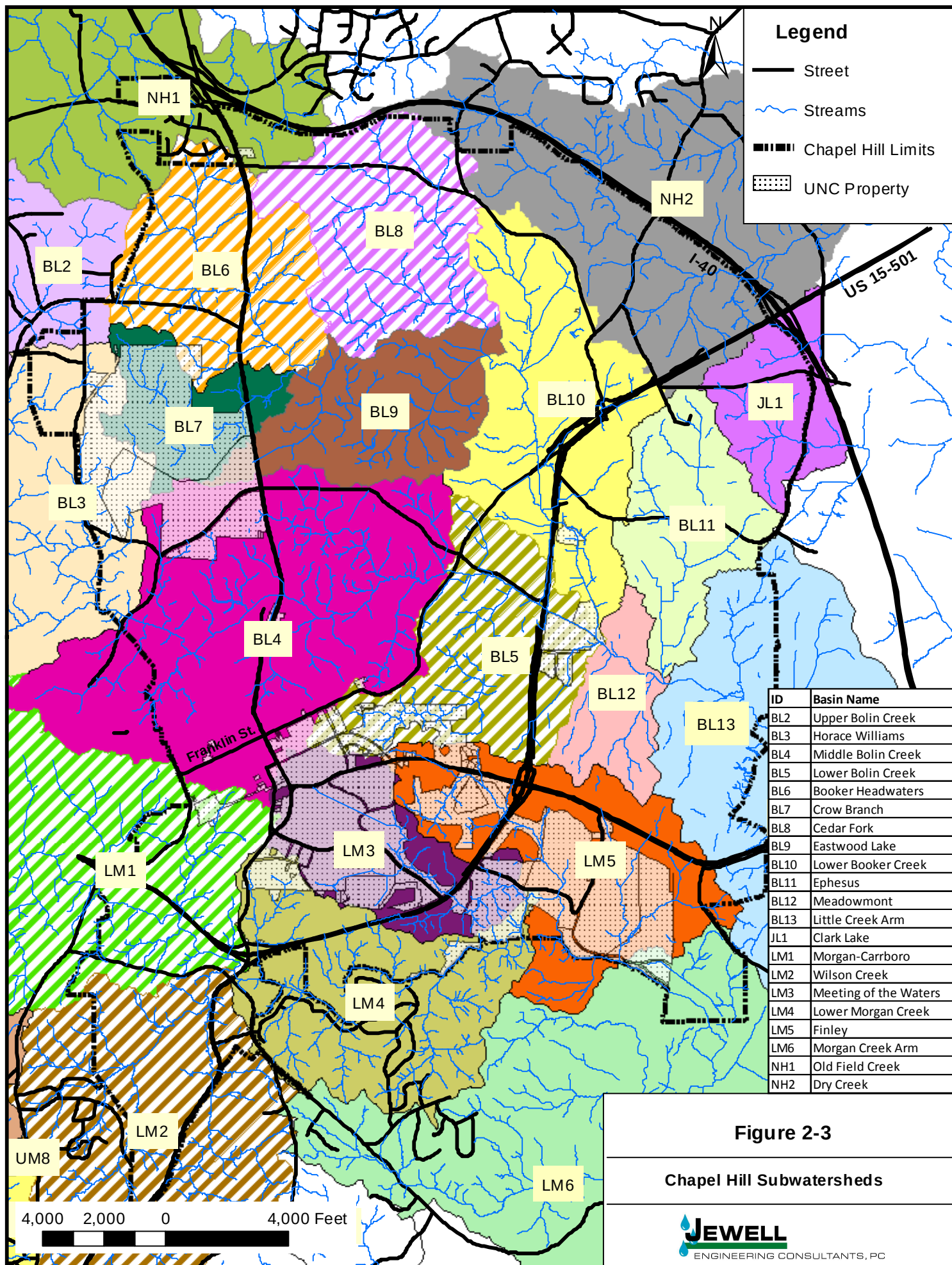
Continued development of subwatershed plans is a strategic initiative under Goals 2, 3, and 4. The process of identifying and reviewing problems, assessing flooding and water quality issues, and developing integrated subwatershed plans for improvements will gradually add to the master plan project lists for the infrastructure and water quality [CIPs](#) and the [DPP](#). The completed subwatershed plans will provide a comprehensive understanding of the scope of potential improvements, facilitating a Town-wide prioritization of proposed projects within the individual programs.

Subwatershed Delineations

Eighteen subwatersheds that lie completely or partially within the Chapel Hill municipal boundary were delineated and named as part of the Ecosystem Enhancement Program (EEP) report developed for Morgan and Little Creeks, and adopted into the Town's Geographic Information System (GIS) stormwater database. Three additional subwatersheds (Old Field Creek, Dry Creek, Clark Lake) are also partially located within the Town. The subwatersheds are shown in Figure 2-3.

Two of the Town's subwatersheds were designated for an initial pilot basin study as part of the Town of Chapel Hill Stormwater Master Plan. The Booker Headwaters (BL-6) and Ephesus (BL-11) subwatersheds were chosen as basins for initial study, because they are representative of typical development in the Town and encompass some different types and ages of development, as well as different natural conditions. Ephesus includes older neighborhoods with minimal stormwater controls and also some extensive multi-family development, while Booker Headwaters has a few stormwater [BMPs](#) in the more newly developed areas and also includes older neighborhoods developed without curb and gutter.

The remaining subwatersheds have been prioritized for future plan development, as listed in Table 2-10 and shown in Figure 2-4. Three subbasins are almost entirely owned by the University of North Carolina (UNC) (LM-3, LM-5, BL-7). For those subwatersheds, as well as several others, only small portions are within the Town's jurisdiction for stormwater management, and they have been combined together with other subbasins for subwatershed plan



ID	Basin Name
BL2	Upper Bolin Creek
BL3	Horace Williams
BL4	Middle Bolin Creek
BL5	Lower Bolin Creek
BL6	Booker Headwaters
BL7	Crow Branch
BL8	Cedar Fork
BL9	Eastwood Lake
BL10	Lower Booker Creek
BL11	Ephesus
BL12	Meadowmont
BL13	Little Creek Arm
JL1	Clark Lake
LM1	Morgan-Carrboro
LM2	Wilson Creek
LM3	Meeting of the Waters
LM4	Lower Morgan Creek
LM5	Finley
LM6	Morgan Creek Arm
NH1	Old Field Creek
NH2	Dry Creek

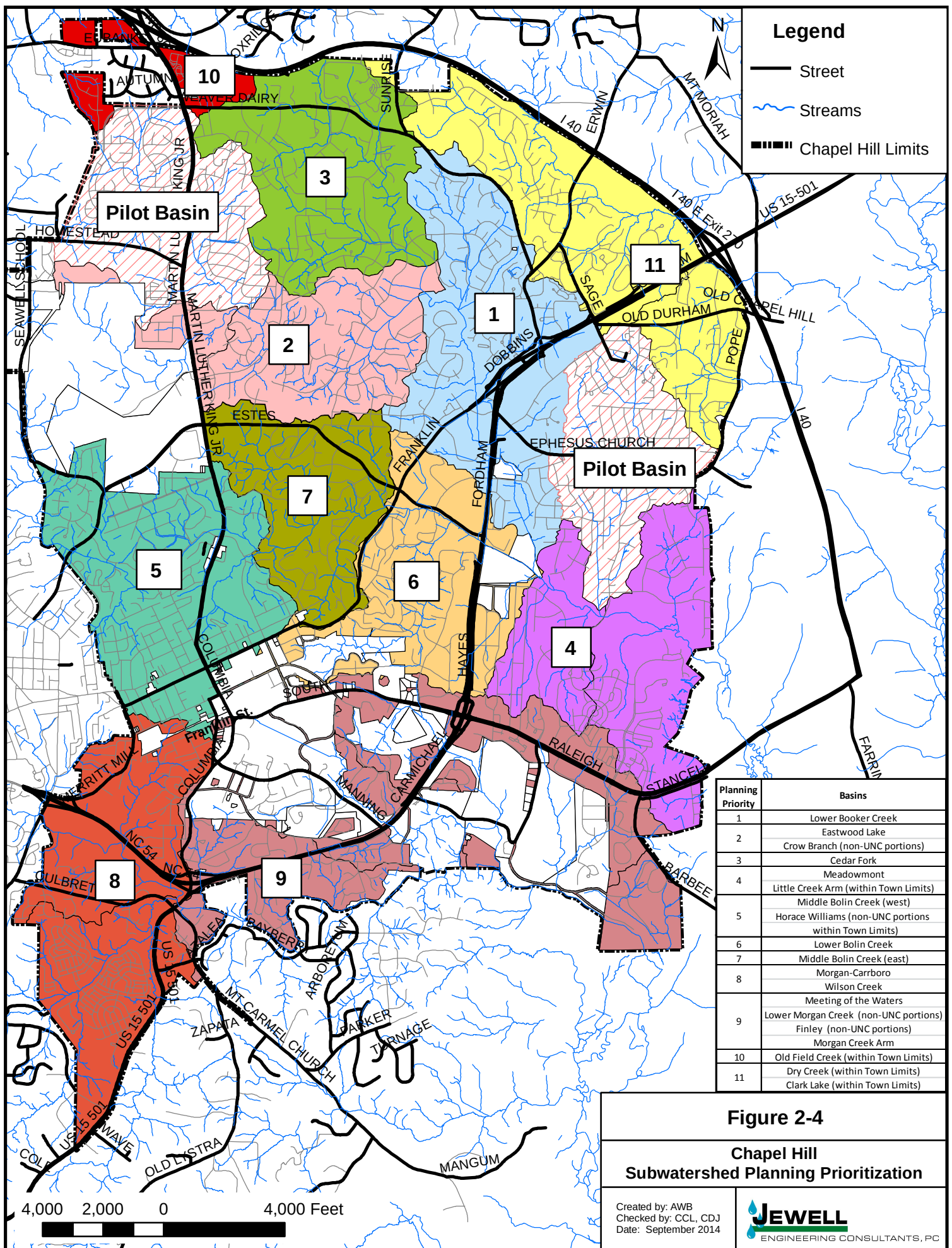




Table 2-10. Grouping and Prioritization for Subwatershed Plans

Priority	EEP/Town Basin IDs	EEP/Town Basin Names
1	BL-10	Lower Booker Creek
2	BL-9 BL-7 (non-UNC portions)	Eastwood Lake Crow Branch
3	BL-8	Cedar Fork
4	BL-12 BL-13 (within Town Limits)	Meadowmont Little Creek Arm
5	BL-4A BL-3 (within Town Limits)	Middle Bolin Creek (West) Horace Williams
6	BL-5	Lower Bolin Creek
7	BL-4B	Middle Bolin Creek (East)
8	LM-1 LM-2	Morgan Carrboro Wilson Creek
9	LM-4 LM-3 (non-UNC portions) LM-5 (non-UNC portions) LM-6	Lower Morgan Creek Meeting of the Waters Finley Morgan Creek Arm
10	NH-1 (within Town Limits)	Old Field Creek
11	NH-2 (within Town Limits) JL-1 (within Town Limits)	Dry Creek Clark Lake

development. It is recommended that Basin BL-4 be split into two separate planning projects, since it encompasses 3.4 square miles and some extensive stormwater conveyance systems.

The proposed prioritization for development of subwatershed plans is based on regulatory mandates, local concerns, and to reflect the direction of the Town Council as contained in a resolution adopted on May 12, 2014. That resolution directed the Town Manager to prioritize the remaining Booker Creek subwatersheds for study and explore upstream stormwater improvements in the Booker Creek Watershed.

The prioritization plan shown in Table 2-10 reflects the following additional goals:

- Mitigate impacts of runoff from areas with a high percentage of impervious cover (IC) and no stormwater controls - High IC areas are known to be associated with flash flooding, stream degradation and high pollutant loadings. The retrofits prescribed for installation under the Jordan Lake existing development rules are generally projected to result in greater runoff volume and nutrient load reductions when sited to capture runoff from high IC areas. The subbasins with the highest percentage of IC are comprised of the downtown district and the areas in and around Eastgate Shopping Center and University Mall.



- Protect and restore Bolin Creek - The BL4 and BL5 subwatersheds, plus a portion of BL3, are the areas within Chapel Hill which drain to Bolin Creek. In planning for further efforts as part of the Bolin Creek Restoration Team, the Town should undertake planning efforts in these subwatersheds as a top priority.
- Seek measures to address flooding concerns - The areas within Town with the most severe flooding concerns are also areas of high impervious cover: parts of downtown, Eastgate Shopping Center, and University Mall.

Subwatershed Planning Tasks

Subwatershed planning should include the following tasks as a minimum. More detailed surveys, analyses and modeling may be required or appropriate for some subbasins.

- Field Reconnaissance/Stream Assessments
- Review of Available Data, Records and Previous Studies
- Field Survey
- Hydrologic and Hydraulic Modeling
- Stream Restorability Evaluations
- Identification of Potential Improvements
- Conceptual Plans for Infrastructure and Water Quality Capital Improvements

Targets and Budget

The proposed schedule and budget (Financial Analysis Model A) is to complete subwatershed plans at a rate of approximately two per year, completing them within roughly a five-year period. Under Financial Analysis Model B, subwatershed planning is deferred beyond the initial five-year planning window.

Table 2-11. Implementation Costs for Continued Development of Subwatershed Plans

		Model A	Model B
Year 1	Program Expenses	\$300,000	
Year 2	Program Expenses	\$300,000	
Year 3	Program Expenses	\$300,000	
Year 4	Program Expenses	\$300,000	
Year 5	Program Expenses	\$300,000	



Transition to Proactive Maintenance Program

The dual objectives of transitioning to a more proactive and integrated drainage maintenance program are long-term cost savings and higher levels of service, both in terms of infrastructure condition and system performance. Cost-effective allocation and application of maintenance resources require adequate knowledge of the locations and conditions of infrastructure components, and the appropriate maintenance practices and repairs for each condition and situation.

The transition to a proactive maintenance program is a strategic initiative related to objectives under Goals 2, 6, and 10. Key strategic measures 3 (*flood risk reductions*) and 5 (*decreases in reactive maintenance activities and repairs*) are directly impacted by efforts related to transitioning to a proactive maintenance program.

Database Development and Inspections

A comprehensive and effective database for managing asset information is the foundation of a proactive maintenance program. Infrastructure component data should include geographic locations, sizes, materials, inspection dates, condition ratings and any associated complaints and maintenance/repair efforts. The Stormwater Division hired summer interns several years ago to perform an initial inventory of the stormwater system. Much of the conveyance system has been mapped, but the initial effort had inadequate QA/QC and didn't fully incorporate condition assessments. Cityworks® software was purchased in 2010 to facilitate a comprehensive asset management system and considerable effort has been devoted to setting up the system framework, but it has not been fully implemented. Portions of the stormwater infrastructure have been inventoried with the proposed Cityworks® database framework and the effort is ongoing. The record-keeping components for citizen complaints, staff responses, and maintenance and repair efforts are being developed.

Ongoing inspections are an essential part of an effective maintenance program, and an initial inspection of each drainage feature is necessary for establishment of a complete database. The Town contracts with the [NC DOT](#) for biannual inspections of twenty major culvert crossings under Town streets. A proposed prioritization ranking for inspections of the other culvert crossings roadways is shown in Table 2-12. The rating table for in-house culvert inspections (see Table 2-3) is a simplified version of the structural rating components of NC DOT's culvert inspection program. In addition to roadway culverts, all corrugated metal pipes need to be prioritized for inspection early in the program. The other components of the drainage network (e.g., small pipes, [catch basins](#), drop inlets) will use an excellent, good, fair, or poor rating as a measure of their condition.



Table 2-12. Procedures for Prioritization of Culvert Inspections

1. Weight culvert crossings by road classification.
5 points: arterial
3 points: collector
1 point: local
Double the point value above if transit route.
Assign a 10-point value to any culvert locations critical for emergency vehicles and/or school access.
2. Rate by maintenance frequency.
3. Weight culvert crossings by road classification.
5 points: arterial
3 points: collector
1 point: local
Double the point value above if transit route.
Assign a 10-point value to any culvert locations critical for emergency vehicles and/or school access.
4. Rate by maintenance frequency.
5 points: excessive maintenance is required and/or frequent complaints received
3 points: non-routine maintenance is frequently required
1 point: non-routine maintenance is sometimes required
5. Rate by flooding problems.
5 points: road overtopping or structure flooding experienced or expected in 10% annual chance event
3 points: road overtopping or structure flooding experienced or expected, but less frequently than 10% annual chance event
1 point: excessive and frequent ponding on road or flooding in yard or parking area
6. Add points for 1, 2 and 3.
7. Inspect highest ranked culverts and score condition per Culvert Condition Rating Table.

The database will include geospatially referenced tracking of locations for complaints and street flooding problems. Staff will also track maintenance efforts in Cityworks® so that the frequency and level of service needed for pipe and inlet cleanouts and repairs are recorded. Over time this will facilitate appropriate scheduling of cleanout frequencies for different parts of Town and will help to determine the most beneficial types of maintenance and repairs. For example, the staff can compare different types of pipe rehabilitation methods relative to the pipe material, age, and condition, developing a growing and well-documented system for prioritizing projects and selecting the most cost-effective solutions.



Planned Maintenance and Repair Program

An additional four-man crew is proposed to be added to the stormwater program to facilitate proactive maintenance of the drainage system. The new crew would add additional capacity for cleanouts and other routine maintenance, and also proactively address repair and rehabilitation needs that are identified as inspections are done and the infrastructure database is expanded. The existing maintenance staff would continue with some of the routine maintenance and with responses to complaints and urgent repair issues, as well having more availability to cover [DPP](#) projects and some of the small maintenance repair projects.

Targets and Budget

The proposed initiative for transitioning to a more proactive maintenance program includes adding another maintenance staff person in Year 1 to perform and/or oversee inspections and to manage the database system. The proposed Year 2 budget includes hiring of four maintenance staff and purchase of a truck around mid-year. The Year 3 budget includes the full four-man crew and purchase of a mini-excavator and trailer. Annual budgets for fuel and fleet charges and for construction materials are ramped up to correspond with increasing availability of equipment and staff. The Year 5 budget includes \$60,000 in construction materials and \$15,000 in fleet use and fuel charges. Purchase of a video camera for pipe inspections is planned for Year 4.

Under Financial Analysis Model B, the proposed stormwater fee credit increases are not sufficient to fund the transition to a proactive maintenance program within the 5-year planning window.

Table 2-13. Implementation Costs for Transition to Proactive Maintenance Program

		Model A	Model B
Year 1	Program Expenses	\$0	
	Additional Full-Time Equivalent Maintenance Staff	1	
Year 2	Program Expenses	\$35,000	
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	2	
Year 3	Program Expenses	\$150,000	
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	4	
Year 4	Program Expenses	\$150,000	
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	4	
Year 5	Program Expenses	\$75,000	
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	4	



Expansion of Small Maintenance Projects Program

The Expansion of the Small Maintenance Projects Program will complement the Proactive Maintenance Program, and contributes to similar goals, objectives and measures. As the Proactive Maintenance Program is established and drainage system components in need of repair or replacement are identified, additional funding and efforts will need to be directed towards remedial repairs in order to maintain the system at desired levels of service and in a cost-effective manner. A couple of recent projects have been undertaken as emergency efforts because a roadway was at risk of failing. Pipe rehabilitation is no longer an option when degradation has reached that level, so a complete replacement is required. Replacing pipe under an emergency contract is typically more expensive than a similar project without the tight time constraints.

Under the existing operational budget, \$100,000 is directed towards construction projects. In the past few years the funds have been used for several culvert replacement projects. Under the Strategic Initiatives budgets, the existing \$100,000 is retained under “Infrastructure [CIP](#).” An additional \$100,000 is proposed for addressing smaller rehabilitation or repair projects. The Small Maintenance Projects Program may include projects constructed by Town crews or a contractor. Projects that can be constructed by Town crews, but require more than \$5,000 in equipment rental and construction materials, would be covered under this “projects” budget instead of the regular maintenance budget. Projects under \$50,000 requiring a contractor, but not an alternatives analysis or detailed construction plans, would also be funded under this program.

Targets and Budget

The proposed program funding is \$100,000 per year. The additional maintenance staff person identified under the [DPP](#) Targets and Budgets proposed in Year 2 at half-time would also manage the Small Maintenance Projects Program. Under the Financial Analysis Model B, the annual budget is reduced to \$50,000, and the hiring of an additional maintenance staff person is delayed until Year 4.

Table 2-14. Implementation Costs for Expansion of Small Maintenance Projects Program

		Model A	Model B
Year 1	Program Expenses	\$100,000	\$50,000
	Additional Full-Time Equivalent Maintenance Staff		
Year 2	Program Expenses	\$100,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	
Year 3	Program Expenses	\$100,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	
Year 4	Program Expenses	\$100,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	0.25
Year 5	Program Expenses	\$100,000	\$50,000
	Cumulative Add'l Full-Time Equivalent Maintenance Staff	0.5	0.5



Comprehensive Monitoring Program

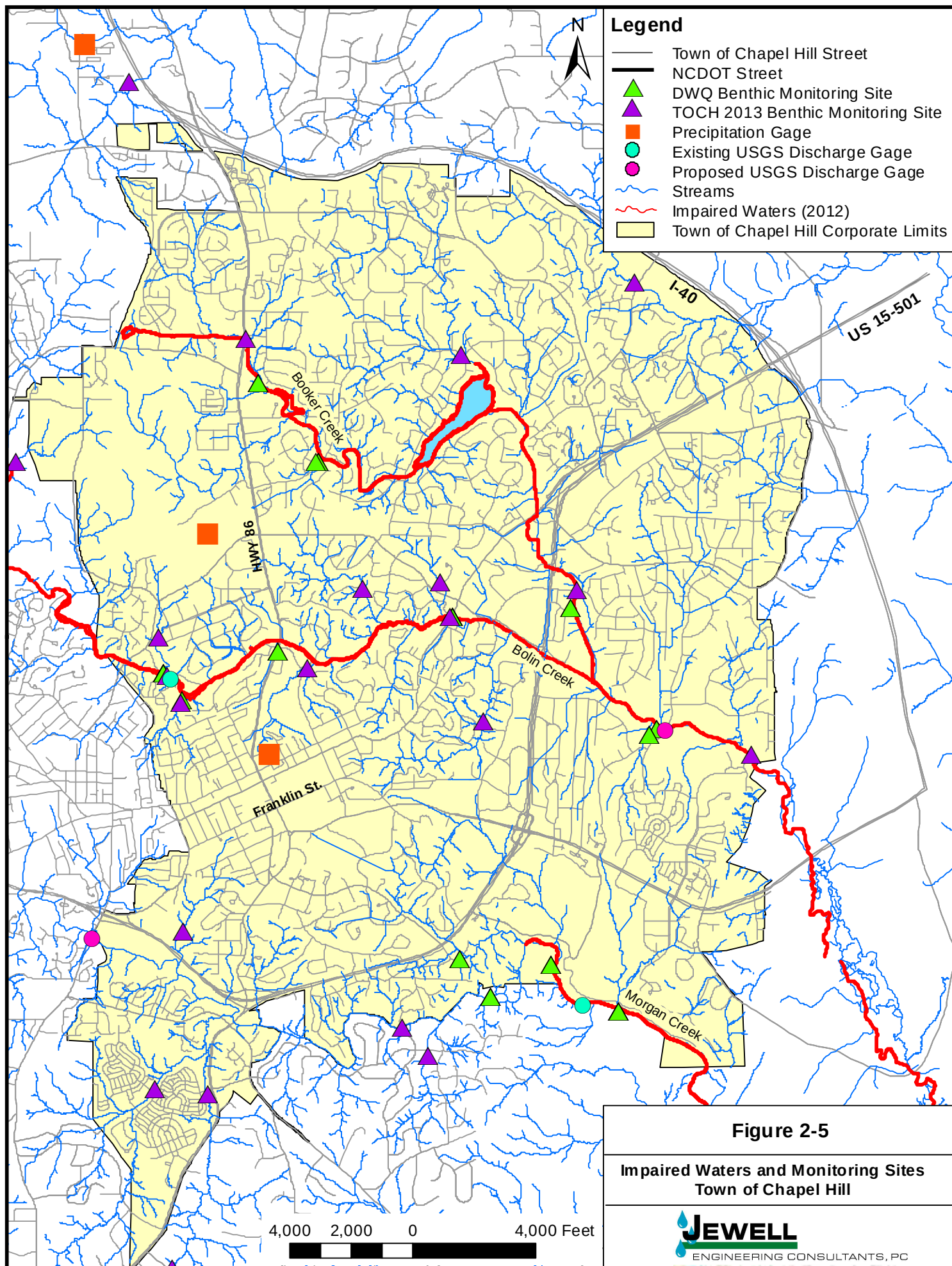
As a Strategic Objective under Program Goal 3, the Town proposes to ‘*perform comprehensive, watershed-based monitoring to assess effectiveness of stormwater control measures and track the biological, chemical and physical health of receiving waters.*’ The comprehensive monitoring program is part of ongoing efforts to better manage, maintain, and protect the Town’s stormwater infrastructure and natural streams. Stream monitoring is an important component of an effective stormwater management program. Monitoring provides baseline data to assess pollutant loads in the Town’s streams, as well as estimating the Town’s contribution to pollutant loads downstream at Jordan Lake. Over time, a well-established monitoring program will provide a basis for measuring trends and assessing the effectiveness of stormwater improvements, including water quality retrofits required under the Jordan Lake existing development rules. The data generated from the monitoring program will be the basis for tracking Key Strategic Measures 1 and 2 (*changes in stream conditions and reduced export of nutrients*). The information can be incorporated into public education efforts, and public involvement in Chapel Hill stormwater issues can be encouraged through incorporating volunteer monitoring into the program, indirectly impacting Key Strategic Measure 6 (*improved stormwater practices*). The proposed monitoring plan includes precipitation and streamflow monitoring; chemical and biological analyses of streams; and various ongoing geomorphological assessments of stream conditions.

Streamflow Monitoring

The initial goal in establishing streamflow monitoring is to estimate imported and exported nutrient loads. A continuous record of stream discharges is a necessary component for using stream sampling data as a basis for computing estimated nutrient exports. Streamflow monitoring will also facilitate validation/calibration of flood and water quality models, as well as potential future establishment of a flood control warning system.

Most of the Town lies within two watersheds (Morgan Creek and Little Creek), such that the Town’s nutrient contribution into Jordan Lake can be estimated by subtracting the nutrient loads at the two “import” points from the Town of Carrboro from the loads at the two “export” points from Chapel Hill. A United States Geological Survey (USGS) discharge gage is already in operation on Morgan Creek at a location that can be considered an export point. As part of the Bolin Creek Watershed Restoration grant project, the Town was successful in getting a USGS gage installed on Bolin Creek at Village Drive in October 2012, which will provide data to determine “import” loadings. Because the Town of Carrboro can use the data for “export” load calculations, it agreed to share the costs for annual operation and maintenance. The highest priority location for establishing another gage is at an export point on Little Creek. The Town also proposes, in cooperation with the Town of Carrboro, to establish [USGS](#) discharge and precipitation gages at the Morgan Creek import point. The existing and proposed USGS gage locations are shown in Figure 2-5.

The [USGS](#) maintains a streamflow discharge gage (# 02097517) on Morgan Creek downstream of the [OWASA](#) wastewater treatment plant, operated in conjunction with the Triangle Area





Water Supply Monitoring Steering Committee. Discharge records have been maintained since 1984, although the site is heavily influenced by the plant discharges. The existing USGS gage on Morgan Creek will initially be utilized for export estimates, although a longer term objective is to locate a gage upstream of the treatment plant. It is expected that the plant's records of discharges can be used as a basis for extracting those flows from the [USGS](#) record in estimating the Town nutrient load exports. Water quality samples will be taken upstream of the treatment plant.

A nearer-term objective will be to establish a discharge gaging station at an appropriate “export” point along Little Creek. Geographically, the best location is at the Pinehurst Drive culverts, but the site is not conducive for setting up a gage because the creek meanders through a wide floodplain at this point and there is massive sedimentation. Town stormwater staff determined that the location isn't suitable for setting up a level logger, but [USGS](#) may be able to establish a gage such that good quality discharge data can be developed there. If USGS recommends against siting a gage at this location, the possibility of establishing a gage at the Upper Little Creek Waterfowl Impoundment should be considered, even though the watershed at that point encompasses portions of the City of Durham and Durham County areas of existing development. If neither of those locations can accommodate a gaging station, then estimates of nutrient exports would need to be extrapolated from flow and monitoring data on one or more of the tributary streams into Little Creek. The USGS briefly operated a gage station (#0209737400) at US 15-501 on Bolin Creek in 2002-2003 in conjunction with water quality sampling. Bolin Creek could again be gaged at the US15-501 crossing and a gage for Booker Creek could be set up at the Willow Drive crossing. A temporary alternative to a USGS gage or gages would be for the Town to set up level loggers to monitor streamflows at these two crossings.

In addition to recording stream discharges at the import and export points, it may also be necessary to obtain additional flow data at other locations in town to validate and calibrate models or to support other types of investigations. For example, staff operated a discharge monitor at a site in Baldwin Park as a required component of the [EPA](#) 319 Bolin Creek Grant Project. The gage was in operation for about a year and an automated sampler was also used at this location. For these types of secondary streamflow monitoring locations, it is recommended that level loggers be set up and maintained by staff. It may also be desirable for gage rods to be set up at volunteer monitoring sites to correlate a flow estimate with the field measurements and analyses.

Associated Costs:

- \$22,000 to \$26,000 each for streamflow discharge gage installation and \$14,000 per year operating and maintenance costs (per USGS 2012 estimates)
- Staff time for monitoring with level loggers and/or coordination of volunteer program
- \$1,000 per level logger installation
- Minor equipment costs associated with gage rods

Precipitation Monitoring

The purposes of precipitation monitoring include validation of rainfall/runoff models and development of baseline data for a longer-term goal of implementing flood warning systems.



The weather station at Horace-Williams airport is part of the National Weather Service's Automated Surface Observing System (ASOS). Parameters include air temperature, humidity, winds, precipitation, visibility, and pressure. The ASOS station was established in July 1999 and most data is recorded sub-hourly. Weather data is also recorded and maintained for Chapel Hill 2W station, which is actually located in Carrboro, has been in service since 1948, and is part of the US Historical Climatology Network. With the development of the Carolina North campus and the closing of the airport, it seems unlikely that an ASOS station will continue to be maintained at the site, although it is possible that the state would fund a comparable weather station as part of the North Carolina Environment and Climate Observing Network (ECOnet).

The Town currently maintains rainfall gages at Town Hall and the Town Operations Center. It is also proposed that the planned [USGS](#) stream gaging sites be developed in conjunction with automated sub-hourly precipitation gages. Additionally, the Town may want to establish a network of volunteer-monitored rainfall gages where daily precipitation rates could be recorded and/or link to private gages that are already reporting data as part of a weather exchange network.

Associated Costs:

- \$3,000 (USGS 2012 cost) to install a precipitation gage in conjunction with a streamflow gage and \$3,200 per year operating and maintenance costs
- Minor costs associated with coordination of volunteer precipitation monitoring

Chemical Monitoring

From 1993 to 2009, the Town of Chapel Hill conducted ambient monitoring of 14 sites, collecting either quarterly or monthly grab samples and measuring temperature, conductivity, pH, dissolved oxygen and turbidity. Routine analyses included total solids, dissolved solids, suspended solids, total phosphorus, ammonia as nitrogen, nitrate-nitrite, [TKN](#), fecal coliform, copper, lead, and zinc. Nutrient analysis was done quarterly and metals semi-annually. The monitoring produced a large volume of data, but did not include wet weather sampling. For some constituents, the lab equipment used was not adequate to detect their presence at very low levels. Also, no discharge monitoring was done in conjunction with the sampling. The ambient monitoring program was discontinued because the sampling frequency was not sufficient to establish statistically valid conclusions or trends.

The primary focus of the revised and updated chemical monitoring program will be an assessment of nutrient load exports from the Town. Secondly, the monitoring will be used to better determine areas with higher nutrient loadings and to locate illicit discharges.

A bi-weekly monitoring frequency has been recommended for establishing baseline estimates of nutrient loads. In addition to recording field measurements, bi-weekly grab samples will be analyzed for nitrogen components and total phosphorus. Additionally, at least one wet weather event will be sampled quarterly. The estimated number of samples per site per year is 32, including two split samples as part of the quality control plan. Initial sampling points will be the two import sites and two export sites for the Little and Morgan Creek watersheds also chosen as



streamflow monitoring points. Budgeting is aimed at adding one or two additional sites each year to expand the sampling effort to some of the major tributaries for purposes of better identifying nutrient sources. The monitoring frequency will be re-assessed after the first year of data. The Town will coordinate with [NC DWR](#) to set up a quality assurance plan so that the data can be incorporated into the State's database. Monitoring locations in addition to the four import/export sites will be periodically reviewed and relocated to optimize the Town's overall nutrient assessment effort.

Other sampling may be undertaken as part of an effort to identify illicit discharges, beginning with a program to assess the level of bacterial pollution problems in the streams and attempt to locate fecal coliform sources. Staff would initially sample and analyze for fecal coliform levels at former ambient monitoring sites and other previously identified locations where problems are suspected, moving on to other sites as the program progresses and develops.

Additional sites may be monitored to meet requirements concurrent with grants for development of [BMP](#) retrofits and/or stream restoration or as part of [synoptic](#) studies. Monthly ambient grab samples and approximately four to six composite wet-weather samples per year were being analyzed for sediment and nutrients at the Baldwin Park site, set up as part of the [EPA](#) 319 Grant Bolin Creek Project.

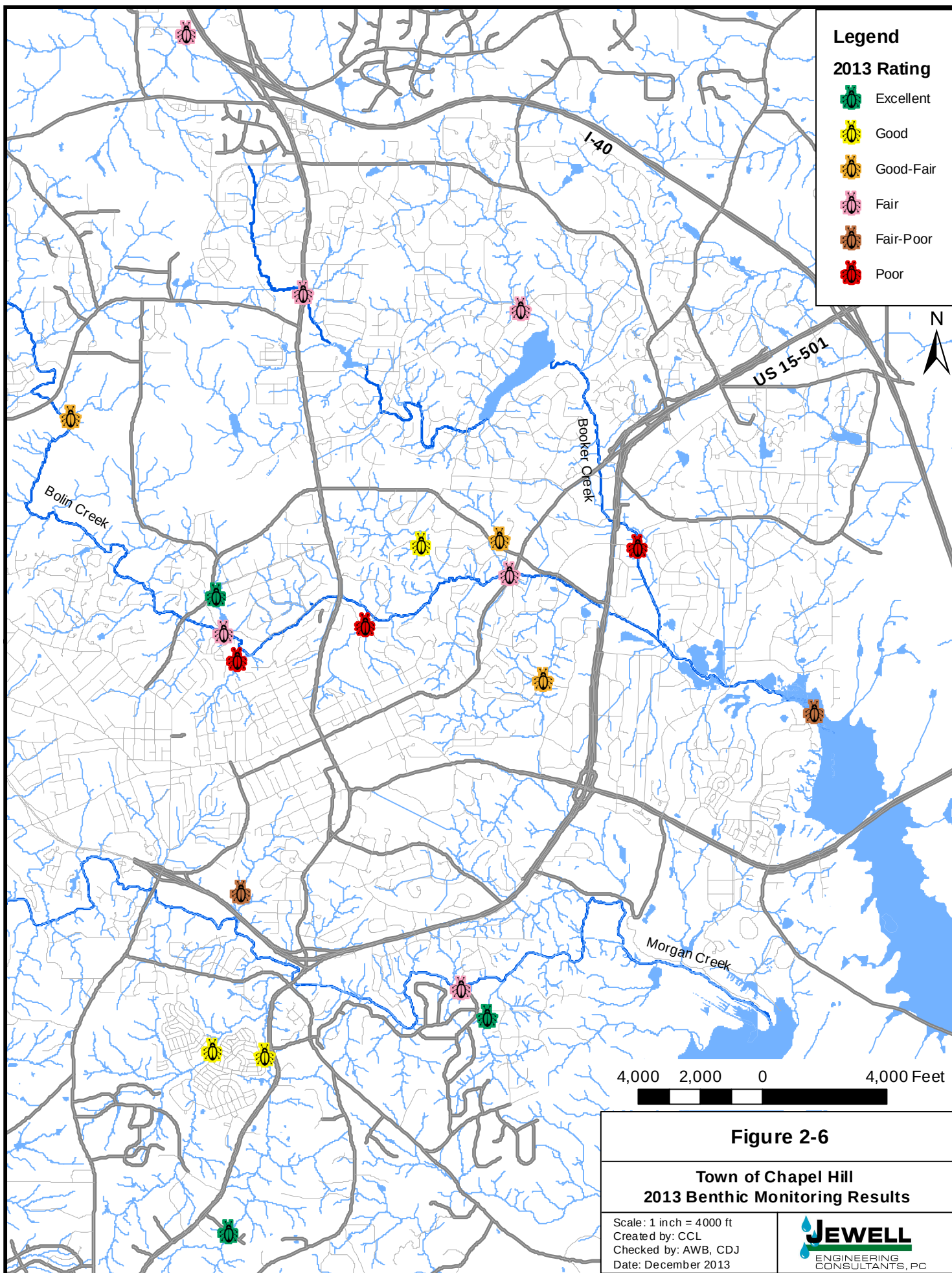
Some limited chemical monitoring is also proposed as part of a volunteer monitoring program.

Associated Costs:

- Lab costs estimated at \$150 to \$200 per sample – estimated total of \$20,000 to \$25,000 for four sites at 32 samples per site per year
- Staff time for sample collection and coordination of water quality database

Biological Monitoring

The Town of Chapel Hill initiated a biological monitoring program in the spring of 2011 and the current operational budget includes funding for annual sampling. The Town contracts with a provider to collect and analyze the samples and provide a summary report. [Benthic](#) macroinvertebrates were sampled at 18 sites along major streams and smaller tributaries in the Town of Chapel Hill. The types and quantities of macroinvertebrates serve as an indication of stream health and support for aquatic life. The [NC DWR](#) bioclassification of streams as Excellent, Good, Good-Fair, Fair, or Poor is used in the biological monitoring program and sampling methodology is based on standard protocols. The initial 2011 effort also included Habitat Scoring for the 18 sites, based on standard NC DWR procedures. For 2012 and 2013, the biological monitoring was expanded to include a few more sites, including the monitoring point in Baldwin Park. One goal of the biological monitoring program is to coordinate with [NC DWR](#) so it can incorporate the Chapel Hill data into its stream assessments. The program will be reviewed and possibly revised after several years of data have been collected. Possible changes would include sampling less frequently, sampling in different seasons of the year, and/or focusing on one or more particular watersheds or problem areas. Stream bioclassifications for the sites monitored in 2013 are shown in Figure 2-6.





Associated Costs:

- Already included in existing budget (not part of strategic initiatives budgeting).

Geomorphological Monitoring

Stream channels are conduits for movement of water and sediment. Erosion and deposition are normal ongoing processes in a stable stream, but urban stream channels very often become unstable in response to the hydrologic changes associated with land development. The multiple purposes of geomorphological monitoring are as follows:

- Assessing the physical stability of the stream channel.
- Ranking the severity of stream channel stability problems.
- Analyzing the response of the stream to various types of impacts that tend to cause disequilibrium in channel processes.
- Projecting where interventions such as grade control, retrofits, and stream restoration will have the most benefit.
- Improving design guidelines for culverts and other types of stream crossings.

The stream walks conducted in conjunction with the pilot basin studies included qualitative monitoring of stream conditions. Additionally, permanent cross-sections were established at three locations within each subwatershed and initial classifications of stream types (based on Rosgen classification system) were made. Rough estimates of Bank Erosion Hazard Indices (BEHI) were also made at the cross-section locations. Subsequent to those initial stream walks, Town staff has received additional training regarding assessments such that more refined analyses are proposed to be incorporated in the Town's geomorphological monitoring program.

Stream walks, either in conjunction with subwatershed planning, or targeted in known problematic stream reaches, will incorporate the following initial geomorphological assessments:

1. To assess impacts of urban hydrological changes: set up discharge monitoring with level loggers if warranted, install bank and scour pins at suspected high erosion locations, quantify BEHI, Near Bank Stress and other indicators of geomorphic stability for selected reaches
2. To assess impacts of stream crossings: survey the stream crossings, including structures, upstream and downstream cross-sections and longitudinal profile; quantify various indicators of geomorphic stability; establish permanent cross-sections and/or bank and scour pins if the crossing appears to have caused instability in the stream reach
3. To assess riparian conditions: note percentage of forest cover, presence or absence of invasive species

Periodic follow-up assessments may also be warranted for some stream reaches.

Associated Costs:

- Staff time for the assessments and monitoring
- Minor costs associated with equipment and supplies



Volunteer Monitoring

Involving Town residents in the monitoring of streams offers a number of benefits to the Stormwater Program. Volunteer monitoring not only provides additional data about local streams, but it can be an important component of the overall public education/public involvement aspect of the Stormwater Program.

Potential outcomes and benefits of a volunteer monitoring program include:

- Developing a larger baseline stream characterization database
- Documenting flow regime and water quality changes over time
- Screening for potential water quality problems
- Educating and encouraging Town residents to watch for pollution and stream damage, and to practice environmental stewardship
- Confirming that local residents are committed to the condition and management of their water resources

Continuing its partnership with the UNC Institute for the Environment, the Town is developing a volunteer Stream Team Monitoring Program based on the Haw River Association's visual monitoring and the University of Wisconsin's stream monitoring program. The Stormwater staff has selected five sites where volunteer monitoring will be useful and beneficial, targeting areas nearby some of the [benthic](#) monitoring sites. A graduated scale, placed in a position such that the depth of the stream can be read, may also be set up as a staff gage at each of the monitoring locations. After one year, the volunteer program will be re-assessed. It is expected that adjustments may be warranted regarding the parameters being monitored, the frequency of the monitoring, the monitoring locations, and/or the training and coordination of volunteers. At that point, Stormwater staff will expand and/or adjust the volunteer program and revise the budget accordingly.

Associated Costs:

- Staff time for training and coordination
- Volunteer water quality parameter kits are estimated at \$115 each for 20 tests
- Volunteer training is budgeted at approximately \$25 per site
- Additional costs will be incurred for the staff gages and for ongoing re-stocking of the test kits.

Targets and Budget

Under the Model A Implementation Schedule and Funding Plan, two [USGS](#) gages are proposed to be installed within the five-year planning window, one in Year 1 and one in Year 3, at the Town's nutrient "export" points. Funds are also budgeted to install and maintain a level logger at the Morgan Creek "import" point. The stormwater program funding level beyond the initial planning window is expected to be adequate to cover the shared costs with Carrboro for installing a gage at this location. The schedule and prioritization of a gage installation will be adjusted to coordinate with Carrboro and their funding availability, such that the import gage may be installed ahead of export gages. The Model B scenario budgets for a shared gage installation with Carrboro in Year 1 and a full gage installation in Year 3.



The level of chemical monitoring also differs between the Model A and Model B scenarios. Under Model A, \$30,000 is budgeted for lab costs beginning in Year 1, increasing by \$5,000 per year to a \$50,000 level by Year 5. Under Model B, chemical monitoring is slated to begin in Year 2 at a \$30,000 level. In Year 5, the budget is increased to \$35,000.

Under the Model A Implementation Schedule and Funding Plan, hiring of an additional staff person, with half time devoted to the monitoring program, is proposed for Year 2. About \$3,000 to \$5,000 per year is also budgeted to cover volunteer monitoring supplies and miscellaneous supplies for geomorphic assessments and collecting samples. Under Model B, there is no funding for additional staff and designated funds to cover miscellaneous supplies are not budgeted until Year 5.

Table 2-15. Implementation Costs for Comprehensive Monitoring Program

		Model A	Model B
Year 1	Program Expenses	\$85,000	\$25,000
	Additional Full-Time Equivalent Operations Staff		
Year 2	Program Expenses	\$70,000	\$40,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 3	Program Expenses	\$115,000	\$90,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 4	Program Expenses	\$90,000	\$60,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 5	Program Expenses	\$95,000	\$60,000
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	



Long-Term BMP Inspection and Enforcement Program

While the design and construction practices for stormwater Best Management Practices (BMPs) have evolved over the past decade or so into an effective means for managing both the quality and quantity of stormwater runoff, a component of the overall management of stormwater [BMPs](#) that has historically not kept pace is the perpetual maintenance these systems require. There has often been a “build-em and walk” mentality that has resulted in degraded effectiveness of many (possibly most) BMPs over time. The degradation has often resulted from one or more of the following factors (in no particular order):

1. Lack of resources (money, equipment, material) to effectively maintain.
2. Inadequate space in which to perform maintenance.
3. Lack of legal and physical access to the BMP.
4. Lack of education and training on effective maintenance practices.
5. Lack of effective regulations to require maintenance.
6. Lack of a means to track and manage the myriad of data related to BMPs.
7. Lack of local government’s inspection authority, resources, and process/procedures.

With the exception of factors 1 and 2, each of the other factors can be addressed by the local government in the form of ordinances, regulations, standards, and/or policies. Even the hurdles imposed by factors 1 and 2 can be reduced for future BMPs through the implementation of regulations that reduce or limit the impediments from these factors. In the case of existing BMPs, factors 3 through 7 can be mitigated through effective regulations, policies and procedures.

The development of an enhanced BMP Inspection and Enforcement program is a strategic initiative related to Objective 3.6 (Ensure proper long-term maintenance and functionality of stormwater control measures) under Goal 3 (Address stormwater quality as an integral function within the program). Key Strategic Measures 1 (*improved stream conditions*), 2 (*reduced export of nutrients*), and 3 (*reduced water quality violations*) are all directly impacted by an enhanced BMP Inspection and Enforcement program. Key Strategic Measure 4 (*reduced flood risks*) will benefit indirectly.

Jordan Lake Nutrient Management Strategy

Over the past decade or so, successive regulations and guidance documents from the State of North Carolina have sought to improve BMP inspections and enforcement with a primary intent of improving long-term maintenance. Most recently the [Jordan Lake Rules](#) have placed the most stringent inspection, enforcement, and maintenance requirements to date on affected local governments and BMP owners. The following discussion addresses BMP inspections and maintenance for existing and new development under the Jordan Lake Rules.



Jordan Lake New Development Rule

Under this rule, certain new development and redevelopment projects will be required to meet stringent [BMP](#) inspection and maintenance standards. Compliance with this regulation should result in maintenance of new development BMPs that ensures perpetually adequate functionality. Implementation of the Jordan Lake New Development Rule was postponed by session laws enacted by the General Assembly in 2012 and 2013.² Delaying implementation of the Jordan new development regulations by the Town of Chapel Hill would have deferred the requirement for new development projects to begin management of nitrogen and phosphorus. However, as part of the Town's obligation to address and retrofit nutrient loads from existing development, nutrient loads from new development approved in that five-year interim would be added to the Town's existing development nutrient loads. The Town chose to enact its Jordan new development ordinance in October 2012, with an effective date of December 1, 2012.

The Jordan Lake New Development Rule requires the following:

1. The owner of each BMP will be required to "...maintain and operate it so as to preserve and continue its function in controlling stormwater quality and quantity..."
2. The person responsible for BMP maintenance will be required to submit an Annual Maintenance and Inspection Report to the local government.
3. The owner of each BMP will be required to enter into an operation and maintenance agreement with the local government. This agreement will be binding on the present owner and all subsequent property owners served by the BMP.
4. For BMPs owned by homeowners' and other similar associations, in addition to the operation and maintenance agreement, the owners will be required to establish an escrow account to fund operations and maintenance. Funds from this account may only be used for specific maintenance and repair purposes and can only be spent with the concurrence of the local government.
5. The local government will be required to implement an inspections program of its own to ensure that BMP operations and maintenance are being properly performed.
6. The local government, at its discretion, may require a performance security for installation and maintenance of any and all BMPs.
7. The applicable operations and maintenance agreement and all associated easements, must be referenced on the final plat and are required to be recorded with the county Register of Deeds so as to appear in perpetuity in the chain of title. Where appropriate, physical signage for the BMP may be required.
8. The BMP owner will be required to keep records of inspections, maintenance and repairs for five years following record creation.
9. Each BMP will be required to be maintained so as not to become a nuisance.
10. Each BMP will be required to be accessible via a maintenance easement that is recorded with the county Register of Deeds.

² Session Laws 2012-200 and 2012-201, enacted August 1, 2012, delayed the deadline for implementation of the Jordan new development stormwater management regulations for two years, or until August 10, 2014. Session Law 2013-395 postponed implementation an additional three years or until 2017.



Jordan Lake Existing Development Rule

Inspections and enforcement of maintenance requirements is somewhat more problematic for existing [BMPs](#), given that they were not required to comply with the same maintenance standards as new development under the [Jordan Lake Rules](#). Under a program called the Stage 1 Adaptive Management Program for Existing Development, the following are required:

1. "...local governments must develop and implement a mechanism to require long-term operations and maintenance of BMPs owned and operated by that local government."
2. Local governments should develop and implement suitable operations and maintenance agreements with owners for existing BMPs.
3. Local governments must implement maintenance and inspection procedures for all BMPs.
4. Local governments should develop and implement a training program for government employees and general public to promote and enhance adequate long-term operations and maintenance of BMPs.

Chapel Hill's Land Use Management Ordinance

Chapel Hill's Code of Ordinances, Appendix A, contains the Town's Land Use Management Ordinance ([LUMO](#)). Article 5 of the LUMO contains Design and Development Standards with Section 5.4 devoted to Stormwater Management. As related to BMP Inspections and Enforcement, Section 5.4 requires the following:

1. Stormwater management facilities (BMPs) constructed on private property must be maintained by the property owner and BMPs constructed on public lands, public rights-of-way or public easements must be maintained by the Town or public entity owning the land.
2. As a permit condition, the owner of the BMP must execute a maintenance easement agreement that is recorded with the appropriate county Register of Deeds. The maintenance easement agreement will be binding on all subsequent property owners.
3. Each BMP must have a maintenance covenant entitled, "Stormwater Operations and Maintenance Plan." A schedule for maintenance and inspections must be included as part of the covenant.
4. The owner is responsible for maintenance of stormwater management facilities; however, the Town may, under certain circumstances, accept dedication of existing or future stormwater management facilities for public maintenance and inspection.
5. All stormwater management facilities must be inspected to identify maintenance and repair needs, and to ensure compliance with Town requirements. Any maintenance and/or repair needs found must be promptly addressed. The inspection and maintenance requirement may be increased as deemed necessary by the Town to ensure proper functioning of the stormwater management facility.
6. Owners must make records of the installation and of all maintenance and repairs and retain those records for at least five (5) years.
7. If the owner does not properly maintain the BMP, the Town may correct a violation of the design standards or maintenance needs by performing necessary work to place the



facility in proper working condition. The Town may assess the owner for the cost of repair work and penalties; and the cost of the work may be placed as a lien on the property or may be placed on the tax bill and collected as ordinary taxes by the county.

8. In addition to inspections by the owner, the Town may inspect the facility as it deems appropriate.
9. The Town maintains right of entry upon private property to inspect and repair BMPs.

Program Enhancements

The Town's Strategic Initiatives call for an enhancement of the Stormwater [BMP](#) Inspection and Enforcement program to ensure BMPs are constructed and maintained to function in perpetuity. While the current program provides a sound basis upon which to grow the BMP Inspection and Enforcement program, a number of enhancement opportunities exist as described in the following:

1. As a means of tracking BMPs within the Town's jurisdiction, the Town should include BMPs in the comprehensive, geo-referenced database of drainage infrastructure. Such a database should include (at a minimum) the following data on each BMP:
 - a. Location (physical address, PIN, and State Plane coordinates)
 - b. Owner (with contact information)
 - c. BMP Type (suitably described, with photos)
 - d. Background design information (area served, dimensions, outlet system(s), performance criteria, etc.)
 - e. Dates of inspections
 - f. Current condition
 - g. Maintenance and repair information (dates, actions, etc.)
 - h. Digital/scanned copies of maintenance covenant, easements, inspection reports, etc.
 - i. Notes and comments
2. Section 5.4.8 of the Town's [LUMO](#) provides authority for the Town to correct a problem with a BMP and to assess the owner for the cost to correct the problem if the Town performs or contracts for the work. To date, this authority has not been exercised. Anticipating that this authority will be needed going forward, the Town should create an internal policy and process to be followed to correct BMP deficiencies when discovered. The policy and process should be reviewed with the Town Attorney to ensure it is enforceable and in keeping with the Town's LUMO.
3. Section 5.4.9 of the Town's LUMO provides authority for the Town to inspect BMPs. To date, this authority has not been exercised in a coordinated and programmed manner. The Town should create and implement an internal policy and process to inspect BMPs on public and private property. Consideration should be given to the following in developing and implementing such a policy and process:
 - a. Random inspections by Town staff of 20% of the BMPs each year so that each BMP is inspected by the Town at least once every five years.
 - b. Section 5.4.9 does not specify any qualifications or certifications appropriate for BMPs inspectors. The Town should develop and implement a policy on BMP



- inspector qualifications and/or certifications using the [Jordan Lake Rules](#) as guidance.
- c. As a means of standardizing inspections and BMP conditions reporting, the Town should develop forms and standards for inspectors (internal and external) to use for conducting and reporting BMP inspections.

Targets and Budget

The proposed initiative for an enhanced [BMP](#) Inspection and Enforcement Program includes adding one stormwater professional to be hired in the latter half of Year 1 to perform and/or oversee inspections and to manage the database system. That person will be also serve as the [IDDE](#) Program manager. Position funding will also include \$5,000 (\$2,500 first year) to cover equipment and supplies. Under Financial Analysis Model B staffing of the position is delayed until the latter half of Year 2 and funding for equipment and supplies is delayed until after Year 5.

Table 2-16. Implementation Costs for Enhanced BMP Inspection and Maintenance Program

		Model A	Model B
Year 1	Program Expenses	\$2,500	
	Additional Full-Time Equivalent Operations Staff	0.25	
Year 2	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	0.25
Year 3	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	0.5
Year 4	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	0.5
Year 5	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	0.5



Illicit Discharge Detection and Elimination ([IDDE](#)) Program Enhancement

The [NPDES MS4](#) Phase II Program established six minimum measures required to be included in municipal stormwater programs in order to meet permit requirements. The Town has established an effective [IDDE](#) program, which includes investigations of reports and ongoing identification of IDDE problems in conjunction with infrastructure database development, subwatershed planning, and other stormwater program efforts. Additional efforts include public education programs targeting businesses that discharge to the stormwater system illegally and notices of violation to offenders.

Proposed enhancements to the IDDE program involve several areas of strategic initiatives:

- Development and adoption of an IDDE ordinance, with clear enforcement authority and procedures
- Additional efforts to specific target business groups, in conjunction with education efforts
- Additional efforts to promote municipal good housekeeping practices
- Development of a program to identify bacteria sources

The [IDDE](#) program is an essential component of regulatory compliance (Goal 7) and the initiative is also key to strategic objectives under Goals 3 and 4. Key Strategic Measures 1 (*improved stream conditions*), 2 (*reduced export of nutrients*), and 6 (*improved stormwater practices*) are directly impacted by the IDDE efforts.

IDDE Ordinance

Many Phase 2 [NPDES](#) communities have chosen to develop and adopt an [IDDE](#) ordinance as part of their effort to comply with Measure 3b of their permit (“Establish and maintain appropriate legal authorities”) for implementation of an IDDE program. Chapel Hill’s IDDE authority to date has been based on a section in the Garbage, Trash and Refuse chapter of the Town’s Code of Ordinances and dates back to 1970:

No person shall throw, dispose or sweep from any household, yard, sidewalk or elsewhere, garbage or miscellaneous refuse into a storm drain, manhole, ditch or median within the Town of Chapel Hill. (Section 8.34)

Violations constitute a misdemeanor, subjecting the violator to a fine of up to \$500 or imprisonment up to 30 days, per day of violation. Violations may also be enforced by the assessment of a civil penalty. One recent improvement for IDDE enforcement has been the Town’s establishment of a Code Enforcement Team to address various enforcement concerns, including IDDE violations.

In order to effectively restrict illicit discharges into the stormwater conveyance system, the Town needs to develop and adopt an [IDDE](#) ordinance that specifically describes and categorizes the



various types of illicit discharges that have been observed in Chapel Hill and establishes appropriate penalties and enforcement mechanisms. The Center for Watershed Protection has a model IDDE ordinance and a number of municipalities in North Carolina have adopted ordinances that can be used as examples.

One mechanism for enforcement policies adopted in some towns is the authority to place a lien on properties to recover civil penalties for illicit discharges. This can be an effective policy when dealing with residential and business property owners. However, one of the challenges in Chapel Hill is that there are recurring problems with several types of mobile businesses and the discharge violations are not tied to a specific property or facility. One possible approach would be to hold property owners responsible for appropriate disposal of waste generated by vendors and contractors performing services on their property or for their facility.

Targeting Business Groups

As noted in Section 1 under Program Goal 5, there are several types of businesses that have been repeatedly identified as generators of illicit discharges. The businesses include paint contractors, concrete companies, mobile car washers, and other types of mobile cleaning services. The Stormwater Program, in a joint effort with [UNC](#), developed a program to educate and train restaurant owners and employees on proper pollution prevention practices. As part of the [IDDE](#) Program Expansion, that type of outreach effort would be extended to other types of businesses. However, connecting with mobile businesses is expected to present additional challenges. Possibly some of the education effort will need to be aimed at homeowner groups, homebuilders and larger construction companies - people and businesses who hire or subcontract with the targeted business groups.

Municipal Good Housekeeping

Another component of the [IDDE](#) Program Enhancement will be working with various municipal departments to eliminate some ongoing illicit discharges associated with municipal operations. Examples include:

- Vehicle washing should be only done in areas with proper containment.
- Garbage dumpsters need to be kept closed and in good repair to minimize stormwater infiltration and leakage from dumpsters.
- Garbage trucks should be properly contained to prevent discharge to the stormwater system.
- Clear guidelines and appropriate practices need to be established for discharges from swimming pools and HVAC systems.

Identifying and Eliminating Sewage Discharges

A significant challenge for any municipal [IDDE](#) program is identifying and eliminating sources of bacterial pollution in urban streams. Sources include failing septic systems, chronic sanitary sewer leaks, wet-weather sanitary sewer overflows, pet wastes, and urban wildlife. Bacteria levels, typically measured as fecal coliform colonies per 100 ml, are highly variable over different locations and different times, making it difficult to track down sources.



As discussed under the ***Comprehensive Monitoring Program*** strategic initiative, monitoring for fecal coliform is proposed as a component of the chemical monitoring program, beginning with areas where problems were previously identified under the ambient monitoring program. Due to the high number of samples that may be necessary to facilitate tracking of bacterial sources, it may be cost-effective for the Stormwater Program to invest in a small incubator to facilitate in-house testing at a much lower cost. Although test results will not have sufficient QA/QC for submittal to [NC DENR](#), once a specific problem has been clearly identified with in-house testing, it could be documented with a follow-up test analyzed by a qualified laboratory.

In cases of a failing septic system, the Stormwater Program will need to work in conjunction with the Orange County Health Department to advise and/or cite the property owner. Procedures for addressing bacterial pollution from specifically identified sanitary sewer system components are to be developed as part of the Memorandum of Understanding with [OWASA](#).

Targets and Budget

The [IDDE](#) Program Enhancement is targeted to begin in Year 1, with an additional staff person splitting responsibilities between IDDE and [BMP](#) inspection and enforcement. Under Financial Analysis Model B, there is no funding for additional staff devoted to IDDE efforts.

Table 2-17. Implementation Costs for IDDE Program Enhancement

		Model A	Model B
Year 1	Program Expenses	\$2,500	
	Additional Full-Time Equivalent Operations Staff	0.25	
Year 2	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 3	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 4	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	
Year 5	Program Expenses	\$5,000	
	Cumulative Add'l Full-Time Equivalent Operations Staff	0.5	



Public Education Program Expansion

Several enhancements to the existing public education program are proposed in order to further extend outreach and target specific audiences. The first is a focused effort on pollution prevention and stormwater management training within the Town operations. Another added program component will be development and support of a public involvement plan for the Bolin Creek Watershed restoration. Outreach and training for additional target audiences that have been identified by the Stormwater staff are also being planned. A new activity, recently initiated, is the publication of an electronic newsletter covering stormwater issues in the community. Periodic community surveys to gauge public stormwater awareness, practices, and perspectives will also be coordinated and budgeted within the public education program.

Municipal Good Housekeeping

The Town's [NPDES MS4](#) permit includes a section on "Pollution Prevention and Good Housekeeping for Municipal Operations." The objectives for this effort are focused on training municipal employees to prevent and reduce stormwater pollution from municipal operations. Since municipalities are charged with administering and enforcing the state and federal mandates of the [Clean Water Act](#), it is important that municipal operations set an example for residents and businesses. In many towns and cities, this is often not the case and there are numerous anecdotal examples of municipal departments violating stormwater regulations and resisting the changes required to properly manage stormwater runoff. Some of the most commonly cited problems within municipalities include vehicle washing with detergents flowing into storm drains, and mowing up to the stream banks and/or over-mowing areas that are supposed to serve as vegetative filter strips.

Although some municipal training has already been done in Chapel Hill, it is proposed that additional training be developed and targeted to specific municipal operations, including landscaping crews, fleet management transit mechanics, solid waste crews, fire and police, inspections and planning staffs.

Programs for Target Audiences

The public education and involvement program will also be expanded to reach and train specific target audiences which have already been identified as part of the [IDDE](#) program and/or earlier public education efforts. For example, civic groups have long been considered an important target audience, and one of the program expansion goals is to involve the Stormwater Advisory Board members' networks to facilitate invitations for stormwater presentations. A recent educational effort of the Town and [UNC](#)'s Institute for the Environment targeted restaurant owners to encourage stormwater pollution prevention measures, such as proper set-up of outside storage areas, spill containment, and disposal of grease and liquid wastes. Target audiences which have been identified for similar future efforts include paint contractors, mobile washers, and construction workers. Stormwater staff has collaborated with Solid Waste and Recycling to develop a bilingual waste disposal guide to be mailed with all business licenses for Chapel Hill. Talks with Orange Water and Sewer Authority staff have also taken place regarding easement



mowing, stream crossings, and sediment filtration during broken water main pumping operations. [OWASA](#) is interested in further cooperating to improve water quality in our streams.

Facilitation of Bolin Creek Watershed Stakeholder Visioning Process

An additional public education and involvement initiative for the Town will be to help develop, support and facilitate a stakeholder visioning process for the Bolin Creek watershed restoration. Visioning will need to incorporate the Town's 2020 community planning results, development of [UNC](#)'s future Carolina North campus, and proposals for new greenway and bicycle paths.

To conduct a neutral and thorough survey of stakeholders as part of the Bolin Creek Watershed Restoration Plan, Chapel Hill contracted with the Watershed Education for Community Officials (WECO), a program within the NC Cooperative Extension Service, to develop a situation assessment. The Bolin Creek Watershed Situation Assessment was published in February 2012. WECO cited a lack of concurrence among stakeholders regarding the causes and sources of Bolin Creek impairments and the preferable restoration strategies. They concluded that facilitation of a comprehensive and collaborative visioning effort is needed. They also recommended that a neutral facilitator be enlisted to lead the effort. The Town's Stormwater program is already involved in initiating and organizing a stakeholder collaboration process.

Future stream restoration planning involving private property will need considerable communication and outreach by staff to affected property owners from the very beginning, i.e., at the conceptual phase. One large stream restoration project under the Bolin Creek Watershed Initiative 319 Grant was replaced with several smaller projects on Town property because critical property owners chose not to provide a temporary construction access easement across their properties necessary to implement the original plan.

Electronic Publication of Annual Stormwater Management Program Report

The first newsletter on stormwater activities and topics of interest, published electronically by posting to the Town website and emailing to appropriate contact lists, was completed in the summer of 2013. An annual report, including a summary of monitoring results, brief descriptions of improvements constructed during the past year, and a summary of the Capital Improvement Program plans, is also planned. As the fee credit policy comes online, it could be highlighted by describing examples of property owners who qualify for a credit. Opportunities for residents, such as the volunteer monitoring program or upcoming workshops, can also be noted in the newsletter and annual report.

Targets and Budget

The proposed public education program expansion is proposed to be implemented with existing staff and within the existing operational budget, with the exception of the community survey, which is scheduled for Year 2 and budgeted at \$20,000 under the Model A implementation schedule and funding plan. Under the Model B scenario, the community survey effort is deferred to the 5-10 Year planning window.



Memorandum of Understanding with OWASA

One recommendation of the Stormwater Management Master Plan is that the Stormwater Program and the [OWASA](#) staffs work to develop a [MOU](#) for cooperatively managing their respective systems to maximize mutual benefits in certain areas of overlapping concerns. Under the Town's [MS4 NPDES](#) permit, the Town is responsible for managing streams in a manner that complies with federal and state regulations. Requirements include adequate protections of stream and stream buffers, ongoing efforts to identify and eliminate illicit discharges, and implementation of measures to reduce nutrient exports. Meeting these regulatory requirements will necessitate coordination with OWASA in some stormwater program areas. Additionally, as the Town begins to plan and implement infrastructure and water quality [CIP](#) projects, coordination with OWASA will be required. There may be some opportunities to schedule stormwater capital improvements to be concurrent with water or sanitary system improvements.

The [MOU](#) should cover several different areas, related to strategic objectives under Goals 3, 4, and 9. Establishing a formal agreement with OWASA is an activity that will indirectly impact Key Strategic Measures 1 and 2 (*improved stream conditions and reduced exports of nutrients*). The proposed MOU is also part of program integration efforts that indirectly contribute to Key Strategic Measures 3 and 6 (*reduced citizen complaints and changed stormwater practices*).

Utility Pipeline Leaks Impacting Streams

Strategic objective 4.4 is to ‘work with [OWASA](#) to identify and reduce sanitary sewage leaks within and along streams, as well as problems with sanitary sewer overflows.’ Sanitary sewer systems rely on gravity flow, which necessitates pipe alignments that tend to follow drainage courses. Sewer pipes have traditionally been located within and along natural streams in urban and suburban areas. As the pipes have aged and deteriorated, problems with both exfiltration and infiltration have increased. Sanitary sewer utility managers tend to be more concerned about infiltration because it greatly increases loadings at treatment facilities during rainfall events or may also cause surcharging of pipes, possibly resulting in a sanitary sewer overflow. Both chronic exfiltration and overflows are a concern for stormwater utility managers, who are increasingly being held responsible for the state of water quality in urban streams. Whether a deteriorating sewer pipe is prone to infiltration or exfiltration is a function of the hydraulic head in the sewer system relative to the groundwater table. OWASA design standards generally require that pipes be buried below the elevation of an adjacent stream bed, but some exceptions are allowed.³

[OWASA](#) has an aggressive capital improvement program to replace or rehabilitate aging pipes and manholes.⁴ Recent improvements have included replacement of portions of sewer mains

³ OWASA Manual of Specifications, Standards and Design, October 2011, downloaded on 3/3/2012: http://www.owasa.org/client_resources/whatwedo/spec/table%20of%20contents%202011%20pdf.pdf

⁴ Capital Improvement Program, Fiscal Years 2012-2016, Orange Water and Sewer Authority, downloaded on 3/30/2012:



along Morgan Creek, Meeting of the Waters Creek, and Bolin Creek. OWASA completed a master planning study in 2011 that identified and prioritized rehabilitation and replacement needs for the sanitary sewer collections system. They plan to replace or rehabilitate, on average, about two miles of sanitary sewer lines annually over the five-year planning horizon. Several pipe lining projects in the CIP include stream crossing areas.

As part of the [IDDE](#) program enhancement and comprehensive monitoring strategic initiatives, the Town will be expanding efforts to identify pollutant sources on stream reaches with elevated bacteria counts. One likely source to investigate will be sanitary sewer leaks. The Town proposes to work jointly with [OWASA](#) to test potentially problematic pipes that are in close proximity to stream reaches with high fecal coliform counts. Other possible bacteria sources include failing septic systems, wildlife, and pets. Where sanitary sewer pipes are identified as a primary pollution source, a plan and schedule for addressing the exfiltration problems will need to be developed.

In conjunction with this area of agreement, the Town Stormwater Program and [OWASA](#) may want to consider some joint public education efforts, or at a minimum, a joint plan for addressing resident complaints in regard to perceived sanitary sewer problems along streams and in buffer areas. For example, when a resident notifies one utility or the other that (s)he noticed a smell or discharge that (s)he thinks may mean a sewer pipe is leaking into a stream, it would be helpful if there are standard protocols for the two utilities to follow. Examples would be joint notification, possibly a joint investigation, and, as a minimum, guidelines on whom to contact and how to proceed if a formal investigation seems warranted. While the two staffs have coordinated with each other, it is important to have the procedures set in writing for new staff members to reference.

Utility Easement Crossings and Corridors

Another area where improved communication and understanding would be beneficial for both utilities is in regard to the establishment and maintenance of sanitary sewer easements and corridors. Strategic Objective 4.2 is to '*maximize the natural continuity of intermittent and perennial stream corridors by minimizing impacts from manmade infrastructure and maintenance activities.*' Numerous sanitary sewer pipes cross beneath streams in Chapel Hill, with a significant number of aerial sanitary sewer crossings also evident in some areas. In some cases, aerial crossings obstruct flood flows and collect debris. Fords have been constructed over buried sewer pipe to facilitate passage of maintenance vehicles along the easement. Some fords are well-constructed, with relatively minimal stream impacts, while others are more problematic. [OWASA](#) has developed design standards and details for stream crossings, but there may be modifications that would make them less problematic for one or both utilities. Adopting specific details and specifications for stream fords to facilitate maintenance vehicle access would be another goal of a [MOU](#). Managers may also want to adopt a standard method for inspecting and possibly improving utility pipes that were previously buried, but have now been exposed as the stream bed has eroded. Photos of some OWASA sewer pipe stream crossings and fords are provided in Figure 2-7.



Sewer Aerial with Beam



Heavy Vegetation on a Sewer Aerial & Beam



Exposed Sewer Pipe Downstream of Culvert



Exposed Sewer Pipe



Riprap Stabilizing Easement Crossing



Easement Crossing Obliterating Channel

Figure 2-7. Photos of OWASA Sanitary Sewer Crossings at Stream Channels



Under state regulations and the local [RCD](#) rules, stream buffer areas are protected in varying degrees against development and disturbance. New sanitary sewer easements generally have to be established outside of the non-disturbance buffers, but maintenance of existing sanitary sewer easements is exempted from buffer regulations. Most of [OWASA](#)'s easements are 30 feet wide, and it typically keeps 20 feet cleared with annual mowing and trimming. As long as a good stand of grass is maintained and mowing is only done annually, there is probably little room for improvement of buffer management in these areas. In easement areas where vegetation is poor, the Town Stormwater Program may have recommendations for establishing appropriate species that will facilitate good filtration of runoff. Both utilities may benefit from a coordinated plan to control invasive species in areas where they are a problem for both streams and easements.

Stream Monitoring/Nutrient Management

Chapel Hill residents will likely experience significant cost impacts of the [Jordan Lake Rules](#) in both their stormwater fees and their utility bills. The Stormwater Program's Water Quality Capital Improvement Program strategic initiative describes some of the required stormwater improvements and associated costs. [OWASA](#) has already invested in significant Wastewater Treatment Plant (WWTP) improvements to facilitate compliance, but will face ongoing impacts to operating costs to accomplish the levels of phosphorus removal that will be required. There are opportunities for the Town and OWASA to work together with regard to monitoring of nutrient level exports, which is what the Jordan Lake Rules target.

Under the Jordan Lake Rules, nutrient load reductions are required for both point sources and non-point sources. [NC DENR](#) developed models to estimate the contributing nutrient loads from various sources to Jordan Lake, relying on limited available data to calibrate the models. [OWASA](#)'s point source is the Mason Farm Wastewater Treatment Plant (WWTP). The Town's [MS4](#) is considered a non-point source. One goal of the Comprehensive Monitoring Plan strategic initiative is to develop data for computing the actual nutrient load exports from the Town of Chapel Hill. As discussed in the section on Comprehensive Monitoring, the OWASA WWTP is located near one of the "export" points for the Town. Both OWASA and the Town share a need to develop statistically defensible data of the point and non-point source nutrient load exports. A plan for gathering and sharing monitoring data to support the mutual effort to document the nutrient loads being exported from Chapel Hill could be developed as part of the [MOU](#).

Stormwater as Potential Special Purpose Water Supply

As stormwater managers seek to encourage runoff reduction measures and water supply managers look for additional water sources, there is opportunity to plan together with [OWASA](#) to develop creative ways of using stormwater runoff as part of the water supply for special purposes. Strategic Objective 9.3 is to *utilize stormwater as a beneficial water resource asset for Chapel Hill and the region*. OWASA and the Town could pursue joint development of guidelines, incentives and public education efforts to encourage and facilitate use of stormwater runoff as a water supply supplement.



Initial local efforts in this regard include several projects developed on the [UNC](#) campus to collect stormwater runoff for use in irrigation and toilet flushing. Also, the Town Stormwater Program annually sponsors a rain barrel sale to encourage and facilitate capture of rooftop runoff for residents to use for watering lawns and gardens. Some other local businesses and institutions are using stormwater collected in cisterns or ponds as a primary or supplemental source for irrigation. All of these efforts serve to reduce stormwater runoff and reduce potable water demand.

For [OWASA](#), rainwater harvesting is similar to other water conservation measures that help to defer the need for expansion of water supplies, but it also represents a loss of revenue for the utility. For the Stormwater Program, rainwater harvesting can only be credited as a [BMP](#) if the property owner can demonstrate that the collected runoff will be regularly used year-round and not only during growing seasons. [NCSU](#) has conducted research on rainwater harvesting as a stormwater BMP and state guidelines are expected to be developed and adopted by [NC DENR](#) within the next few years.

Summary

In summary, the following items should be considered for inclusion in a comprehensive Memorandum of Understanding:

1. Sanitary sewer leaks (illicit discharges) impacting streams
2. Siting and maintenance of utility stream crossings and easement corridors adjacent to streams
3. Stream monitoring/nutrient management
4. Stormwater as potential water supply

Development of an [MOU](#) with [OWASA](#) is targeted for Year 2. No additional budget is planned for this effort as it is expected to be accomplished with existing staff and within the current operational budget.



Fee Credit Policy and Program

A stormwater fee credit is an option utilized by many municipal stormwater management programs around the country to provide incentives for property owners to implement stormwater management practices that provide benefit to the community. As part of the stormwater program master planning process, a stormwater fee credit policy and program has been proposed for consideration by the Chapel Hill Town Council.

History of Stormwater Utility Fee

The Town of Chapel Hill created a Stormwater Management Utility in 2004. The stormwater utility is an organizational structure that is responsible for funding, administering, and operating the Town's stormwater management program. The stormwater utility is funded entirely by the stormwater management enterprise fund through a rate structure based on the amount of [impervious area](#) on a property. Based on an analysis of impervious surface area on properties throughout Chapel Hill, an impervious surface area of two thousand (2,000) square feet was designated and adopted as one (1) [ERU](#) for billing purposes. There is no distinction in Chapel Hill's stormwater utility fee structure between residential and non-residential customers. Both classes of customers are charged based on the effective number of equivalent rate units within the respective customers' property boundaries. Stormwater charges are rounded up to the nearest one ERU for administrative billing purposes. The initial annual fee rate remained unchanged from \$39.00 per ERU per year (\$3.25 per ERU per month) until June 2013. As part of the budget deliberations, the Chapel Hill Town Council changed the ERU basis from 2,000 square feet to 1,000 square feet and increased the stormwater fee to \$24.00 per ERU per year, effective with the FY 2014 (July 1, 2013 - June 30, 2014) budget. With the increase, revenue from the stormwater utility user fee is projected to generate approximately \$2.1 million per year to fund Chapel Hill's Stormwater Management Program. The Stormwater Utility was, in large part, necessitated by the Town's requirements under the [NPDES](#) – Phase II Regulations.

The Stormwater Management Utility Ordinance adopted by the Town included the option for a stormwater fee credit, defined as “ongoing reductions in the stormwater management service charge applicable to a given zoning lot or tract in recognition of onsite or offsite systems, facilities, measures, and/or actions undertaken to reduce or mitigate the stormwater quantity and/or quality impact(s) of the zoning lot or tract that would otherwise impact the public stormwater management system.” The ordinance further stated that “credits shall be conditioned on the continuing performance of the mitigation systems, facilities, measures, or actions in reference to standards adopted by the stormwater management utility, and may be revised or rescinded for cause. In no case shall credits exceed the amount of the stormwater management service charge.”

Development of Fee Credit Policy

As part of the Stormwater Management Master Planning process, the Town of Chapel Hill directed JEWELL Engineering Consultants (JEC) to conduct a survey of communities in North Carolina and around the U.S. regarding fee credit policies associated with stormwater utilities. JEC gathered information from nine North Carolina cities and 28 out-of-state cities, including a



number of cities where major universities are located. The survey was conducted in January and February of 2009.

The results of the fee credit survey have been compiled in a table, attached as Appendix B. All but four of the 37 cities surveyed have some type of stormwater fee credit policy in place. About half offer credits only to non-single family property owners. A number of the programs extend credits only for *exceedance* of stormwater management requirements. Maximum allowable credits vary from 40% to 100%. Portland, Oregon has the most comprehensive crediting program, with 36,000 active fee credit participants with credits totaling 8.1% of the annual \$67 million stormwater program revenue. Among North Carolina cities, Charlotte, Wilmington, and Greensboro each have a significant number of property owners who receive some type of fee credit, with total annual financial values of the credits estimated at \$75,000 to \$124,000. All but one of the sixteen universities included in the survey pay a stormwater utility fee to the municipality in which they are located. One-third of those receive credit for a portion of their fee.

Recommendations and a summary of the fee crediting study were presented by Jewell Engineering Consultants to the Town's Stormwater Management staff and Stormwater Advisory Board in a technical memorandum. The fee credit was recommended as being appropriate for stormwater control measures that effectively reduce the public cost of service for managing the Town's stormwater system and/or activities that otherwise benefit the community's stormwater program. Potential benefits of a fee credit policy include increased public understanding and acceptance of the stormwater program and fee, incentives to implement enhanced onsite stormwater controls, and increased participation in pollution prevention and low impact development (LID) stormwater management activities.

A financial analysis of the Town's stormwater utility typical expenditures by major function or service provides an accounting basis for understanding which components of the stormwater service charge are potentially creditable. The stormwater staff estimate for the breakdown of stormwater management costs in Fiscal Year 2014 is shown in Table 2-18. Certain aspects of the Town's stormwater service charges are related to fixed costs or are otherwise required regardless of the level of stormwater management controls and/or activities implemented by utility customers. However, other aspects of the Town's stormwater services and stormwater management program may benefit from onsite stormwater control measures and/or pollution prevention activities by utility customers. The first two stormwater budget areas listed in Table 2-8 account for 67% of the 2014 budget and encompass activities with minimal potential to be impacted by customer initiatives. However, expenditures for storm drain maintenance and repair, capital improvements, and other types of projects could potentially be reduced by privately developed stormwater measures.



Table 2-18. Chapel Hill Fiscal Year 2014 Stormwater Budget Breakdown

Stormwater Budget Area	% of Town Stormwater Budget
Stormwater Regulatory Compliance (e.g., NPDES permit activities, Jordan Lake regulations, stream determinations, floodplain management, watershed planning)	51%
Street Sweeping	16%
Stormwater Infrastructure (e.g., storm drain maintenance and repair, drainage projects; capital projects)	33%
	100%

Following discussion and consideration of the survey findings and consultant recommendations, the Stormwater staff and Stormwater Advisory Board developed a fee credit policy framework. The Town proposes to offer stormwater fee credit, up to a total of 50% reduction, for properties other than non-single and two-family residential properties. Property owners demonstrating exceedance in the areas of water quality or peak rate controls, or by treating offsite runoff, are potentially eligible for credit. Credit will be offered only for low impact and structural controls, and not for public education efforts. Credit may also be available for [NPDES](#) MS-4 permit holders.

The adoption by the NC State Legislature in 2009 of the [Jordan Lake Rules](#) significantly impacts the Town's stormwater management program. The proposed fee credit criteria are partly derived from the requirements under various components of the Jordan Lake Rules. When fully implemented, the Jordan Lake Rules will require, among other things, that new development and re-development sites meet nutrient discharge limits of 2.2 pounds/acre/year for nitrogen and 0.82 lb/ac/yr for phosphorus in the Upper New Hope arm where Chapel Hill is located. A spreadsheet-based accounting tool for computing nutrient export loads from a site has been developed by the [NC DWR](#) and is the basis for enforcement of this rule. The tool projects the nutrient reductions from a variety of [LID](#) practices, as well as more traditional stormwater control measures. Under the Jordan Lake existing development rules, the Town will be charged with implementing measures to reduce nutrient loads from areas of existing development and could eventually face requirements to reduce loads by designated percentages. The Jordan Lake Rules also require preservation of stream buffers, in a manner similar to what has already been required under Chapel Hill's [LUMO](#), but with some variations. One objective of the stormwater credit policy is to provide incentives for private property owners to contribute to meeting the Town's efforts to reduce nutrient loading to Jordan Lake.



Fee Credit Overview

The Town of Chapel Hill has peak rate reduction, volume reduction and pollutant removal requirements which are described in the Town's [LUMO](#). These measures have been in place since 2003 and were updated in 2012 to incorporate the regulations under the [Jordan Lake Rules](#) for new development and to modify the stormwater requirements for individual single-family residential projects. Table 2-19 provides a summary of these stormwater requirements.

Table 2-19. Chapel Hill Stormwater Control Requirements

Type of Control	Control Levels Required
Peak Flow Rate*	For 1-yr, 2-yr, and 25-yr storms, post-development peak discharge rates from site may not exceed pre-development rates.
Volume*	For the 2-yr, 24-hr storm, post-development runoff volume may not exceed pre-development volume (2-5 day release for runoff that is ponded).
Total Suspended Solids (TSS)*	Removal of 85% of TSS from site runoff resulting from first one-inch of rainfall before discharge
Nitrogen	Annual load discharged from site shall not exceed 2.2 #/ac/yr.
Phosphorus	Annual load discharged from site shall not exceed 0.82 #/ac/yr.
Riparian Buffer	Varies depending on stream mapping and classification and applicability of RCD and Jordan Lake buffer rules; Jordan Lake buffer rules require that a portion of the buffer remain undisturbed

* For all non-single family residential development and for single-family residential development that disturbs more than 20,000 square feet.

For new development or re-development, credit is offered where stormwater measures exceed those required under the current regulations. A property where stormwater controls route and treat offsite runoff in a manner that complies with the Jordan Lake regulations is also eligible for stormwater fee credit. For properties developed prior to implementation of the Jordan Lake Rules, potential fee credits are available for nutrient reduction and peak rate controls. Credit is also available for implementing controls which mitigate the impacts of offsite runoff.

Of the three pollutants addressed in the current stormwater control requirements ([TSS](#), nitrogen and phosphorus), the most stringent control is the nitrogen discharge limit set by the Jordan Lake new development rules. In addition, the nitrogen reduction targets projected for future phases of the Jordan Lake existing development rules are expected to be significantly more difficult to meet than the phosphorus reduction targets. Nitrogen reduction is proposed as the criterion for the water quality component of the fee credit policy.

The proposed fee credit policy is intended to provide incentives for non-residential property owners to implement low impact development and/or traditional stormwater control measures that are above and beyond the stormwater requirements in place at the time the property was or is being developed. The fee credit will help to offset some of the costs that private owners will



incur in **exceeding** required efforts to reduce nutrient loads to Jordan Lake, lessen the negative impacts of urban development on local streams, and reduce downstream flooding. For both new development and retrofit credits, the Jordan Lake Stormwater Load Accounting Tool will serve as the basis for nutrient load computations.

Performance Requirements for New Development Credit

In order for a new development or re-development property to be considered for a stormwater fee credit, the proposed combination of low impact and stormwater controls must be demonstrated to exceed the current requirements. Even though a combination of measures could theoretically qualify for a credit exceeding 50% of the property's fee, the maximum credit available will be 50%. Property owners are required to maintain stormwater controls in order to continue to receive the fee credit. Table 2-20 lists the credits proposed for properties being developed or re-developed.

Table 2-20. Fee Credits for New & Re-Development Stormwater Controls

Type of Control	Credit Structure	Maximum Credit
Nitrogen Reduction	5% credit for each additional 0.1#/ac/yr reduction below the required 2.2#/ac/yr.	30%
Peak Flow Rate *	5% credit is available for each additional 10% reduction in the peak discharge rates for the 1-, 2- and 25-year storms.	20%
Runoff from Offsite Tributary Impervious Areas w/o Stormwater BMPs	Credits for nitrogen reduction and peak flow rate controls for flows from offsite tributary impervious areas are computed as retrofit credits. Percent reductions are applied to the applicable stormwater fee for the tributary impervious area, but credit is given to the owner of the site under development. If adjacent property is later re-developed with its own stormwater controls, fee credit may be adjusted.	50% of fee for offsite area

**To receive a fee credit, the peak flow rate for all three design storms must be reduced by 10%.*

Performance Requirements for Retrofit Credit

A property developed prior to implementation of the [Jordan Lake Rules](#) will be eligible for a stormwater fee credit if retrofits are implemented on the site in a manner that contributes to the Town's stormwater management goals. A key objective of the retrofit fee credit is to encourage implementation of measures that enhance the Town's efforts to comply with the Jordan Lake existing development rules. Credit will be granted only for retrofit stormwater measures that control nitrogen exports and/or peak flow rates in a manner that exceeds the stormwater requirements in effect at the time of site development. Total maximum fee credit for a site is 50%. Property owners are required to maintain stormwater controls in order to continue to receive the fee credit.

Retrofit credits are based on proposed measures in comparison to baseline conditions for the site. Baseline conditions are the computed peak flow rates and nitrogen load exports for the site without consideration of the stormwater controls for which retrofit credit is sought. For most



applicants, baseline conditions will refer to the existing site conditions prior to construction of a proposed retrofit stormwater control. For applicants seeking retrofit credits for stormwater control measures previously installed, which exceeded requirements in effect at the time of site development, baseline conditions will be the computed stormwater quantities and pollutant loads with only the required stormwater controls in place. Applicants for retrofit credits must provide documentation of baseline conditions. Photos of any existing stormwater features and stream buffer areas must be included in the application for fee credit. The submittal should include the estimated annual nutrient exports from the site with the retrofit stormwater controls in place, as compared to nutrient exports for the baseline condition. Computations should be made using the Jordan Lake Stormwater Load Accounting Tool, a spreadsheet tool provided by [NC DWR](#) to estimate nutrient exports from sites in the Jordan Lake watershed. If credit is being sought for peak flow rate and/or offsite runoff controls, then computations of peak flow rates for baseline and retrofit conditions for must also be included in the application. Baseline conditions should assume good operation of any stormwater control features which were required at the time of development. Stormwater controls which have fallen into disrepair will need to be rehabilitated prior to or in conjunction with incorporation of retrofit measures. Fee credits are not extended for efforts necessary to return the site to a condition which meets the stormwater requirements applicable at the time of development. Proposed retrofit stormwater fee credits are listed in Table 2-21.

Table 2-21. Fee Credits for Retrofit Stormwater Controls Exceeding Requirements

Type of Control	Credit Structure	Maximum Credit
Nitrogen Reduction	5% credit for each 10% reduction in annual nitrogen export load, as compared to the baseline condition.	30%
Peak Flow Rate *	5% credit is available for each 10% reduction in the peak discharge rates for the 1-, 2- and 25-year storms. This credit is only available for peak rate controls on sites where no stormwater detention was required at time of development.	20%
Runoff from Offsite Tributary Impervious Areas w/o Stormwater BMPs	If retrofits are implemented to additionally treat runoff from offsite tributary impervious areas, additional fee credit will equal to the dollar amount that would apply for a similar control were it located on the adjacent property. If the adjacent property is later re-developed with its own stormwater controls, fee credit may be adjusted.	50% of fee for offsite area

* To receive a fee credit, the peak flow rate for all three design storms must be reduced by 10%.

If a property owner seeks to apply for credit for stormwater controls previously implemented (i.e., baseline conditions are not equal to existing conditions), they will need to provide documentation that the measures exceed the stormwater requirements in place at the time of development. For example, copies of as-built drawings, a certificate of occupancy, or other Town approvals or correspondence may need to be included in the application. For measures installed subsequent to initial site development, documentation demonstrating the time of



installation (before and after photographs, receipts, etc.) may be sufficient. Stormwater fee credits are not retroactive, and will be applied beginning with the next billing cycle following approval by the Town of Chapel Hill Stormwater Management Program.

Requirements for NPDES Credit

Properties which are covered under an [NPDES](#) stormwater permit, separate from the Town of Chapel Hill's permit, may be eligible for a stormwater fee credit. The only other NPDES stormwater permit holder in the Town of Chapel Hill is the University of North Carolina, which has a negotiated cost-sharing arrangement with the Town under the development agreement for Carolina North. Based on the initial determination of cost-sharing, [UNC](#) will pay a stormwater utility fee pro-rated at 24% for the Carolina North campus. The cost-share percentage is to be re-assessed every three years. No agreement has been determined regarding payment of a stormwater utility fee for the main campus. UNC has a comprehensive stormwater management program and pays a large portion of its own costs for managing stormwater.

The Town recognizes that private properties may potentially be permitted under an [NPDES](#) industrial stormwater permit. Such properties may be eligible for a stormwater fee credit, with the amount to be determined based on a cost analysis similar to that done for the [UNC](#) agreement.

Incentives

The Town may also opt to adopt other types of incentives, for both residential and non-residential property owners, to encourage adoption of stormwater best management practices. The following lists some types of incentive programs used in other cities:

- Riparian buffer restoration incentive program – Town can offer expertise and/or materials and/or labor to encourage property owners to revegetate denuded stream buffers and grant a conservation easement to the Town.
- Recognition/award programs – could be applied for various categories of properties and/or specific types of stormwater practices.
- Grants or in-kind services to be applied for construction of retrofits – an example would be having the Town supply materials and oversee construction of a stormwater wetland or pond or daylighting of a pipe where a neighborhood organization has agreed to provide labor and appropriate easements.
- Contests – could be conducted among site designers as an incentive for more comprehensive low-impact site development designs; among residents within a neighborhood; or between different neighborhoods to spur implementation of stormwater [BMPs](#).



Targets and Budget

The fee credit policy is proposed to be adopted in conjunction with the [LUMO](#) update in Year 1. There is no additional program cost budgeted for the fee credit program. For the financial analyses described in the Implementation Schedules and Funding Plan in Section 1, it is assumed the 0.5% of properties that are not single-family-residential will qualify for a maximum 50% stormwater fee credit. The estimated annual revenues for the stormwater program are reduced accordingly.



Community Rating System Program

[FEMA](#) offers the Community Rating System (CRS) Program to encourage communities to adopt sound and proactive [floodplain](#) management practices. Discounts on flood insurance rates are offered to property owners residing in those communities participating in the CRS program. Under the [CRS](#) program, FEMA encourages and rewards community activities that go beyond the minimum requirements of the [NFIP](#) to:

- Reduce and avoid flood damage to insurable property,
- Strengthen and support the insurance aspects of the [NFIP](#), and
- Foster comprehensive floodplain management.

The Town's floodplain management program includes a number of the creditable activities under the [CRS](#) program. Documenting and furthering these efforts under the CRS program is one of the Goal 2 strategic initiatives and indirectly contributes to Key Strategic Measure 4 (*reductions in flooding risks*).

Of the 570 [NFIP](#) communities in North Carolina, a total of 82 communities were participating in the CRS as of May 2013. Property owners in North Carolina CRS communities save over \$7.5 million annually on flood insurance premiums. The City of Charlotte, the Town of Grifton and the Town of Kinston have the highest ratings in the state (Classification 5) and property owners in those communities receive a 25% discount on flood insurance premiums. The median rating of participating CRS communities in North Carolina is 8, where property owners receive a 10% flood insurance discount. Within the Town of Chapel Hill, 717 property owners carry flood insurance policies, with annual premiums totaling \$528,779.⁵

CRS Schedule and Activities

The CRS schedule is the tool communities use to describe and evaluate floodplain management activities. The schedule includes the application procedures, the list of 19 creditable activities, and the range of points assigned to each activity. There are ten CRS classes, with 10 as the default class for [NFIP](#) communities claiming no CRS credits and 1 as the class with the most credit points and the maximum insurance premium discount. The community submits an application to FEMA for a particular classification by documenting the applicable credits. The community's efforts are reviewed by FEMA during a verification visit, and FEMA notifies the community, state, insurance companies, and other appropriate parties of the classification designation. The classification becomes effective on May 1 or October 1, whichever comes first after verification. Annual recertification is required. Table 2-22 lists the CRS Schedule Activities from the 2013 CRS Coordinator's Manual.⁶ The 2013 update was published in April 2013 and is awaiting approval from the Office of Management and Budget.

⁵ NFIP Policy Statistics, 9/30/2013. <http://bsa.nfipstat.fema.gov/reports/1011.htm#NCT>

⁶ National Flood Insurance Program Community Rating System Coordinator's Manual, 2013 Edition, FIA-15/2013, Federal Emergency Management Agency. Available for download at <http://www.fema.gov/media-library/assets/documents/8768?id=2434>



Table 2-22. 2013 [CRS](#) Schedule Activities

ACTIVITY	MAXIMUM POSSIBLE POINTS ^A	MAXIMUM POINTS EARNED ^B	AVERAGE POINTS EARNED ^C	PERCENTAGE OF COMMUNITIES CREDITED ^D
300 Public Information				
310 Elevation Certificates	116	116	46	100%
320 Map Information Service	90	70	63	92%
330 Outreach Projects	350	175	63	90%
340 Hazard Disclosure	80	57	14	72%
350 Flood Protection Information	125	98	33	92%
360 Flood Protection Assistance	110	65	49	46%
370 Flood Insurance Promotion ^E	110	0	0	0%
400 Mapping & Regulations				
410 Floodplain Mapping	802	585	65	50%
420 Open Space Preservation	2,020	1,548	474	68%
430 Higher Regulatory Standards	2,042	784	214	98%
440 Flood Data Maintenance	222	171	54	87%
450 Stormwater Management	755	540	119	83%
500 Flood Damage Reduction				
510 Floodplain Management Planning	622	273	123	43%
520 Acquisition and Relocation	1,900	1,701	136	23%
530 Flood Protection	1,600	632	52	11%
540 Drainage System Maintenance	570	449	214	78%
600 Warning and Response				
610 Flood Warning and Response	395	353	144	37%
620 Levees ^F	235	0	0	0%
630 Dams ^F	160	0	0	0%

A The maximum possible points are based on the 2013 **CRS Coordinator's Manual**.

B The maximum points earned are converted to the 2013 Coordinator's Manual from the highest credits attained by a community as of October 1, 2011. Growth adjustments and new credits for 2013 are not included.

C The average points earned are converted to the 2013 Coordinator's Manual, based on communities' credits as of October 1, 2011. Growth adjustments and new credits for 2013 are not included.

D The percentage of communities credited is as of October 1, 2011.

E Activity 370 (Flood Insurance Promotion) is a new activity in 2013. No community has earned these points.

F Activities 620 and 630 were so extensively revised that the old credits cannot be converted to the 2013 Coordinator's Manual.



There are six minimum [CRS](#) program prerequisites that a local government must meet to be considered for the program. They are:

1. The community must have been in the Regular Phase of the National Flood Insurance Program (NFIP) for at least one year.
2. The community must be in full compliance with the minimum requirements of the NFIP.
3. The community must maintain FEMA Elevation Certificates on all new buildings and substantial improvements constructed in the Special Flood Hazard Area (SHFA) after the community applies for CRS credit.
4. If there are one or more repetitive loss properties in the community, the community must take certain actions as specified in Sections 501–504. These include reviewing and updating the list of repetitive loss properties, mapping repetitive loss areas, describing the causes of the losses, and sending an outreach project to those areas each year.
5. The community must maintain all flood insurance policies that it has been required to carry on properties owned by the community.

To the extent that the Town's [LUMO](#) and the [RCD](#) requirements extend beyond the standard NFIP rules, points could potentially be awarded in the Higher Regulatory Standards and Open Space Preservation categories of the CRS program. Some of the existing activities and services of the Stormwater Program, such as providing FEMA map information on the Town's website and conducting workshops for real estate and insurance agents, could also be credited. Participation in the CRS program would require some additional ongoing efforts in regard to public outreach, [floodplain](#) management, and record-keeping.

Targets and Budget

The CRS application process is budgeted for \$5,000 in Year 3 for some initial effort, which could include survey work and possibly assistance from a consultant or temporary employee. Year 4 and Year 5 are budgeted at \$5,000 each, with \$10,000 annually also budgeted for development of a flood hazard mitigation plan concurrent with the CRS application process. Possibly the CRS application can be completed in-house, but the budget acknowledges that significant staff time will be required for the effort.

Financial Analysis Model B does not include any funding for the CRS program. Under the lesser stormwater fee increases, it is expected that the CRS program would be postponed until the 5-10 year planning horizon.

Table 2-23. Implementation Costs for CRS Program

		Model A	Model B
Year 3	Program Expenses	\$5,000	
Year 4	Program Expenses	\$5,000	
Year 5	Program Expenses	\$5,000	



Flood Hazard Mitigation Program

As a participating community in [FEMA](#)'s National Flood Insurance Program, the Town regulates development within the Special Flood Hazard Areas ([SFHAs](#)). FEMA uses the 1% annual chance storm event as the primary benchmark for delineating and mapping special flood hazard areas adjacent to streams and rivers. The 1% annual chance event, also sometimes referred to as the 100-year storm or flood, is the magnitude of storm that is estimated to have a 1% chance of occurring in any given year. To address flooding problems for existing homes or businesses within the FEMA-mapped [floodplain](#), the Town proposes to develop a comprehensive Flood Hazard Mitigation Program (FHMP).

The goal of a Flood Hazard Mitigation Program (FHMP) is to reduce the potential for personal injury and property damage due to flooding. Development of a FHMP is a strategic initiative under Goal 2 and directly contributes to Key Strategic Measure 4 (reductions in flooding risks). Although a comprehensive FHMP is not a requirement of the [CRS](#) program, a plan to reduce flood damage risks on properties with *repeated* flood damage losses is one of the pre-requisites for the CRS program. Additional flood hazard mitigation efforts will be creditable under the CRS program and allow for a higher classification and level of insurance discount. As an [NFIP](#) community, the Town will develop a FHMP that aligns with FEMA policies and incorporates procedures required to obtain FEMA hazard mitigation grant funding.

According to FEMA records, flood insurance payments in Chapel Hill as of September 30, 2013 have totaled over \$7 million for 231 claims.⁷ An additional 62 claims are listed by FEMA as "claims without payment." Chapel Hill has a number of properties where damages due to flooding have been incurred multiple times, classified by FEMA as "repetitive loss claims" (RLC) properties.

FEMA Hazard Mitigation Program

FEMA defines hazard mitigation as "any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards and their effects." FEMA's decision as to whether or not it makes sense to buyout or improve a particular property is based on weighing the *benefits*, (expected flood damage losses that would be avoided over the next 30 years) against the *costs* of buying the property or undertaking a project to reduce flooding. Only where it can be proven that the benefits will be greater than the costs will FEMA deem the project to be cost-effective. The higher the benefit/cost ratio for a buyout or project, the greater the possibility that FEMA grant funding can be obtained. FEMA encourages states and local governments to take advantage of funding provided by hazard mitigation assistance (HMA) programs.

⁷ "[NFIP Policy & Claim Statistics for Flood Insurance](#)." Washington D.C. Federal Emergency Management Agency. Database online. Available from <http://bsa.nfipstat.fema.gov/reports/1040.htm#37> accessed on December 13, 2013.



[FEMA](#) administers three programs to fund hazard mitigation efforts, having recently combined several programs:

- Hazard Mitigation Grant Program (HMGP) – assists in implementing long-term hazard mitigation measures following Presidential disaster declarations. Funding is available to implement projects in accordance with State, Tribal, and local priorities.
- Pre-Disaster Mitigation (PDM) – provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects prior to a disaster.
- Flood Mitigation Assistance (FMA) – provides funds on an annual basis so that measures can be taken to reduce or eliminate risk of flood damage to buildings insured under the [NFIP](#). There are special emphases and provisions for projects related to repetitive loss and severe repetitive loss properties.

Typically, FEMA funds 75% of a project and the local government, or some other party, funds 25%. Funding availability among the various programs fluctuates from year-to-year with changes in federal budgets. For flood-prone properties, there are several different types of projects to which HMA funds can be applied.

- Acquisition of real property for willing sellers and demolition or relocation of buildings to convert the property to open space use
- Retrofitting structures and facilities to minimize damages from high winds, earthquake, flood, wildfire, or other natural hazards
- Elevation of flood-prone structures
- Minor flood control projects that do not duplicate the flood prevention activities of other Federal agencies
- Localized flood control projects, such as certain ring levees and floodwall systems, that are designed specifically to protect critical facilities

When a local government acquires a property with FEMA assistance, a permanent conservation easement is established on the entire property and the municipality becomes responsible for ongoing property maintenance.

Chapel Hill FHMP History and Proposed Development

One flood hazard mitigation grant project has been successfully implemented in Chapel Hill, and one proposed project failed to obtain adequate property owner participation. Three homes on Dickerson Court were purchased by the Town under a FEMA grant. In 2005, the Town was approved by FEMA for a \$2.3 million grant to purchase and demolish 36 condominium units at Camelot Village. FEMA's flood mitigation programs are based on voluntary participation, and in the case of buildings with multiple owners, 100% of the owners in a building have to be willing to participate in order for FEMA to fund the property purchase. Camelot Village has two-story buildings and one-third of the property owners at the time of the FEMA grant had never experienced a flood loss. Even for the ground level condominium units, some owners may not have experienced the trauma and personal losses often accompanying flood damages to a structure because they maintain their units as rental properties. For these reasons, there was not



sufficient willingness from the owners to participate and the FEMA grant project was cancelled. Severe flooding subsequently occurred at Camelot Village in June of 2013.

Flood-prone properties can be identified in several ways. [FEMA](#) has mapped Special Flood Hazard Areas (SFHAs) along most of the major streams in Chapel Hill. Properties both within and outside of the mapped [SFHAs](#) have experienced flooding in the past, and thus are known to be at risk of future flooding. Other properties at risk of flooding may be identified in the process of subwatershed planning or analyses done in conjunction with infrastructure capital improvement projects.

The starting point for developing a flood hazard mitigation plan is documenting the number of buildings and the acreage of property in a FEMA-mapped SFHA. For buildings in the SFHA where finished flood elevations are unknown, survey of building elevations is necessary to document the expected level of damage in a flood. FEMA's standard benefit-cost analyses (BCAs) can then be applied to assess the level of projected flood damages and the benefit-cost ratios for buyouts or capital improvements for which FEMA flood hazard mitigation grants may be sought. Additional flood-prone properties, outside of the FEMA SFHAs, should also be included in the flood hazard mitigation program. Developing BCAs for these properties will require hydrologic and hydraulic analyses in order to estimate projected flood levels. Those analyses should be funded and completed as part of a subwatershed plan or planning for a proposed [CIP](#).

Property owners may also report flooding problems to Town staff or specifically request some type of assistance. Unless the Town's stormwater staff ascertain that a particular flooding problem within a FEMA-mapped SFHA is primarily the result of an undersized culvert downstream, the following procedure will be applicable in responding to property owners in areas not yet analyzed as part of a subwatershed plan:

1. Town staff will provide property owner with information about FEMA policies regarding buyouts or other flood mitigation assistance.
2. If property owner has indicated an interest in a buyout (or other applicable FEMA hazard mitigation assistance) and a preliminary BCA indicates that project benefits likely exceed costs, the Town will then contact other property owners in the immediate area who are also subject to flooding in order to assess overall interest.
3. Town will prepare a hazard mitigation grant fund application on behalf of property owners who are interested in buyouts or other applicable assistance. Scheduling for grant application and budgeting of matching funds from Town is subject to ranking of project under the Flood Mitigation [CIP](#) Prioritization.

Development of a [FHMP](#) will provide a roadmap for the Stormwater Program in addressing long-standing flooding problems. The FHMP will also lay the groundwork for leveraging federal and/or state grant monies to assist in CIP projects or buyouts.



Targets and Budget

Development of a [FHMP](#) is budgeted at \$20,000 spread equally over Years 4 and 5, concurrent with the [CRS](#) program development.

Financial Analysis Model B does not include any funding for FHMP. Under the lesser stormwater fee increases, it is expected that development of a FHMP would be postponed until the 5-10 year planning horizon.

Table 2-24. Implementation Costs for Flood Hazard Mitigation Program

		Model A	Model B
Year 4	Program Expenses	\$10,000	
Year 5	Program Expenses	\$10,000	



Glossary of Abbreviations and Technical Terms

1% annual chance floodplain – FEMA uses computer modeling of flood events to predict what areas would be inundated in a flood event with a 1% chance of occurring within a given year, referred to as the 1% annual chance flood. Because a flood event of that magnitude would theoretically occur an average of every 100 years, it is sometimes called the 100-year flood. Over the life of a 30-year mortgage, there is roughly a 1-in-4 probability of occurrence of a 1% annual chance flood.

303(d) list - A list of impaired waters, developed by a state to comply with the requirements of section 303(d) of the Clean Water Act.

Benchmarking – evaluating the quality of an organization’s policies, programs, strategies, etc. by comparison with standard measurements, or similar measurements of its peers.

Benthic - Refers to material, especially sediment, at the bottom of an aquatic ecosystem. It can be used to describe the organisms that live on, or in, the bottom of a waterbody.

Benthos – Animals without backbones that live in or on the benthic sediments and are large enough to be seen by the unaided eye.

BMP - Best Management Practice. A measure, practice, or activity that is implemented to mitigate the adverse impacts of uncontrolled runoff. BMPs may be structural (e.g., retention basin) and non-structural (e.g., public education).

Catch basin - A combined stormwater inlet and junction box, usually located at a street curb. A pipe connected to the catch basin conveys stormwater towards a stream or river.

CIP - Capital Improvement Program

Clean Water Act - The series of legislative acts that form the foundation for protection of U.S. water resources, including the Water Quality Act of 1965, Federal Water Pollution Control Act of 1972, Clean Water Act of 1977, and Water Quality Act of 1987. CWA Sections 305(b) and 303(d) deal specifically with water quality assessment and TMDL development and Section 402(p) requires NPDES permits and stormwater quality management programs for stormwater discharges from certain municipal separate storm sewer systems (MS4s).

CRS - Community Rating System, a program administered by the National Flood Insurance Program.

DAP - Drainage Assistance Project / Drainage Assistance Program

DPP – Drainage Partnership Program

EEP – The Ecosystem Enhancement Program is a NC DENR initiative that restores and protects wetlands and waterways by providing mitigation from the environmental damage caused by economic development.



EPA - United States Environmental Protection Agency

Ephemeral stream - A feature that carries only stormwater in direct response to precipitation with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well-defined channel, the aquatic bed is always above the water table, and stormwater runoff is the primary source of water. An ephemeral stream typically lacks the biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

ERU - An Equivalent Rate Unit is a unit of measure used to equate non-residential or multi-family residential runoff to an amount of storm water runoff from an average single family residence.

ESC – Erosion and Sediment Control.

Eutrophication - The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process.

FEMA – United States Federal Emergency Management Agency

FHMP – Flood Hazard Mitigation Program

Floodplain – Any land area susceptible to being inundated by water from any source during the base flood.

FTE - Full-Time Equivalent

FY - Fiscal Year

Geomorphological – Relating to the characteristics, origin, and development of landforms, including streams and rivers.

GIS - Geographic Information System

HMGP - Hazard Mitigation Grant Program

Headwall - A structural retaining wall at the ends of a culvert, or at the end of a drainage conduit, used primary to control seepage from behind the wall and to prevent undermining of the structure.

Headwater streams – The small swales, creeks, and streams that are the origins of most rivers.

IDDE - Illicit Discharge Detection and Elimination



Impaired waterbody - A waterbody (i.e., stream reaches, lakes, waterbody segments) with chronic or recurring monitored violations of the applicable numeric and/or narrative water quality criteria.

Impervious area - Developed areas of land that prevent or significantly impede the infiltration of stormwater into the soil.

Intermittent stream - A well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff. An intermittent stream often lacks the biological and hydrological characteristics commonly associated with the continuous conveyance of water.

Jordan Lake Rules - The Jordan Lake Rules are the Jordan Lake Nutrient Management Strategy designed to restore water quality in the lake by reducing the amount of pollution entering upstream. <http://portal.ncdenr.org/web/jordanlake>

LID - Low Impact Development or Low Impact Design is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. In addition to making a development (or redevelopment) less impervious for stormwater management, there are other non-stormwater approaches to low impact design such as the C-RED program, pedestrian and bike paths, solid waste (reduce, reuse, recycle), reclaimed water use, energy conservation, etc.

LUMO - Town of Chapel Hill Land Use Management Ordinance

Monitoring - Periodic or continuous sampling and measurement to determine the physical, chemical, and biological status of a particular medium, such as air, soil or water.

MOU – Memorandum of Understanding

MS4 - Municipal **S**eparate **S**torm **S**ewer **S**ystem

NC DENR - North Carolina Department of Environment and Natural Resources

NC DOT - North Carolina Department of Transportation

NC DWR – North Carolina Division of Water Resources

NCSU - North Carolina State University

NFIP - National Flood Insurance Program

NPDES – The National Pollutant Discharge Elimination System is a national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under Section 307, 402, 318, and 405 of the Clean Water Act. Facilities subjected to NPDES permitting regulations include operations such as municipal wastewater treatment plants and industrial waste treatment facilities.



Nutrients - Substances necessary for the growth of all living things, such as nitrogen, carbon, potassium, and phosphorus. Excessive amounts of nutrients in waterbodies can be harmful to aquatic environments.

O&M - Operations and Maintenance. Refers to the plan required for each stormwater management structure associated with development projects. The plan details the inspection, operation, and maintenance needs for the structure.

OWASA - Orange Water and Sewer Authority

Perennial stream - A well-defined channel that contains water year-round during a year of normal rainfall with the aquatic bed located below the water table for most of the year. Groundwater is the primary source of water for a perennial stream, but it also carries stormwater runoff. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

RCD - Town of Chapel Hill Resource Conservation District

ROW - Right-of-Way

Runoff - Water from rain, snowmelt, or irrigation that flows over the ground and returns to streams. It can collect pollutants from air or land and carry them to streams and other waterbodies.

SESWA – Southeast Stormwater Association.

SFHA – Special Flood Hazard Area. The land area covered by the floodwaters of the base flood (1% annual chance flood) is the Special Flood Hazard Area (SFHA) on NFIP maps. The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

Stormwater - Water that originates during precipitation events. It may also be used to apply to water that originates with snowmelt that enters the stormwater system. Stormwater that does not soak into the ground becomes surface runoff, which either flows directly into surface waterways or is channeled into storm sewers, which eventually discharge to surface waters.

Stormwater Advisory Board - formally named the “Stormwater Management Utility Advisory Board”, this group of nine members (five residential property owners, three business owners or employees and one UNC employee) is charged with providing recommendations regarding various aspects of the Town’s stormwater management program and assisting Town staff in public education and outreach efforts.

Stressor - Any substance or condition that adversely impacts the aquatic ecosystem.

Synoptic - Relating to or displaying conditions as they exist simultaneously over a broad area. A synoptic water quality study involves concurrent sampling at multiple locations.



TJCOG - Triangle J Council of Governments

TKN – Total Kjeldahl Nitrogen is the sum of organic nitrogen and ammonia in the chemical analysis of soil, water, or wastewater.

TMDL - A Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. The law requires that states establish priority rankings for waters on the 303(d) lists and develop TMDLs for these waters. In a broader sense, TMDL refers to a regulatory program developed by a state to improve the quality of a stream, river or lake that is impaired.

TSS - Total Suspended Solids. A measure of the suspended solids in wastewater, effluent, or water bodies, determined by tests for total suspended nonfilterable solids.

UNC - University of North Carolina at Chapel Hill

USGS - United States Geological Survey

Watershed - Area that drains or contributes water to a particular point, stream, river, lake, or ocean. Larger watersheds are also referred to as basins. Watersheds range in size from a few acres for a small stream to large areas of the country.