Goose Creek Water Quality Recovery Program Plan for the Fecal Coliform TMDL

Goose Creek in Mint Hill

Prepared for:

Mecklenburg County
Mint Hill
Stallings
Indian Trail

Prepared by:

Mecklenburg County Storm Water Services
Version 2: November 12, 2009

Charlotte-Mecklenburg STORM WATER Services

TABLE OF CONTENTS

Figures:

Tables:

Appendices:

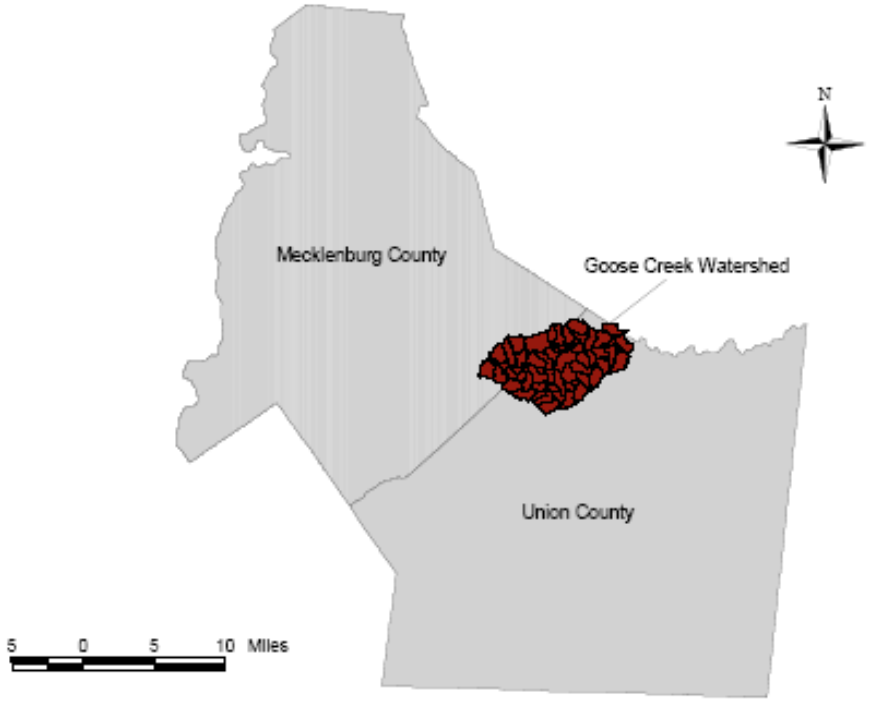
Common Acronyms:

BMP:	Best Management Practice
DWQ:	N.C. Department of Environment and Natural Resources, Division of Water Quality
EDMS:	Environmental Data Management System
FY:	Fiscal Year running from July 1 through June 30 of the following year with the FY number based on this last year (Example: FY10 runs from July 1, 2009 through June 30, 2010)
HOA:	Homeowners' Association
MCWQP:	Mecklenburg County Water Quality Program which is a component of Charlotte-Mecklenburg Storm Water Services
MS4:	Municipally Separate Storm Sewer System
TMDL:	Total Maximum Daily Load
WQRP:	Water Quality Recovery Program

SECTION 1.0 BACKGROUND

The Goose Creek Watershed is located in the Yadkin/Pee Dee River Basin in southeastern Mecklenburg County and northeastern Union County in the southern piedmont region of North Carolina (see Figure 1).

Figure 1: Location of the Goose Creek Watershed in Mecklenburg and Union Counties



The headwaters of the Goose Creek Watershed originate in Mecklenburg County and flow to Union County where the creek discharges to the Rocky River. The main channel of Goose Creek has a length of approximately 16.3 miles. Stevens and Duck Creeks, which originate in Mecklenburg County, are both tributaries to Goose Creek. Stevens Creek flows to Goose Creek at the Mecklenburg-Union County line west of Stevens Mill Road while Duck Creek joins Goose Creek just upstream of Brief Road in Union County. The Goose Creek Watershed contains four (4) jurisdictions that have been issued NPDES Phase II Storm Water Permits for their municipally separate storm sewer systems (MS4s), including Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail. Table 1 below describes the area within the Goose Creek Watershed contained in these jurisdictions. Table 2 below contains general information regarding the Goose Creek Watershed.

Table 1: MS4 Jurisdictions in the Goose Creek Watershed

MS4 Jurisdiction	Area in Watershed	% of Watershed
Mint Hill/Mecklenburg County(1)	7,195 acres	26%
Stallings	1,400 acres	5%
Indian Trail	855 acres	3%

(1) Mecklenburg County includes the Town of Mint Hill

Figure 2: Goose Creek Watershed Area

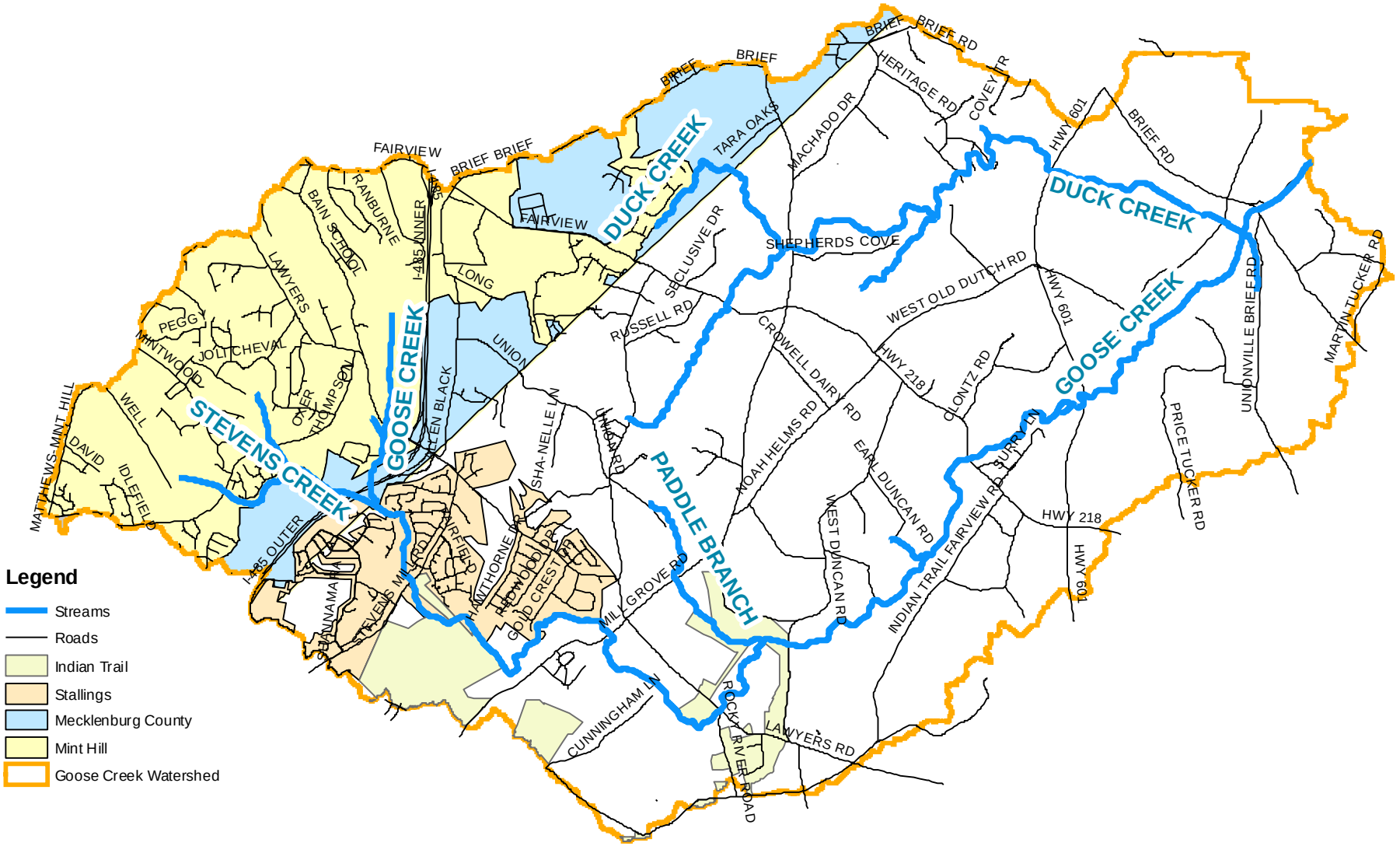


Table 2: General Information Regarding the Goose Creek Watershed

Watershed Area	42 square miles or 27,720 acres in the Yadkin/Pee Dee River Basin
Stream Length	Approximately 16.3 main channel miles
Stream Classification	Class C: Protected for secondary recreation, fishing, aquatic life, including propagation and survival, and wildlife.
Predominant Land-uses	Forest = 12,828 acres @ 46%
	Agricultural = 6,461 acres @ 23%
	>2 Acre Residential = 3,946 acres @ 14%
	0.5 – 2 Acre Residential = 1,592 acres @ 6%
Topography	Highest elevation = 754 ft m.s.l. Lowest Elevation = 494 ft m.s.l. Generally the topography is rolling hills with moderate slopes of 2-4%.
Vegetation	Vegetation is a mix of hardwood forested areas, agriculture (row crops and hay) and grasses and shrubs associated with suburban development.
Climate	The climate is temperate with approximately 43" of rain per year.
Hydrology	Hydrology follows a typical dendridic drainage pattern typified by most piedmont areas.
Geology	Piedmont soils and occasional bedrock outcrops. This gives way to Carolina Slate Belt deposits that begin at the Mecklenburg and Union County line and extend east to where Goose Creek enters the Rocky River.
NPDES Permitted Dischargers	Oxford Glen: 15349 Bexley Place (0.075 mgd)
	Ashe Plantation: Quarters Lane (0.154 mgd)
	Country Woods: Country Woods Dr (1.036 mgd)
	Fairfield Plantation: Stoney Ridge Rd (0.108 mgd)
NPDES Phase II Storm Water Permits	Mint Hill and Mecklenburg County
	Stallings
	Indian Trail
Soils	Approximately 88% of the watershed is made up of Class B soils and 12% is Class C soils.
Population	The approximate population of the Goose Creek Watershed is 10,000 residents.
Aquatic Species	Typical piedmont aquatic species including several varieties of caddisflies, mayflies and stoneflies, terrestrial insects, fish, amphibians, mussels, snails and other species.

In 1998, North Carolina's 303(d) list of impaired waters identified Goose Creek from its source to the Rocky River as impaired due to elevated fecal coliform concentrations. This impairment triggered the development of a total maximum daily load (TMDL) for the watershed that was subsequently submitted and approved by EPA on July 8, 2005. The TMDL encompasses all the stream segments contained in the 303(d) list for the watershed. Goose Creek is also listed as impaired due to a lack of aquatic life; however, a TMDL has not been developed for this listing. Another issue in Goose Creek is that it provides critical habitat for the Carolina heelsplitter (*Lasmigona decorate*), a species of freshwater mussel that is listed as federally endangered by the U.S. Fish and Wildlife Service under the provisions of the Endangered Species Act. The document contained herein addresses only the fecal coliform TMDL and does not address the biological impairment or the preservation of the Carolina heelsplitter.

The Town of Mint Hill and Mecklenburg County as well as the Towns of Stallings and Indian Trail in Union County are located in the Goose Creek Watershed and have been issued NPDES

Phase II Storm Water Permits. Part II, *Final Limitations and Controls for Permitted Discharges*, Section A, *Program Implementation*, Paragraph 11 of these Phase II Permits specifies the following: "If the permitted MS4 becomes subject to an approved TMDL, and following notice of such by the Division, the permittee shall implement a TMDL Water Quality Recovery Program." Parts (a) through (e) of Paragraph 11 contain additional requirements relating to the development and implementation of this Water Quality Recovery Program (WQRP) as follows:

(a) Within two years after receiving the Division's notice that the permittee is subject to a TMDL, the permittee shall establish a TMDL Water Quality Recovery Program and shall identify the locations of all currently known MS4 outfalls within its jurisdictional area with the potential of discharging the pollutant(s) of concern: to the impaired segments, to their tributaries, and to segments and tributaries within the watershed contributing to the impaired segments. The permittee shall also develop a schedule to discover and locate all other MS4 outfalls within its jurisdictional area that may be discharging the pollutant(s) of concern: to the impaired stream segments, to their tributaries, and to segments and tributaries within the watershed contributing to the impaired segments.

(b) Within two years after receiving the Division's notice that the permittee is subject to a TMDL, the permittee shall develop a monitoring plan for each pollutant of concern. The monitoring plan shall include the sample location by verbal description and latitude and longitude coordinates, sample type, frequency, any seasonal considerations, and a monitoring implementation schedule for each pollutant of concern. Where appropriate, the permittee may reduce the monitoring burden by proposing to monitor outfalls that the Division would consider substantially similar to other outfalls. The permittee may also propose in-stream monitoring where it would complement the overall monitoring plan. The monitoring plan shall be adjusted as additional outfalls are identified in accordance with the schedule required in (a) above and as accumulating data may suggest.

(c) The permittee shall include the location of all currently known MS4 outfalls with the potential of discharging the pollutant(s) of concern, the schedule for discovering and locating currently unknown MS4 outfalls with the potential of discharging the pollutant(s) of concern, and the monitoring plan, (all as required in (a) and (b) above, and all part of the TMDL Water Quality Recovery Program) in the first Storm Water Management Plan annual report due no earlier than two years after the Division's initial notification of the applicability of a TMDL.

(d) The next and each subsequent Storm Water Management Plan annual report shall include an assessment of the available data for each pollutant of concern, and an assessment of the effectiveness of the BMPs employed, to determine what, if any, additional BMP measures may be necessary to return the impaired segments to compliance with state water quality standards. The permittee shall implement appropriate BMPs to control the pollutant(s) of concern to the maximum extent practicable. Implementation of the appropriate best management practices constitutes compliance with the standard of reducing pollutants to the maximum extent practicable.

(e) Following any review and comment by the Division on the TMDL Water Quality Recovery Program, the permittee shall incorporate any necessary changes into the program. The permittee shall incorporate the revised TMDL Water Quality Recovery Program into the Storm Water Management Plan.

On August 10, 2006, the North Carolina Department of Environment and Natural Resources, Division of Water Quality (DWQ) initiated Paragraph 11 of the Phase II Permits by issuing written notification to Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail that they were subject to the Goose Creek TMDL for fecal coliform bacteria. The letter specified that requirement (a) through (e) of Paragraph 11 be fulfilled within a specific time frame (see Appendix 1). On October 12, 2007, DWQ provided the Phase II jurisdictions in the Goose Creek Watershed with the "Goose Creek TMDL Water Quality Recovery Program (WQRP) Guidance Document" (see Appendix 2). This document was used as a guide by the Phase II jurisdictions to develop the "Goose Creek Water Quality Recovery Program" which was submitted as part of the annual report dated July 9, 2008. The document contained herein is the Water Quality Recovery Program Plan (WQRP Plan), which serves as a guide in the implementation of the WQRP.

SECTION 2.0 PROGRAM DEVELOPMENT

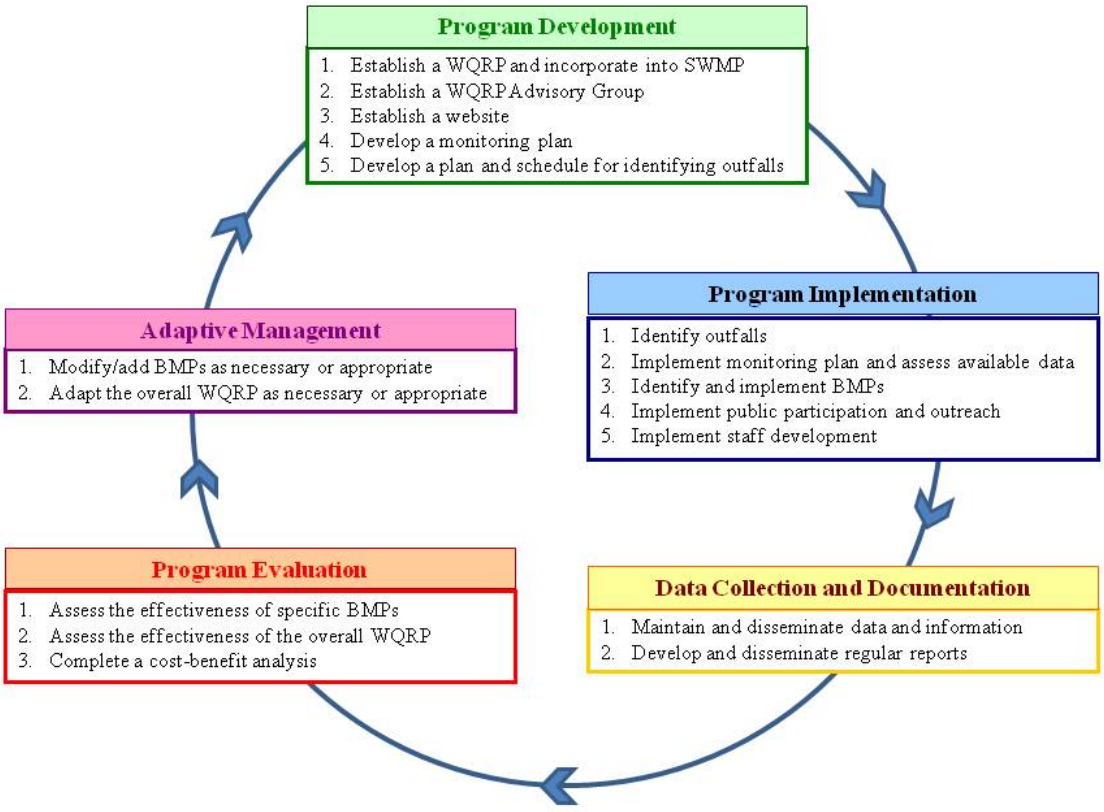
2.1 Components of the Water Quality Recovery Program (WQRP) for Goose Creek

The WQRP developed for the Goose Creek Watershed includes the following five (5) major components

1. Program Development
2. Program Implementation
3. Data Collection and Documentation
4. Program Evaluation
5. Adaptive Management

These five (5) components include a total of 17 program activities that combine to form the WQRP as described in Figure 3.

Figure 3: Goose Creek Water Quality Recovery Program (WQRP)



2.2 Pollutant of Concern Addressed by the Water Quality Recovery Program

The pollutant of concern addressed in the WQRP for the Goose Creek Watershed is fecal coliform bacteria as identified in the approved TMDL. Fecal coliform bacteria are found in the fecal material of humans and animals and can enter surface waters through direct discharges of waste from mammals and birds as well as from agriculture, storm water runoff and malfunctioning sewage collection and treatment systems. Fecal coliform bacteria do not cause diseases but rather serve as an indicator of a variety of microorganism in feces that are known to

be pathogenic. Fecal coliform bacteria is used as an indicator of these pathogens in surface waters because testing for its presence is cheap, reliable and fast particularly in comparison to tests for known pathogens. Water quality monitoring performed by DWQ in the Goose Creek Watershed has revealed elevated levels of fecal coliform bacteria, which is the reason for concern.

2.3 Purpose of the Water Quality Recovery Program

The purpose of the WQRP is to reduce fecal coliform bacteria levels, to the maximum extent practicable, in accordance with the assigned MS4 NPDES regulated Waste Load Allocation (WLA) identified in the approved TMDL for the Goose Creek Watershed, which is represented as a 92.5% reduction in the existing fecal coliform load from the MS4. There are four (4) NPDES regulated MS4s in the Goose Creek Watershed, including Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail. The TMDL further identifies a 92.5% reduction in the fecal coliform load associated with nonpoint sources that do not originate from the MS4s. The TMDL indicates that these combined reductions will restore water quality conditions in the Goose Creek Watershed in compliance with the North Carolina fresh water quality standard for fecal coliform in Class C waters (T15A:02B.0211) that states:

> *"Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100 ml (membrane filter count) based upon at least five consecutive samples examined during any 30-day period, nor exceed 400/100 ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique will be used as the reference method."*

The WQRP specifically addresses the 92.5% reduction in fecal coliform loading assigned to the MS4s in the TMDL and does not cover the 92.5% reduction that is not associated with the MS4s. The biggest source of this non-MS4 related fecal coliform bacteria load is agricultural activity, which encompasses approximately 23% of the Goose Creek Watershed (see Table 2). Other than forests, this is the predominant land-use in the watershed. Based on the TMDL, in the absence of control of these non-MS4 sources the water quality standard will not be achieved; therefore, the achievement of this standard is not a specific goal of the WQRP.

The WQRP endpoint of a 92.5% reduction in fecal coliform loading from MS4s will be achieved through the implementation of structural and non-structural BMPs as described in the WQRP Plan (see Section 3.0). The implementation of these BMPs in accordance with the WQRP Plan will constitute compliance with the standard of reducing pollutants to the maximum extent practicable as specified in the Part II, Section A, Paragraph 11 (d) of the Phase II Permits. For each BMP utilized, a fecal coliform removal efficiency will be assigned in future versions of the WQRP Plan, including non-structural BMPs such as education and septic system inspections. The combined removal efficiencies of BMPs employed to treat the runoff from an MS4 area will need to total at least 92.5% for the area to be considered compliant with the assigned TMDL WLA. Once this has been achieved for all MS4 areas within the Goose Creek Watershed the

WQRP Plan will consider the MS4 areas to be compliant with the TMDL and the WQRP will have reached its endpoint. Section 3.4 contains additional information regarding this process.

To ensure the effective and efficient implementation of the WQRP in accordance with Phase II Permit requirements, the WQRP Plan contained herein has been incorporated into the Storm Water Management Program Plans for Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail.

2.4 Purpose of the Water Quality Recovery Program (WQRP) Plan

The document contained herein is referred to as the WQRP Plan. The purpose of this Plan is to guide the implementation of the WQRP. It includes the monitoring plan, plan and schedule for identification of municipally separate storm sewer system (MS4) outfalls, description of best management practices (BMPs) to be employed to meet the TMDL, and other necessary TMDL compliance measures. This Plan will not include the assessment of the available data or an assessment of the effectiveness of the BMPs employed as required by Part II, Section A, Paragraph 11 (d) of the Phase II Permits. These assessments will be included in the annual reports developed for the WQRP by July 15th of each year. These annual reports will also include a determination regarding additional BMPs or other measures necessary to return the impaired segments to compliance with State water quality standards. These additional BMP measures as well as additions and/or modifications to any other compliance measures or plans will be incorporated into annual updates to the WQRP Plan that will be completed by August 30th of each year. These updates to the WQRP Plan are necessary to ensure its continued effectiveness as a guide to the implementation of the WQRP. Section 6 describes this process in more detail.

2.5 Water Quality Recovery Program Advisory Group

The first step in the development of the Goose Creek WQRP was the establishment of the TMDL Advisory Group consisting of representatives from the following:

- Mecklenburg County Water Quality Program
- Town of Mint Hill
- Town of Stallings
- Town of Indian Trail
- Union County
- DWQ

Initial TMDL Advisory Group meetings focused on the development of the Goose Creek WQRP and resulted in a request to DWQ for a more detailed outline of the requirements of the WQRP. DWQ provided the group with the Draft "Goose Creek TMDL Water Quality Recovery Program Guidance Document" on October 12, 2007 (see Appendix 2), which formed the basis for the development of the WQRP for Goose Creek. Subsequent meetings of the group led to development and implementation of the WQRP by July 2008. The 17 program activities identified in the WQRP Plan (see Figure 3) are implemented by the Mecklenburg County Water Quality Program (MCWQP) under Charlotte-Mecklenburg Storm Water Services for Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail. The TMDL

Advisory Group meets at least annually to review program activities and successes and to modify the WQRP Plan as necessary to improve its overall effectiveness.

2.6 Water Quality Recovery Program Website

A page was developed off Charlotte-Mecklenburg Storm Water Services' website as follows: http://stormwater.charmeck.org (select "Storm Water Professionals", select "Water Quality", and select "TMDLs-Mecklenburg County"). This website serves to document and disseminate information and results regarding the Goose Creek WQRP. The WQRP Plan along with annual reports and water quality monitoring data are maintained on this website.

2.7 Water Quality Recovery Program Monitoring Plan

2.7.1 Purpose

The purpose of the water quality monitoring plan developed for the Goose Creek WQRP is to present a strategy for the collection of information to support the implementation of the WQRP for the Goose Creek Watershed and to monitor its effectiveness. The monitoring plan also serves to identify pollution sources that are subsequently eliminated if found to be in noncompliance with water quality regulations. Some sources such as livestock in the stream are not in violation and therefore will not be eliminated unless voluntarily done so by the property owner. The monitoring plan outlines a strategy for sampling individual land-use sources from select MS4 outfalls as well as in-stream fecal coliform concentrations. The plan describes the sampling strategy for Mecklenburg County and the three (3) incorporated areas of the watershed, including the Towns of Mint Hill, Indian Trail and Stallings.

2.7.2 Water Quality Monitoring Strategy

The goals of the Goose Creek Water Quality Monitoring Plan are as follows:

1. Obtain watershed data and information for the successful development and implementation of BMPs as part of the WQRP.
2. Identify and eliminate pollution sources.
3. Evaluate Goose Creek for compliance with the State's fecal coliform standard for Class C waters as described in Section 2.2 above.

The monitoring strategy developed to achieve these goals consists of the following components that are described in detail in the following Sections:

1. Stream Walks
2. Land-Use Monitoring
3. In-Stream Monitoring
4. Continuous Monitoring and Alert Notification Network (CMANN)
5. USGS Monitoring

2.7.3 Stream Walks

Between May and July 2007, MCWQP walked and/or waded all the perennial and intermittent streams in the Goose Creek Watershed and its tributaries within the boundaries of Mecklenburg

County and the Towns of Mint Hill, Stallings and Indian Trail. It is anticipated that these streams will be walked again in 2012 to document changes. The purpose of the stream walks is three (3) fold as follows:

1. Identify and eliminate potential sources of fecal coliform bacteria.
2. Identify land-use monitoring sites.
3. Identify MS4 Outfalls for each jurisdiction.

In addition to those streams within each jurisdiction, streams flowing into a jurisdiction or those streams likely to be annexed by a jurisdiction are also identified for stream walks. The distribution of streams to be walked by jurisdiction is shown in Figure 4. The following information is collected during stream walks:

1. Samples are collected at tributaries upstream of the confluence of tributary mid-points and 50-acre drainage terminus points if stream flow is present. Samples are analyzed for fecal coliform and temperature.
2. Samples are collected of observed dry weather flows and laboratory analyses are performed for fecal coliform, temperature, specific conductance, chlorine, nutrients, fluoride, surfactant, NO_2, and estimated flow (gpm).
3. A record is obtained of the locations of all storm water outfalls, pipe material and pipe diameter as well as any maintenance issues with the outfalls.
4. A record is obtained of the location of all Charlotte-Mecklenburg Utilities critical assets (aerials, stream crossings, etc.).
5. A record is obtained of the location of all stream blockages that could potentially cause flooding.
6. A record is obtained of potential sources of fecal coliform. These include dog kennels, active domestic animal operations, potential septic system problems and industrial outfalls, etc. Follow up investigations are conducted as necessary to eliminate pollution sources.
7. A record is obtained of areas of excessive erosion.
8. Future land-use sampling sites as described in Section 2.6.2 are identified.

More detailed information regarding the procedures followed in the performance of stream walk activities is contained in the Illicit Discharge Detection and Elimination (IDDE) Policies and Procedures Manual (Mecklenburg County Water Quality Program, 2009).

Figure 4: Distribution of Stream Walks by Jurisdiction

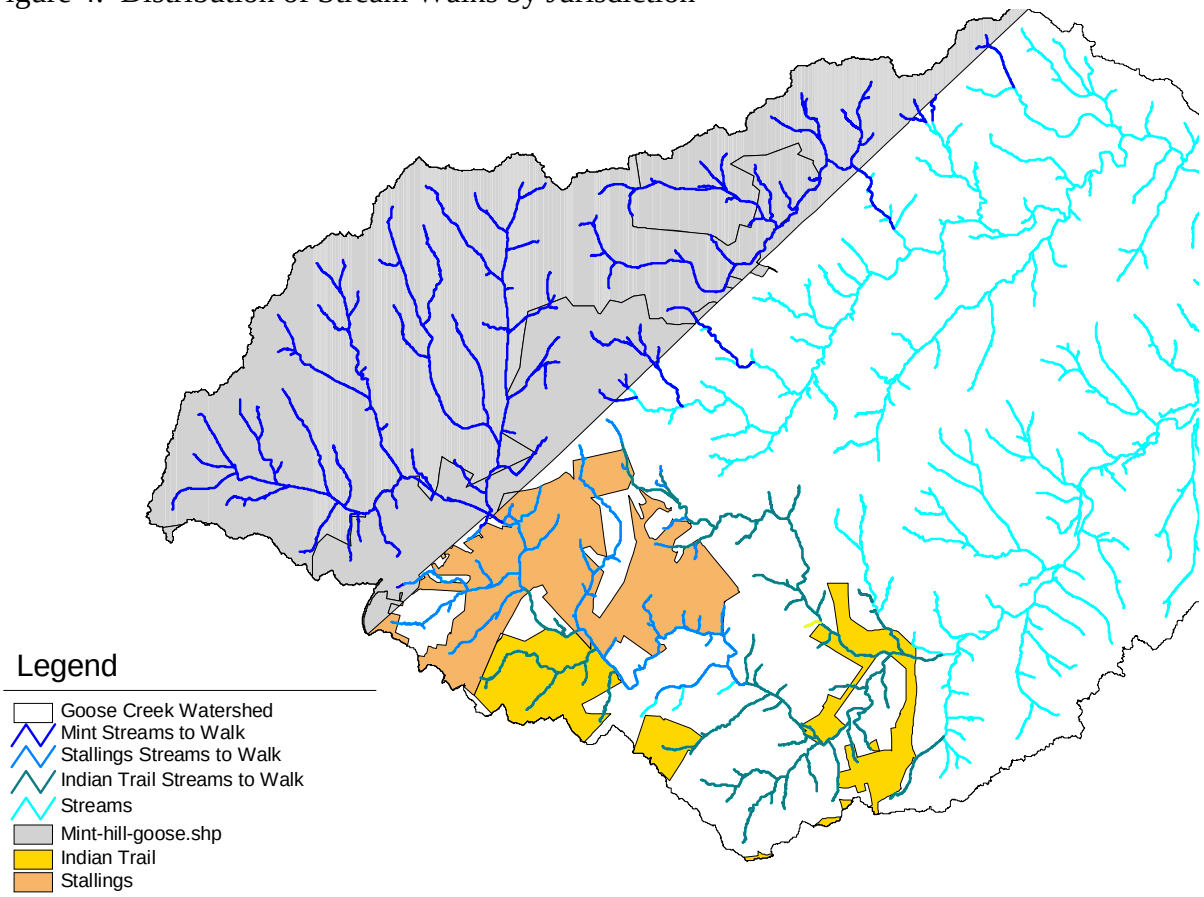


Table 3 presents the miles of stream walked or waded by jurisdiction in the Goose Creek Watershed.

Table 3: Miles of Streams Walked or Waded by Jurisdiction

Jurisdiction	Miles Perennial Stream	Miles Intermittent Stream	Total Miles to Walk
Mint Hill	32.8	13.9	**46.7**
Indian Trail	16.9	6.4	**23.3**
Stallings	9.3	4.4	**13.7**

2.7.4 Land-Use Monitoring

MCWQP personnel are performing monthly sampling at select MS4 outfalls located downstream of each of the land-use types in the jurisdictions described in Table 4. The physical locations of the monitoring sites as identified in Table 5 and Figure 6 were identified during the stream walks conducted between May and July 2007 (see Section 2.6.3). This land-use monitoring began in October 2007 and is planned to continue through June 2010. The purpose of this monitoring is to categorize fecal coliform levels originating from individual land-uses in each of the jurisdictions. This monitoring data will be used identify specific land-uses for BMP retrofits to decrease fecal coliform levels in Goose Creek in compliance with the TMDL. As outlined in the Goose Creek TMDL Water Quality Recovery Program Guidance Document provided by DWQ,

permit holders may sample "substantially similar outfalls" to reduce the monitoring and analysis burden. Therefore, a minimum of one (1) site is sampled monthly downstream of each of the major land-use types found in Mint Hill, Stallings and Indian Trail. Figure 5 shows the general distribution of land-uses within the Goose Creek Watershed. Monitoring sites will be evaluated annually and new sites selected as necessary to ensure representativeness of the watershed as a whole. The following changes have occurred to site locations since monitoring began in October 2007:

- Site B moved from 6400 Matthews Mint Hill Road (longitude -80.662952, latitude 35.169341) to 3501 Matthews Mint Hill Road (Site B1) on October 5, 2009 (see Table 5).
- Site I moved from 2002 Centerview Drive (longitude -80.63122, latitude 35.118041) to 5004 Centerview Drive on September 18, 2008 due to 2002 Centerview Drive being discontinued as an active construction site (see Table 5).

Table 4: Jurisdictions and Land-Use Types to be Sampled

Jurisdiction	Land-Use Types				
Mint Hill	0.25 – 0.5 ac Residential	Commercial	Institutional (school)	Medium Density Residential (0.5 – 1 ac)	I-485
Stallings	0.25 – 0.5 ac Residential	Commercial			
Indian Trail	0.25 – 0.5 ac Residential	Active Development			

Table 5: Land-Use Monitoring Sites in the Goose Creek Watershed

Jurisdiction	Monitoring Type	ID	Location	Longitude	Latitude
Meck. Co.	Runoff (0.25-0.5acre res.)	A	15130 Yarmouth Rd.	-80.655236	35.139909
Meck. Co.	Runoff (Commercial)	B1	3501 Matthews Mint Hill Rd.	-80.683341	35.138450
Meck. Co.	Runoff (Institutional)	C	11524 Bain School Road	-80.647348	35.174619
Meck. Co.	Runoff (0.5 - 1 acre res.)	D	5221 Turkey Oak Drive	-80.660474	35.146612
Meck. Co.	Runoff (I-485)	E	I-485	-80.629102	35.163096
Stallings	Runoff (0.25-0.5 acre res.)	F	9108 Tenby Lane	-80.637598	35.138339
Stallings	Runoff (Commercial)	G	7800 Stevens Mill Road	-80.622643	35.140097
Indian Trail	Runoff (0.25-0.5 acre res.)	H	7006 Joyful Noise Lane	-80.629475	35.117090
Indian Trail	Runoff (Active Const.)	I	5004Centerview Dr.	-80.629790	35.117733

Table Notes: Meck. Co. includes the Town of Mint Hill. Latitude and Longitude in Decimal Degrees.

Figure 5: Land-Use Distribution in the Goose Creek Watershed

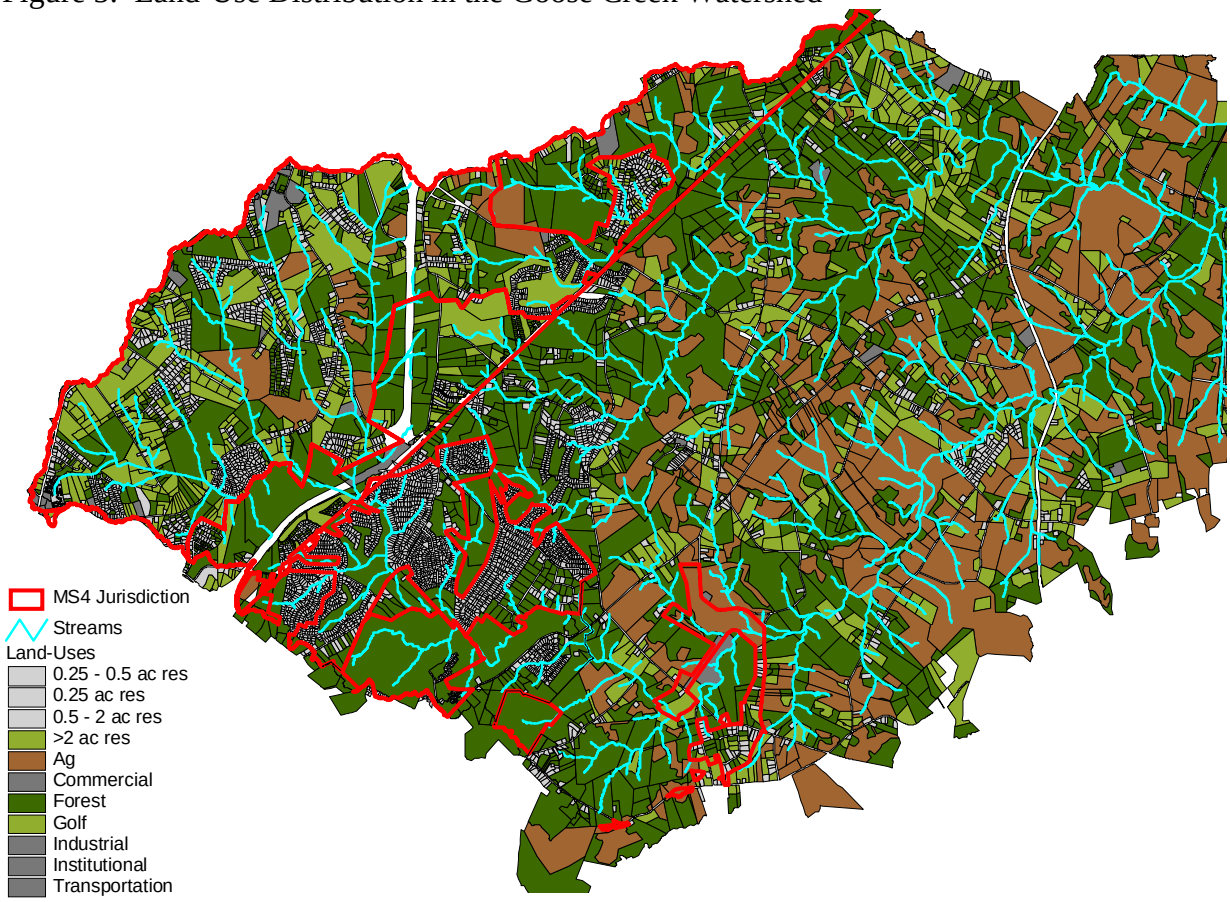


Table 6 provides a description of the land-use monitoring performed in Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail as part of the Goose Creek WQRP.

Table 6: Description of Land-Use Monitoring in the Goose Creek Watershed

Sample Type	Grab sample collected at MS4 outfalls at the locations described in Table 5 above.
Frequency	Monthly during runoff events.
Seasonal Considerations	Sampling is performed without seasonal variation.
Implementation Schedule	Begin in October 2007 and continue through June 2010.
Parameters Analyzed	Fecal coliform bacteria, E coli, nitrite + nitrate, ammonia, total kjeldahl nitrogen, total phosphorus and copper.

2.7.5 In-Stream Monitoring

MCWQP personnel are performing monthly in-stream sampling at the six (6) sites identified in Table 7 and Figure 6. Monitoring began in June 2007 at the in-stream monitoring sites located at Goose Creek and Stevens Mill Road in Union County (MY9) and at 10801 Tara Oaks Drive in

Mecklenburg County (MY14). Plans are to continue in-stream monitoring at these two (2) sites indefinitely. These sites are sampled on the third Wednesday of every month unless flow conditions are determined to be unsafe in which case sampling is performed immediately upon the return of safe conditions. This is referred to as fixed interval monitoring. Sampling began at the other four (4) in-stream sites identified in Table 7 in October 2009. Plans are to discontinue this monitoring in June 2010 along with the land-use monitoring described in the previous Section. These four (4) in-stream sites are sampled during runoff conditions along with the land-use monitoring sites. The purpose of in-stream monitoring is as follows:

- Identify and eliminate pollution problems.
- Measure watershed scale fecal coliform levels.
- Assess the overall effectiveness of the WQRP at attaining the water quality standard for fecal coliform.

Table 7: In-Stream Monitoring Sites in the Goose Creek Watershed

Jurisdiction	Monitoring Type	Location	ID	Longitude	Latitude
Meck. Co.	Runoff	14805 Bridgewater Ln	MY9A	-80.657647	35.141011
Meck. Co.	Runoff	4216 Crump Hill Ct	SCT	-80.652128	35.146806
Meck. Co.	Runoff	16100 Thompson Rd	GT1	-80641504	35.150959
Meck. Co.	Runoff	13186 Lawyers Rd	GC1	-80.639121	35157171
Stallings	Fixed Interval	Goose Creek at Stevens Mill Rd	MY9	-80.631719	35.130114
Mint Hill	Fixed Interval	10801 Tara Oaks Dr.	MY14	-80.587390	35.180144

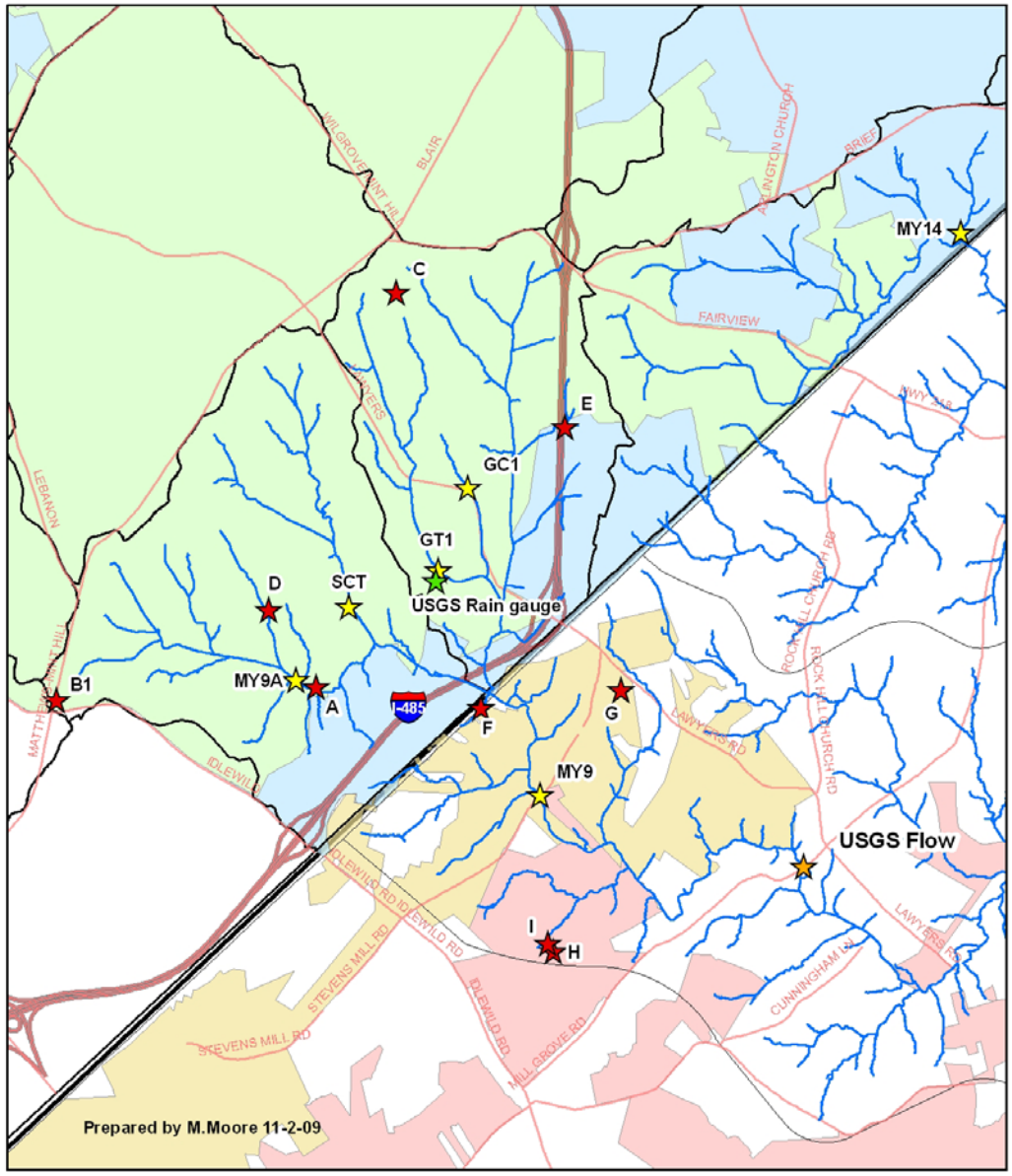
Table Notes: Meck. Co. includes the Town of Mint Hill. Latitude and Longitude in Decimal Degrees.

Monitoring sites will be evaluated annually and new sites selected as necessary to ensure representativeness of the watershed as a whole. The following changes have occurred to site locations since in-stream monitoring began in June 2007:

- Sample site located at the DWQ compliance point on Mill Grove Road at Goose Creek moved to 10801 Tara Oaks Drive in July 2008.
- Four (4) runoff sample sites added in October 2009.

Table 8 provides a description of the in-stream monitoring performed as part of the Goose Creek WQRP.

Figure 6: Location of WQRP Monitoring Sites for FY10



Label	Type	Longitude (Decimal Degrees)	Latitude (Decimal Degrees)
A	Land Use	-80.655236	35.139909
B1	Land Use	-80.683341	35.138450
C	Land Use	-80.647348	35.174619
D	Land Use	-80.660474	35.146612
E	Land Use	-80.629102	35.163096
F	Land Use	-80.637598	35.138339
G	Land Use	-80.622643	35.140097
H	Land Use	-80.629475	35.117090
I	Land Use	-80.629790	35.117733
GC1	In-Stream	-80.639121	35.157171
GT1	In-Stream	-80.641504	35.150959
MY14	In-Stream	-80.587390	35.180144
MY9	In-Stream	-80.631719	35.130114
MY9A	In-Stream	-80.657647	35.141011
SCT	In-Stream	-80.652128	35.146806
USGS Rain gauge	USGS Rain Gauge	-80.642499	35.148999
USGS Flow	USGS Flow	-80.602830	35.124892

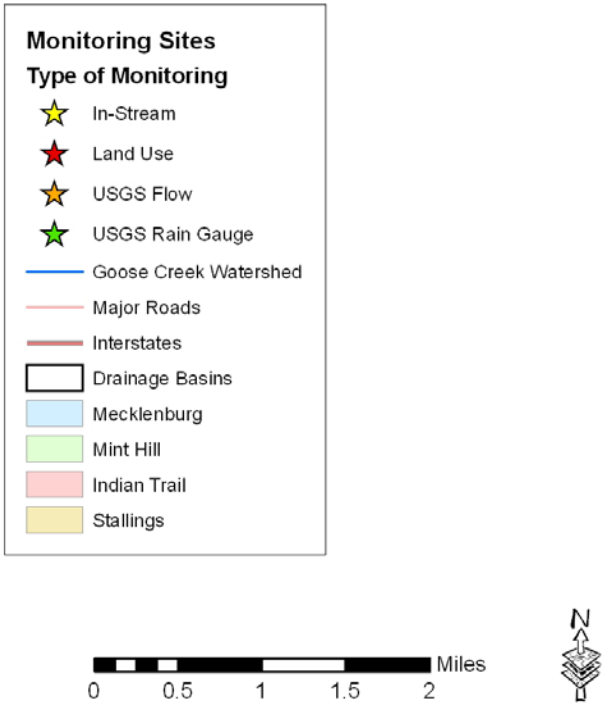


Table 8: Description of In-Stream Monitoring in the Goose Creek Watershed

Sample Type	Grab sample collected in the main flow of the stream channel.
Frequency	1. Two (2) sites sampled monthly on a fixed interval, which is the third Wednesday of every month unless flow conditions are determined to be unsafe in which case sampling is performed immediately upon the return of safe conditions. These sites are identified in Table 7 above as the "Fixed Interval" monitoring type. 2. Four (4) sites sampled monthly during runoff events at the same time that land-use monitoring is performed. These sites are identified in Table 7 above as the "Runoff" monitoring type.
Seasonal Considerations	Sampling is performed without seasonal variation.
Implementation Schedule	Fixed interval monitoring began in June 2007 and will continue indefinitely. Runoff monitoring began in October 2009 and will continue through June 2010.
Parameters Analyzed	1. Fixed Interval Monitoring Sites (2): USGS flow rate, temperature, dissolved oxygen, conductivity, pH, fecal coliform bacteria, E-coli bacteria, enterococcus bacteria, ammonia nitrogen, nitrate + nitrite, total kjeldahl nitrogen, total phosphorus, suspended solids, suspended sediment, turbidity, copper, zinc, chromium, and lead 2. Runoff Monitoring Sites (4): Fecal coliform bacteria.

2.7.6 Continuous Monitoring and Alert Notification Network (CMANN)

In July 2009, MCWQP personnel installed a Continuous Monitoring and Alert Notification Network (CMANN) monitoring site at the in-stream monitoring site at MY9 (see Table 7 and Figure 6). CMANN monitoring began in June 2007 and is ongoing. The purpose of this monitoring is as follows:

- Identify pollution problems for implementation of corrective actions.
- Identify the relationship between turbidity (an indicator of suspended sediment) and fecal coliform levels.

Monitoring sites will be evaluated annually and new sites selected as necessary to ensure representativeness of the watershed as a whole. The following changes will occur to CMANN site locations:

- By January 1, 2010, two (2) additional CMANN sites will be added, including one at MY14 (see Table 7 and Figure 6) and another at 12809 Bain School Road.

Table 9 provides a description of the CMANN monitoring performed as part of the Goose Creek WQRP.

Table 9: Description of CMANN Monitoring in the Goose Creek Watershed

Sample Type	Automated sampling using a YSI multi probe sonde which transmits data to a data logger that downloads to a website via an automated dial out system.
Frequency	Hourly.
Seasonal Considerations	Sampling is performed without seasonal variation.

Implementation Schedule	Begin in June 2007 and continue indefinitely.
Parameters Analyzed	Turbidity, temperature, pH, dissolved oxygen, and conductivity.

2.7.7 USGS Monitoring

The USGS maintains a flow gauge at Goose Creek at Mill Grove Road (USGS Site 0212467595) and a rainfall gauge at the Thompson Farm site off Lawyers Road in Mint Hill, NC (USGS Site 350857080383245) as indicated in Figure 6. Data from these sites will be incorporated into the WQRP.

2.7.8 Monitoring for Identification and Elimination of Pollution Sources

Identification and elimination of sources of fecal coliform in the Goose Creek Watershed is an essential element in the overall strategy for reducing in-stream fecal coliform concentrations in Goose Creek. To accomplish this goal, MCWQP will utilize the same techniques outlined in its Illicit Discharge Detection and Elimination (IDDE) Policies and Procedures Manual (Mecklenburg County Water Quality Program, 2009). In addition, stream walks will be initiated as necessary to more thoroughly evaluate larger catchments. These procedures are identified in the monitoring plan described in Section 2.5.3 above. Over and above the IDDE Manual and monitoring plan, several specialized procedures have been developed for the identification of sources of fecal coliform in the Goose Creek Watershed as described below.

<u>Specialized IDDE Monitoring:</u>
An enhanced monitoring strategy was developed for the identification and elimination of pollution sources in the Goose Creek Watershed. This strategy involved the collection of samples every Thursday that were analyzed for temperature, fecal coliform and E coli. On the second Tuesday of each month, samples were collected and analyzed for temperature, fecal coliform, E coli, ammonia nitrogen (NH_3), total kjeldahl nitrogen (TKN), nitrite + nitrate (NOx) and total phosphorus (TP). The monitoring consisted of at least five (5) consecutive samples collected during a 30 day period to determine if the fecal coliform levels exceeded the State standard (referred to 5/30 monitoring). Data from this sampling was used to identify sites for more source specific monitoring, including DNA analyses. This specialized monitoring was initiated every Thursday beginning on May 8, 2008 as well as the second Tuesday of each month beginning on May 13, 2008. The monitoring was conducted at the State compliance point located at Stevens Mill Road (Site MY9) and at six (6) locations upstream of MY9 as well as the compliance point located on Mill Grove Road (Site GC4) and the in-stream monitoring site at GC4. The monitoring sites are shown in Figure 7. All the sites were found to be in compliance with the State's 5/30 standard except GC2A and GC3, which had fecal coliform counts at 878 c.f.u. and 810 c.f.u., respectively. Both of these sites are located on a tributary of Goose Creek. DNA analyses were performed on samples collected from this tributary confirming that the source was human. The area draining to this tributary was targeted for septic system inspections resulting in the identification of two (2) system malfunctions that were subsequently repaired. The 5/30 monitoring was discontinued on September 4, 2008. Sampling is planned at site GC2A

during FY10 to determine if the elimination of the septic system discharges will result in compliance with the standard.

Livestock Impact Monitoring:
In August and September 2009, samples were collected and analyzed for fecal coliform bacteria on three (3) separate occasions upstream and downstream of an area where cows have direct access to Goose Creek. The three (3) monitoring points are shown if Figure 8. This monitoring confirmed that the cows had a significant impact on fecal coliform levels in the creek. The property owner has been contacted and negotiations will occur in FY10 to attempt to eliminate livestock access to the creek.

Figure 7: Specialized IDDE Monitoring Sites

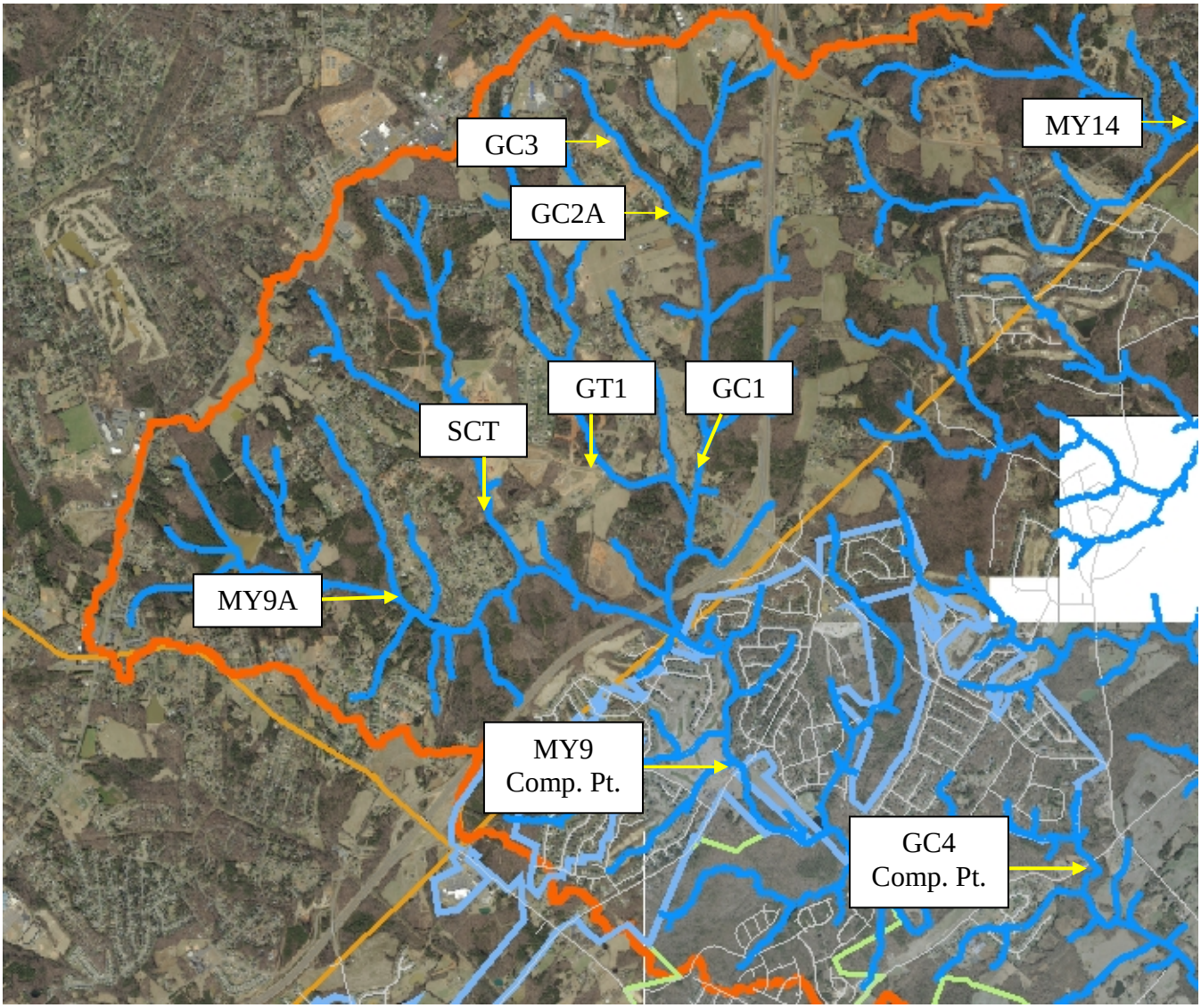
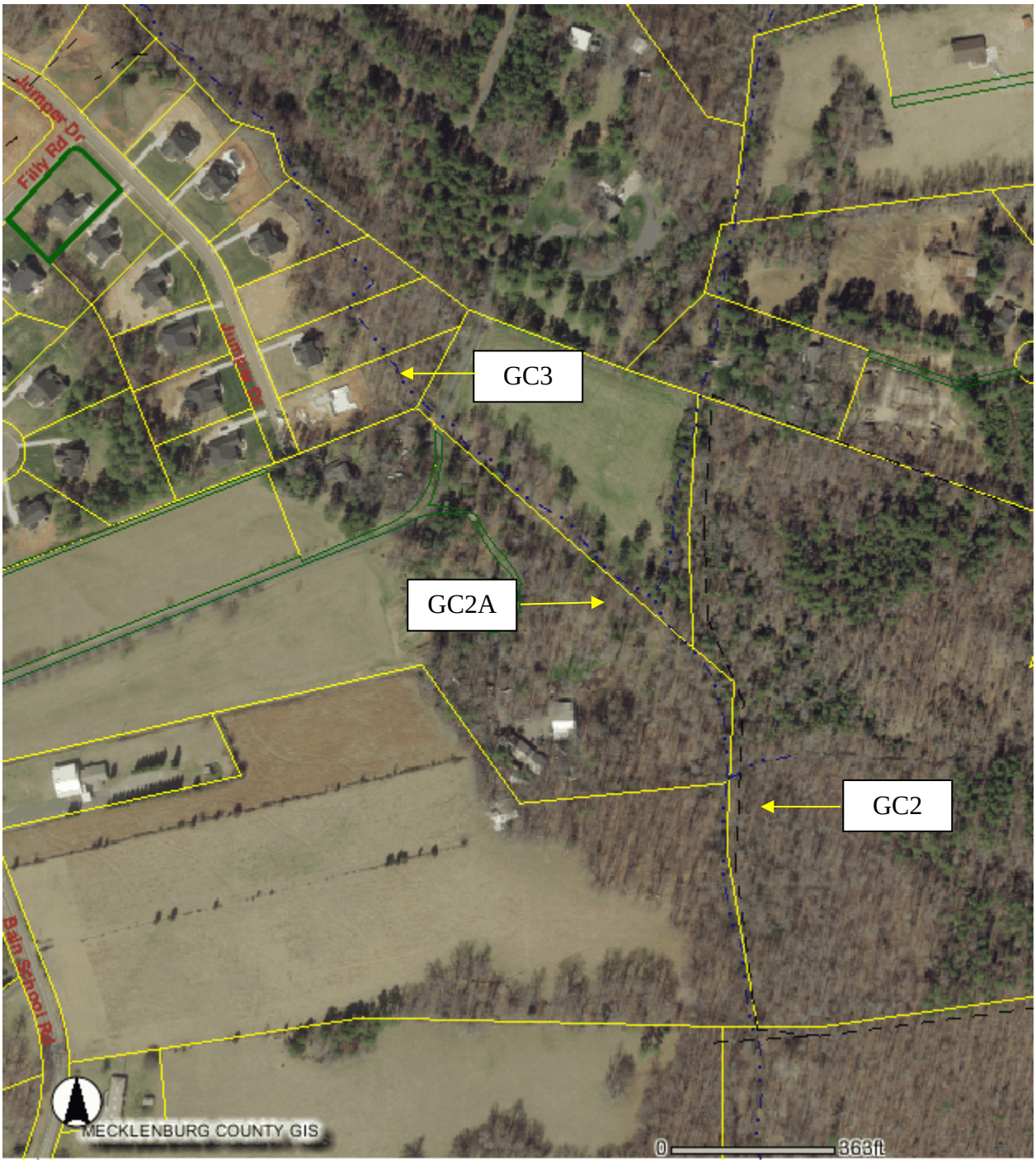


Figure 8: Livestock Impact Monitoring Sites



DNA Analysis:

DNA analysis can determine the presence, identify the source and quantify fecal contamination in water samples. One method used targets bacteroidetes that are present in warm blooded animals. *Bacteroidetes* are predominately found in humans, cattle, swine, horses and dogs. These tests are effective for determining recent forms of fecal pollution.

The phylum *Bacteroidetes* is composed of three (3) groups of bacteria with the best-known category being *Bacteroidaceae*. This family of bacteria is found primarily in the intestinal tracts and mucous membranes of warm-blooded animals and is sometimes considered pathogenic.

Fecal *Bacteroidetes* are considered an alternative to more traditional indicator organisms such as *E. coli* and *Enterococci*. Since they are strict anaerobes, they are indicative of recent fecal contamination when found in water systems. This is a particularly strong reference point when trying to determine recent outbreaks in fecal pollution. They are also more abundant in feces of warm-blooded animals than *E. coli* and *Enterococci*. Furthermore, these latter two (2) organisms are facultative anaerobes and as such they can be problematic for monitoring purposes since it has been shown that they are able to proliferate in soil, sand and sediments, which is not the case for *Bacteroidetes*.

Costs:
The estimated costs for implementing the enhanced monitoring effort are outlined in Table 10. Costs shown are for each 30 day period.

Table 10: Estimated Enhanced Monitoring Costs

Task Description	Cost per 30 day period
Fecal Coliform Sample Analysis (8 sites x $34.00/sample x 5 samples)	$1,360.00
Nutrient Sample Analysis (8 sites x $62.75 x 1 sample)	$502.00
Sample Collection, prep and sample turn in (4 hrs. x $42.80 x 5 events)	$856.00
Total Cost per 30 Day Period	**$2,718.00**

2.7.9 Quality Assurance / Quality Control

All data discussed above will be collected by MCWQP staff, with the exception of flow and rainfall data which is collected by USGS. All sampling performed and data collected by MCWQP staff is in strict adherence to the following documents:

- Charlotte-Mecklenburg Surface Water Quality Sampling Procedures Manual, 2005
- Continuous Monitoring Policy and Procedure Manual, 2005
- Mecklenburg County Water Quality Program QA/QC Data Tracking, 2006
- Charlotte-Mecklenburg Storm Water Services Quality Assurance Project Plan (QAPP), 2007

Mecklenburg County holds the following certifications associated with monitoring:

- *NC Division of Water Quality Laboratory Certification Program – 5235:* This certification is associated with the collection of samples, field parameters and instrumentation.

2.7.10 Data Analysis

Data collected under this plan is subject to analysis on several levels as follows:

1. Stream Walks: Information collected from the stream walks will be categorized and converted to GIS format. The locations of sampling sites, storm water outfalls and

potential pollution sources will be identified. Sample results indicating the presence of high levels of fecal coliform (>1,000 c.f.u.) will be assigned for follow-up activities by the appropriate jurisdiction. The purpose of these follow up activities will be to identify and eliminate pollution sources. Identified land-use sampling sites will be established and sampled.

2. Land-Use Monitoring: The results from the land-use samples will be analyzed on a site by site basis. Basic descriptive statistics will be calculated for the data collected at each site, each group of like sites (e.g. residential), each jurisdiction and the data set as a whole. The land-use fecal coliform data set will be compared to rainfall and flow records, which are collected by the USGS, to develop a better understanding of fecal coliform build-up and wash-off for each of the land-uses. The number of dry days prior to sample collection, time since start of rainfall, rainfall intensity and other parameters will be assessed and compared to the fecal coliform dataset. It is anticipated that trends will be detected in the data which will help guide watershed restoration and retrofit efforts.
3. In-Stream Monitoring: The results from the in-stream fecal coliform sampling will be analyzed on a site by site basis to assess compliance with the fecal colifom standard. Sample results indicating the presence of high levels of fecal coliform ($\geq$1,000 c.f.u.) will be assigned to MCWQP staff for the initiation of immediate follow-up activities. The purpose of these follow up activities will be to identify and eliminate pollution sources. Basic descriptive statistics will be calculated for the data collected for each site and the dataset as a whole. Sample date and time will be used to identify the rainfall and flow regime in Goose Creek at the time of sample collection. The primary purpose of evaluating a flow or rainfall versus fecal coliform level is to determine if a reproducible relationship between the two exists. If a strong correlation does exist, USGS flow data may be used as a surrogate for fecal coliform.
4. CMANN: The results from the CMANN automated monitoring will be analyzed using basic descriptive statistics. The results will be compared to the USGS dataset to determine if a turbidity versus flow relationship exists. Monitoring results indicating potential water quality problems (action level exceedances) will be assigned for follow-up activities by MCWQP. The purpose of these follow up activities will be to identify and eliminate pollution sources.
5. USGS Monitoring: The USGS flow and rainfall dataset will be downloaded and analyzed to determine basic flow and rainfall distribution for the Goose Creek Watershed. USGS monitoring data will be used in conjunction with other data to determine if relationships between flow and or rainfall and fecal coliform or turbidity exist.
6. Pollution Sources: Records will be maintained of all pollution sources identified and eliminated, including source location and description, pollutant type, date detected and corrected, responsible staff, and any other relevant information.

2.8 Plan and Schedule for Identification of Storm Water Outfalls

During the performance of stream walk activities for the water quality monitoring program, MCWQP staff collected data regarding the location of all storm water outfalls, pipe material and pipe diameter as well as any maintenance issues with the outfalls. This work was performed in

Mecklenburg County as well as the Towns of Mint Hill, Stallings and Indian Trail. Stream walk activities are discussed in more detail in Section 2.5.3 above. All spatial data was geocoded and stored in hand-held computers while in the field. Upon returning to the office, the data was downloaded into GIS and made available to staff for implementation of the WQRP. All outfall data was compiled and provided to DWQ in June 2007. It is anticipated that streams will be walked again in 2012 and the storm water outfall data updated.

SECTION 3.0 PROGRAM IMPLEMENTATION

MCWQP anticipates that new sources of fecal coliform bacteria will be effectively controlled by the restrictions on future land development activities and wastewater treatment plant expansions imposed by the N.C. Site Specific Water Quality Management Plan for the Goose Creek Watershed that went into effect in February 2009. Therefore, the focus of MCWQP's water quality recovery efforts in the Goose Creek Watershed will be on the control of existing sources of fecal coliform bacteria. This will be accomplished through the implementation of structural and non-structural best management practices (BMPs) designed to restore water quality conditions in the Goose Creek Watershed in compliance with the approved fecal coliform TMDL. The following Sections describe these BMPs.

3.1 Structural Best Management Practices

3.1.1 Purpose

Retro-fitting existing land uses with structural BMPs to treat fecal coliform bacteria is one tool that can be implemented to reduce fecal coliform loading in the Goose Creek Watershed. The purpose of this Section is to identify structural BMPs that are effective at removing fecal coliform bacteria based on available research and to identify existing and proposed structural BMPs in the Goose Creek Watershed. Information regarding nonstructural BMPs for the control of fecal coliform bacteria in the Goose Creek Watershed is provided in Sections 3.2 and 3.3.

3.1.2 Structural BMP Analysis

To evaluate the fecal coliform removal capabilities of various BMPs, MCWQP performed the following activities:

- Review of Fecal Coliform TMDL Implementation Plans from other jurisdictions.
- Research literature values for fecal coliform removal efficiencies for BMPs.
- Summarize and analyze local fecal coliform removal rates from MCWQP's Pilot BMP Monitoring Program.

3.1.2.1 Review of Fecal Coliform TMDL Implementation Plans

MCWQP reviewed 20 published plans to evaluate the structural BMPs other jurisdictions propose to use or are using as part of their Fecal Coliform TMDL Implementation Plan, The plans typically included lists of non-structural controls that were going to be implemented to reduce fecal coliform loadings. In addition, most plans indicated that structural BMPs may be used for control, but provided no data on the level of control or treatment that would be provided by the BMPs. MCWQP reviewed three (3) plans in detail and the results are provided below.

Plan 1: The *Moore's Creek Fecal Coliform TMDL Implementation Plan* (Thomas Jefferson Planning District Commission, 2005) noted that regional storm water treatment BMPs were not feasible for achieving the required fecal coliform reduction from existing urban lands and that non-structural measures, such as sanitary sewer and septic system improvements, would be used in these areas.

Plan 2: A few plans did mention structural storm water BMPs that were proposed for reducing fecal coliform loads and indicated levels of treatment for several BMPs. The *Implementation Plan for the Fecal Coliform TMDL (Total Maximum Daily Load) for Four Mile Run, Virginia* (Northern Virginia Regional Commission, 2004) included a graph of BMPs and approximate removal efficiencies from the Metropolitan Washington Council of Government's Presentation Materials dated September 26, 2004. Table 11 provides a summary of the data contained in this graph. The plan concludes that BMPs with biological and chemical treatment processes (wet ponds, wetlands, and bioretention facilities are more effective at removing fecal coliform bacteria.

Table 11: BMP Data from TMDL Implementation Plan, Four Mile Run, Virginia

Structural BMP	Bacteria Removal Efficiency (%)
Bioretention	85
Infiltration Trench	85
Sand Filter	70
Wetlands	72
Wet Ponds	65

Note: Removal efficiency is concentration based.

Plan 3: The *Water Quality Implementation Plan for Blacks Run and Cooks Creek (Fecal Coliform and Aquatic Life TMDLs)* (Virginia Department of Conservation and Recreation, 2006) identified the BMPs indicated in Table 12 as appropriate for implementation as part of their TMDL.

Table 12: BMP Data from TMDL Implementation Plan, Blacks Run & Cooks Creek, Virginia

Structural BMP	Bacteria Removal Efficiency (%)
Bioretention Filter	85
Rain Garden	85
Wet Retention Pond	80
Vegetated Buffer	50

Note: Removal efficiency is concentration based.

This plan referenced that the removal efficiencies for the bioretention filter, rain garden, and wet retention pond BMPs were estimated based upon total suspended solid (TSS) removal efficiencies. Additionally, the vegetated buffer BMP efficiency was for buffers that treat twice the buffer area upstream of the buffer.

3.1.2.2 Fecal Coliform Removal Efficiencies for BMPs

MCWQP reviewed several publications that contained BMP performance data for fecal coliform. In addition, the International Storm Water Database (Water Environment Research Foundation et al, 1999 - 2007) was used to search for performance data for various BMPs. One article entitled Grant Ranch Stormwater-Quality Management Program published in Storm Water Magazine (Jones et al, 2004) featured an evaluation of the performance of BMPs for a residential sub-division (Grant Ranch) in Littleton, CO. The 77-acre subdivision was designed with three (3) extended dry detention basins that discharge into a single wetland, thus creating a BMP

treatment train system. Three (3) years of influent and effluent data was collected on the BMP system. Table 13 summarizes the fecal coliform results from the BMP system.

Table 13: Fecal Coliform Removal Efficiency for BMP Treatment Train in Littleton, CO

Structural BMP	Minimum Fecal Coliform Removal Efficiency (%)	Maximum Fecal Coliform Removal Efficiency (%)	Mean Fecal Coliform Removal Efficiency (%)
Dry Detention with Wetland	81	99	91

Note: Removal efficiency is concentration based.

The above BMPs were reportedly constructed in accordance with the 1992 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual for Colorado (Urban Drainage and Flood Control District, 1992).

A publication by Rutgers, The State University of New Jersey entitled *Efficiency of Bioretention Systems to Reduce Fecal Coliform Counts in Storm Water* (Rusciano et al, 2005) studied the effects various media depths of soil media, sand, and gravel had on the fecal coliform removal efficiency of bioretention systems. The pilot study was conducted in a laboratory using bioretention tubes. The results provided in Table 14 were provided by this study.

Table 14: Data from Bioretention Study by the State University of New Jersey

Structural BMP	Minimum Fecal Coliform Removal Efficiency (%)	Maximum Fecal Coliform Removal Efficiency (%)	Mean Fecal Coliform Removal Efficiency (%)
Bioretention (varying depths of soil media, sand, and gravel	54.7	99.7	87.8

Note: Removal efficiency is concentration based.

The same study also quoted literature values reported by other studies as summarized in Table 15.

Table 15: Data Summarized in the State University of New Jersey Report

Structural BMP	Reference	Fecal Coliform Removal Efficiency (%)
Wetland	Birch et al., 2004	76
Wetland	Kadlec and Knight, 1996	90
Wetland	Davies and Bavor, 2000	79

Note: Removal efficiency is concentration based.

The Rutgers' study indicated that fecal coliform removal in BMPs was increased with:

- Removal of particle sizes of 2 micron and greater because fecal coliform has an affinity for adsorbing to particle sizes greater than 2 microns.
- Increased vegetation.

- BMPs that have periods of wetness and dryness (such as bioretention) that stimulate increased anaerobic and aerobic microbes that are predatory to bacteria.
- Increased temperature.

A publication entitled *Removal of Microbial Indicators From Storm Water Using Sand Filtration, Wet Detention, and Alum Treatment Best Management Practices* presented at the Sixth Biennial Storm Water Research & Watershed Management Conference September 14-17, 1999 (Southwest Florida Water Management District, 1999) studied three (3) BMPs under simulated storm conditions produced by flowing storm water (previously collected in a holding tank) of known fecal concentration into the BMP and collecting effluent samples at various time periods. Table 16 provides the results of this study.

Table 16: Data from 6th Biennial Storm Water Research & Watershed Conference (Southwest Florida Water Management District, 1999)

Structural BMP	BMP Condition 1	BMP Condition 2	Fecal Coliform Removal Efficiency (%)
Wet Pond	3.3-ft water depth	5-day detention	98.2
Wet Pond	9.0-ft water depth	5-day detention	88.5
Wet Pond	3.3-ft water depth	14-day detention	76.4
Wet Pond	9.0-ft water depth	14-day detention	69.2
Sand Filter	--	--	65.4
Alum Settling (jar test)	--	--	99.9

Note: Removal efficiency is load based.

The above BMPs were reportedly constructed in accordance with Chapter 40D-4 of the Florida Administrative Code (Southwest Florida Water Management District, 1999). The study noted that shallower wet ponds were more effective at removing fecal coliform because of increased exposure to sunlight or UV radiation, which is known to eliminate fecal coliform.

In addition to reviewing articles, MCWQP conducted searches on the International Storm Water Database for BMPs (Water Environment Research Foundation et al, 1999 - 2007) that have fecal coliform data. Neither the sampling protocols used nor the construction specifications for these BMPs were available for review. Table 17 presents the data obtained from searches on the International Storm Water Database for BMPs (Water Environment Research Foundation et al, 1999 - 2007).

Table 17: Data Obtained from the International Storm Water Database for BMPs

Structural BMP	BMP Name	Fecal Coliform Removal Efficiency (%)
Wet Pond	La Costa WB	99
Sand Filter	La Costa PR	99.8
Sand Filter	Foothill SF	71.5
Wet Pond	DUST Marsh Debris	90
Peat/Sand Filter	Via Verde	40

Note: Removal efficiency is concentration based.

3.1.2.3 Fecal Coliform Data from Local Pilot BMP Monitoring Program

MCWQP has been monitoring several BMPs locally for the past four (4) years. The data has been tracked by MCWQP in cooperation with the City of Charlotte and North Carolina State University (NCSU). A summary of the monitoring data was provided by NCSU in a series of reports dated January 2007 (North Carolina State University, 2007). The reports included estimates of the efficiency ratios for each BMP based upon influent and effluent concentrations. Since influent and effluent flow data was also monitored for each BMP, MCWQP was able to calculate load efficiencies for certain BMPs. A summary of the monitoring data is provided in Table 18.

Table 18: Data from BMP Monitoring in Mecklenburg County

Structural BMP	NCSU Fecal Coliform Removal Efficiency (%)	MCWQP Fecal Coliform Removal Efficiency (%)
Hal Marshall Rain Garden	69	94
Bruns Rain Garden	--	36
Bruns Wetland	70	--
Edwards Branch Wetland	99	--
West Brandywine Wetland	--	51
Pierson Wet Pond	57	--
Morehead Place Dry Detention	< - 21 >	< - 49 >
University Executive Park Dry Detention	< - 3 >	< - 160 >

Note: Removal efficiency is concentration based.

It should be noted that the sampling protocol for fecal coliform grab sampling did not specify at which point during the rain event (runoff hydrograph) the influent and effluent samples were to be collected; therefore, the grab samples were collected at various periods during the rain event.

Table 19 provides a summary of the BMPs studied and evaluated as part of the WQRP for Goose Creek.

Table 19: Summary of all Data Collected

Structural BMP	Reported Fecal Coliform Removal Efficiency (%)	Average Fecal Coliform Efficiencies from Studied BMPs (%)
Hal Marshall Rain Garden	94	78
Bruns Rain Garden	36	
VA 4-mile Rain Garden	85	
VA Blacks Run Rain Garden	85	78
Rutgers Rain Garden	88	

Structural BMP	Reported Fecal Coliform Removal Efficiency (%)	Average Fecal Coliform Efficiencies from Studied BMPs (%)
Bruns Wetland	70	79
Edwards Branch Wetland	99	
West Brandywine Wetland	51	
VA 4-mile Wetland	72	
Grant Ranch Dry Detention /Wetland	91	
Birch Wetland	76	
Kadlec Wetland	90	
Davies Wetland	79	

Note: Removal efficiency is concentration based.

3.1.2.4 Observations from BMP Data Analysis

Based upon review of the various fecal coliform TMDL Implementation Plans, literature publications, laboratory and field monitoring data, MCWQP makes the following observations:

- Other jurisdictions are using structural storm water BMPs as one tool for meeting their fecal coliform TMDL limitations.
- There is variability in the design criteria proposed for optimizing fecal coliform removal in BMPs.
- Dry detention ponds were not found to be effective at removing fecal coliform and in some instances increased loads of fecal coliform.
- Bioretention gardens, wet ponds, wetlands, sand filters, and infiltration BMPs show removal of fecal coliform from storm water runoff. It should be noted that all studied BMPs were designed according to different specifications.
- The depths of soil media, gravel, and sand layer in a bioretention cell do not affect the fecal coliform removal capability of the bioretention cell.
- Wet ponds with shallower permanent pool depths are more effective at removing fecal coliform than deeper wet ponds.
- Wet Ponds with 5-day detention time are more effective at removing fecal coliform than wet ponds with 14-day detention times.
- Comparison of the “tested” BMPs indicates variability of fecal coliform removal rates for various BMP types, but general trends were noted.

3.1.2.5 Recommendations

MCWQP recommends that structural storm water BMPs be used as one tool for reducing fecal coliform concentrations in the Goose Creek Watershed. For BMP selection and use, the following additional recommendations are provided:

- Dry Detention BMPs should not be used to remove fecal coliform loads.
- Bioretention cells, wetlands, wet ponds, infiltration BMPs, and sand filters can be used to effectively remove fecal coliform loads.
- Since BMPs designed according to different standards showed fairly consistent removal of fecal coliform, MCWQP believes that there is no need to provide specific design

standards for BMPs used to remove fecal coliform. MCWQP recommends the use of existing design standards contained in the Mecklenburg County BMP Design Manual.

- In the absence of test data for a site-specific BMP, MCWQP recommends the use of the fecal coliform removal rates contained in Table 20 for estimating removal for retro-fitted BMPs.

Table 20: Recommended BMP Removal Efficiencies for Retro-Fitted BMPs

Structural BMP	Reported Fecal Coliform Removal Efficiency (%)
Bioretention Cells	80
Wetlands	80
Wet Ponds	80
Sand Filters	80

Note: Removal efficiency is concentration based.

3.1.3 Existing and Proposed Structural BMPs in the Goose Creek Watershed

Table 21 provides the locations and types of BMPs either currently in operation in the Goose Creek Watershed and those proposed for installation by June 30, 2010. A map showing the locations of these BMPs in the watershed is provided in Figure 9.

Table 21: Locations & Types of BMPs Completed or Proposed in the Goose Creek Watershed

BMP-ID	Location	Status	BMP Type	Longitude	Latitude
97	Bain School	Completed	Bioretention	-80.6497	35.17484
87	Mint Hill Park	Completed	Bioretention	-80.6343	35.1795
88	Mint Hill Park	Completed	Bioretention	-80.6345	35.17919
89	Mint Hill Park	Completed	Bioretention	-80.6338	35.17948
90	Mint Hill Park	Completed	Bioretention	-80.6341	35.17912
91	Mint Hill Park	Completed	Bioretention	-80.634	35.17857
92	Mint Hill Park	Completed	Bioretention	-80.6341	35.17823
93	Mint Hill Park	Completed	Bioretention	-80.6336	35.17805
94	Mint Hill Park	Completed	Bioretention	-80.6342	35.17722
95	Mint Hill Park	Completed	Bioretention	-80.6324	35.17973
534	Trinity Episcopal Church	Completed	Wet Pond	-80.6814	35.13748
389	Bain School	Completed	Bioretention	-80.6486	35.17508
511	Byrd & Ropas Doctor's Off.	Completed	Bioretention	-80.6646	35.16752
535	Trinity Episcopal Church	Completed	Wet Pond	-80.6811	35.13768
544	CMC Medical Building	Completed	Dry Detention	-80.6811	35.14706
G-1	Yarmouth Road	Completed	Bioretention	-80.6497	35.14305
G-2	**Oxford Glen Sub-division**	**Proposed**	**Bioretention**	**-80.651**	**35.14633**
G-3	Queens Grant School	Completed	Dry Detention	-80.6627	35.16575
G-4	Country Woods	Completed	Linear Wetland	-80.6336	35.14531
G-5	**Bain School Road**	**Proposed**	**Livestock Fencing**	**-80.6352**	**35.16246**

Note: Latitude and Longitude in Decimal Degrees.

As indicated in Table 21, the two (2) new BMPs planned for implementation in the Goose Creek Watershed in FY10 include the installation of a structural BMP with a culvert improvement in the 15400 block of Thompson Road in Mint Hill and the installation of a fence to exclude livestock from the creek at 12601 Bain School Road also in Mint Hill. Figure 9 shows these sites as G2 and G5, respectively.

Figure 9: Locations of BMPs Completed or Proposed in the Goose Creek Watershed

3.2 Septic System Inspections (Non-Structural BMP)

The primary sewage disposal method in the Goose Creek Watershed is the on-site septic system. It is estimated that over 1,300 of these systems are in operation on single-family residential lots dispersed throughout the watershed in Mecklenburg County. Municipal sewer collection is very sparse in the Goose Creek Watershed and there are only five (5) private wastewater treatment plants with two (2) in Mecklenburg County and three (3) in Union County. Due to the proliferation of septic systems in the watershed, it is expected that failing or malfunctioning systems are a source of fecal coliform bacteria from humans. The primary reasons for failing systems are improper maintenance by the system owner and poor installation. A pilot study for the inspection of individual septic systems was implemented from April through June of 2009 in the Goose Creek Watershed in Mecklenburg County. Septic systems in Mecklenburg County are regulated by Ground Water and Waste Water Services (GWWS); therefore, MCWQP worked with the inspectors employed by GWWS in the completion of this pilot study. The purpose of these inspections was to inform residents regarding the proper maintenance of their septic systems and to inspect the system to ensure proper operation. The inspection form used is provided Appendix 3. A copy of the educational information distributed during these inspections is provided in Appendix 4. All septic systems in Mecklenburg County are planned to be inspected by July 2011. The prioritization scheme to be following in scheduling these inspections is provided in Appendix 5. Stallings and Indian Trail are considering the implementation of a similar septic system inspection program within their jurisdictions.

3.3 Public and Staff Participation and Outreach (Non-Structural BMP)

3.3.1 Methodology

The goals of the public participation and outreach efforts to be conducted in the Goose Creek Watershed are as follows:

- Increase awareness of the WQRP on the part of citizens and public employees in the watershed and inform them of the actions they can take to lower fecal coliform concentrations in the creek.
- Increase participation among residents in the watershed in existing volunteer programs offered by Mecklenburg County, including Adopt-A-Stream and Storm Drain Marking.
- Inform citizens of the proper disposal of dog waste.

These goals will be achieved by completing the following actions at least once during each fiscal year beginning in FY10. The following Sections provide additional detail regarding these actions.

- Conduct a minimum of one (1) public workshop in the watershed.
- Conduct a minimum of one (1) workshop targeted toward public employees within the watershed, particularly employees with the Mecklenburg and Union Counties as well as the Towns of Mint Hill, Stallings and Indian Trail.
- Place a minimum of one article in the newsletters distributed by the Towns of Mint Hill, Stallings and Indian Trail.
- Distribute postcards, fliers and other written educational materials by mail, at event displays, etc.

3.3.2 Public Workshop

Beginning in FY2010, MCWQP will conduct annual workshops for staff and the general public in the Goose Creek Watershed to inform them of the WQRP in Goose Creek and the actions they can take to assist in our efforts to reduce fecal coliform bacteria levels. Brochures and various other educational materials will be distributed during these workshops. Attendees will be solicited for participation in volunteer activities to restore water quality conditions in Goose Creek, including Storm Drain Marking and Adopt-A-Stream.

3.3.3 Staff Development

Beginning in November 2009, MCWQP will host annual workshops for the staff of Mecklenburg and Union Counties as well as the Towns of Mint Hill, Stallings, Fairview and Indian Trail. The workshops will include the use of PowerPoint presentations, handouts and other information to cover the following topics:

- Why efforts to protect and restore water quality conditions in Goose Creek were initiated, how have these efforts evolved over time and why, and what is our measure of the success of these efforts.
- Overview of the Goose Creek Water Quality Recovery Program, including a description of each component and time frame for implementation.
- Overview of the Goose Creek Site Specific Management Plan.
- Detailed description of how staff will be involved in the implementation of the programs described in numbers 2 and 3 above.
- Description of educational materials available to residents.

3.3.4 Newsletters

Beginning in January 2010 and occurring annually thereafter, MCWQP will provide the Towns of Mint Hill, Stallings and Indian Trail with articles for inclusion in their newsletters to inform residents of the WQRP in Goose Creek and the actions they can take to assist in our efforts to reduce fecal coliform bacteria levels. Participation in the volunteer programs will also be solicited in the articles and dates for future workshops will be announced.

3.3.5 Dog Waste

Dog waste is a potential contributor of elevated fecal coliform bacteria levels. Dog waste left on trails, sidewalks, streets, and grassy areas are carried by rainwater into storm drains to nearby rivers, lakes and streams, including Goose Creek. Like human waste, animal waste may contain parasites, viruses, intestinal worms and bacteria, particularly fecal coliform. A single gram of pet waste contains an average of 23 million colonies of fecal coliform bacteria.

Some of the suggested behaviors for pet owners to adopt to reduce fecal coliform bacteria levels in surface waters are as follows:

- Pick up after your pet every single time they defecate.
- Check with your pet store for products that make picking up dog waste easy.
- Throw away pet waste in the garbage; never wash it into the gutter or storm drain.

- Never dispose of waste in or leave it near creeks and lakes.
- Carry extra bags in your car, so you are prepared when you travel with your pet.
- Get involved in a pet group and remind others to pick up after their pets.
- Educate neighbors.

MCWQP believes that by educating pet owners in the Goose Creek Watershed regarding the above behaviors an increased amount of pet waste will be properly disposed of and not end up in the creek thus reducing in-stream fecal coliform bacteria levels. The target of this educational campaign will be pet owners. Typically, active dog walkers pick up after their pets; therefore, the educational campaign will focus on residents in the Goose Creek Watershed that leave their dogs in the yard. In the Goose Creek Watershed, the addresses of pet owners that reside adjacent to the creek have been obtained. During November and December of 2009, MCWQP will mail these pet owners a postcard with information regarding the proper disposal of pet waste (see Figure 10). Homeowner Association (HOA) presidents in the Goose Creek Watershed will also receive this information as well as an article for inclusion in the HOA newsletter.

The next step in the educational campaign for proper pet waste disposal will be to partner with veterinarians and dog related businesses to get the message out where dog owners shop. Each veterinarian and pet store within the Goose Creek Watershed will receive posters to hang up in their business and information to hand out to customers. This will occur in February and March of 2010.

The final approach will be to reach dog owners where they take their pets. This will occur in May and June of 2010. MCWQP will partner with Mecklenburg County Park and Recreation to establish protocol for dog waste removal at its numerous dog parks. Their mutt-mitt stations will be labeled with a message to promote cleaning up after pets. A traveling exhibit will also be created to take to dog related events, such as Bark in the Park, Pet Parade and Earth Day.

Some of the products of the campaign have already been created; others will be designed around the focus group results. In preliminary discussions the following are being considered:

- Postcards for distribution in mail or at businesses (see Figure 10).
- Posters at veterinarians' offices.
- Signs in pet store waste removal aisles.

Incentives have also been considered to help dog owners establish correct pet waste disposal methods. In order for the avid dog walker to always be prepared when taking walks with their pet, MCWQP will provide bags on board product (see Figure 11) to pet owners in the Goose Creek Watershed that attend a dog event.

The major baseline for program evaluation is water quality. We have sampling sites in all of the target watersheds. Fecal numbers will be recorded before the marketing campaign begins, during the campaign, as well as to be determined intervals after the message goes out.
Other methods of evaluation are the number of pledge cards received, to be counted by staff. Charlotte-Mecklenburg Storm Water Services will work with pet stores to determine the number of pet waste disposal products sold in their stores. Veterinarians will tally the number of materials handed out in their offices.

Figure 10: Pet Waste Postcard (front)

(back)

Figure 11: Bags on Board Containing Pet Waste Disposal Bags

3.4 Documenting Removal Efficiencies for Structural and Non-Structural BMPs

As described in Section 2.2, fecal coliform removal efficiencies will be assigned to each BMP utilized in the Goose Creek Watershed as part of the WQRP, including both structural and non-structural varieties. Section 3.1.2 contains sufficient documentation for the establishment of the removal efficiencies for structural BMPs but research needs to be completed to establish the removal efficiencies for the non-structural variety, including septic system surveys, public education and involvement, etc. It is believed that such removal efficiencies have been documented elsewhere in the country. During FY09-10, MCWQP will research this documentation and establish removal efficiencies for non-structural BMPs using the best available data and information. This research and established removal efficiencies will be documented in the FY10 revisions to Section 3 of the WQRP Plan, which will be completed and submitted to DWQ for review and consideration by August 31, 2010. Following approval of by DWQ, MCWQP will track and total the removal efficiencies for all the BMPs completed in the watershed. Once sufficient BMPs have been employed to achieve a 92.5% removal efficiency in all the MS4 areas in the Goose Creek Watershed the WQRP Plan will consider the MS4 areas to be compliant with the TMDL and the WQRP will have reached its endpoint.

3.5 BMP Implementation Schedule for FY10

Provided below is the schedule for the development and implementation of the BMPs planned for FY10:

1. July 2009 through June 30, 2010: Continuation of the septic system survey in the watershed.
2. October 2009: Initiate efforts toward the installation of fencing at 12601 Bain School Road in Mint Hill to exclude livestock from the creek.
3. November 2009: Conduct annual workshop for staff and the general public.
4. December of 2009: Mail pet waste postcard.

5. January 2010: Initiate efforts toward the installation of BMPs with the culvert project planned for the 15400 block of Thompson Road in Mint Hill.
6. January 2010: Distribute articles in the Towns' newsletter.
7. February and March of 2010: Partner with veterinarians and pet related businesses to distribute pet waste information.
8. May and June of 2010: Reach owners where they take their pets (dog parks, etc.).

SECTION 4.0 DATA COLLECTION AND DOCUMENTATION

4.1 Data Collection

The data collected for the Goose Creek WQRP consists of water quality monitoring data, locations of the storm drain inlets and outlets, and various data and information documenting the activities performed and BMPs employed to restore water quality conditions in compliance with State standards. The data in each of these three (3) categories differs with regard to how it is collected, assessed and maintained as described below. All data is stored on a Mecklenburg County server that is maintained by the IST Department.

4.1.1 Monitoring Data

All monitoring activities for the WQRP will be performed in strict accordance with MCWQP's QAPP. This QAPP is maintained on the following LAN site: G:\WQ_Xfer\WQ\Policies & Procedures\11.QAPP. MCWQP's Quality Assurance and Quality Control (QA/QC) Officer will be responsible for ensuring compliance with this QAPP. The majority of the samples collected by MCWQP for the WQRP will be delivered for analysis to the laboratory operated by Charlotte-Mecklenburg Utilities (CMU) located at 4222 Westmont Drive in Charlotte, N.C. (certification #192). On occasion, due to laboratory work load or in order for holding times to be met, samples will be delivered for analysis to Prism Laboratory located at 449 Springbrook Road in Charlotte, N.C. (certification #402). Analytical results will be transferred digitally and via hard copy to the QA/QC Officer from the laboratory within 45 days of sample collection. The only exception to this rule will be with the CMANN data, which will be reviewed and quality assured by the CMANN Project Officer and submitted to the QA/QC Officer electronically. Field staff will provide completed field data sheets and copies of Chain of Custody forms to the QA/QC officer on the same day the samples and field measurements are collected. The QA/QC Officer is responsible for the compilation, review, verification, validation, and warehousing of all water quality monitoring data collected by MCWQP. As part of this process, the QA/QC Officer will immediately forward all exceedances of State standards or local Action Levels as well as any observed negative water quality conditions to the Water Quality Supervisor for the initiation of immediate follow up activities to identify and eliminate pollution source(s) in accordance with IDDE Procedures for MCWQP.

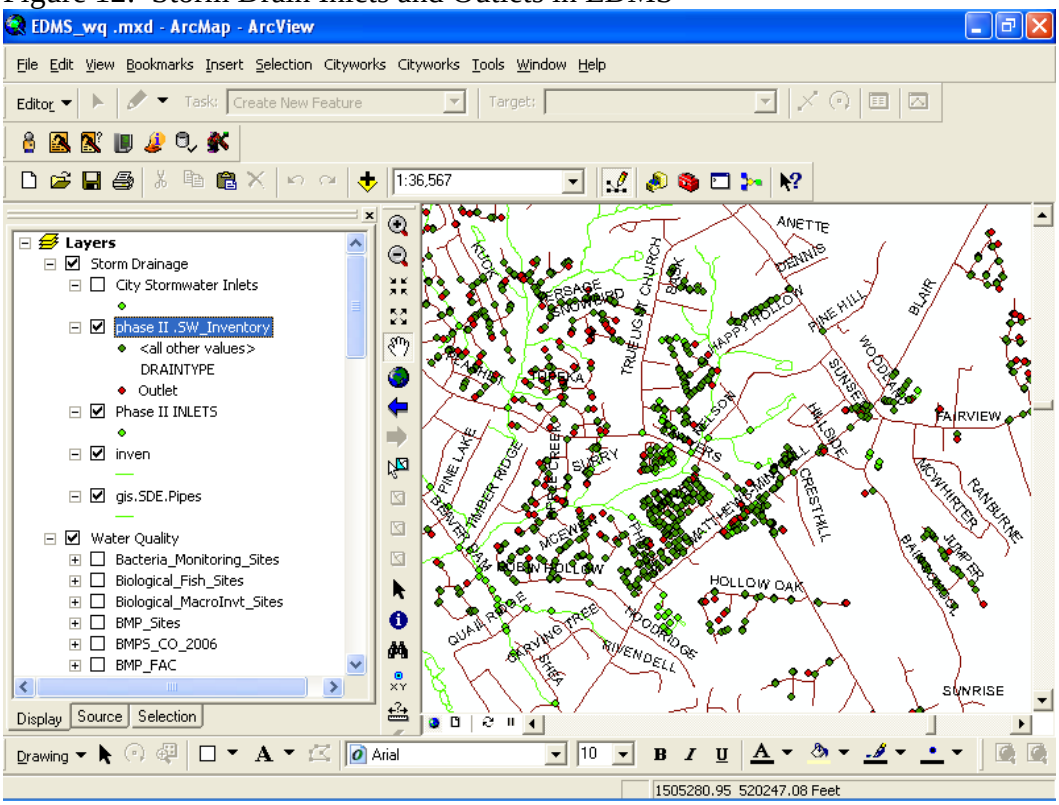
On at least a monthly basis, data will be compiled, quality assured and added to the Water Quality Data Repository (WQDR), which is a component of the Environmental Data Management System (EDMS) maintained for MCWQP. This data will be readily available to staff through the use of SAS reports. In addition, data will be maintained on the website described in Section 2.4 above.

4.1.2 Storm Drain Inventory Data

During the course of the stream walks conducted in the Goose Creek Watershed during the summer of 2007, all storm drain inlets and outlets were identified in Mecklenburg County and the Towns of Mint Hill, Stallings and Indian Trail. Data was collected in the field using ArcPad software installed on GPS enabled hand-held computers called Trimble Units. Upon return to

the office, data was downloaded from the Trimble Units into GIS and stored in EDMS, which is accessible by all MCWQP staff for Mecklenburg County and Mint Hint Hill. Figure 12 illustrates how this data is represented in EDMS. For the Towns of Stallings and Indian Trail, GIS data was downloaded onto a CD and provided to staff for their use.

Figure 12: Storm Drain Inlets and Outlets in EDMS

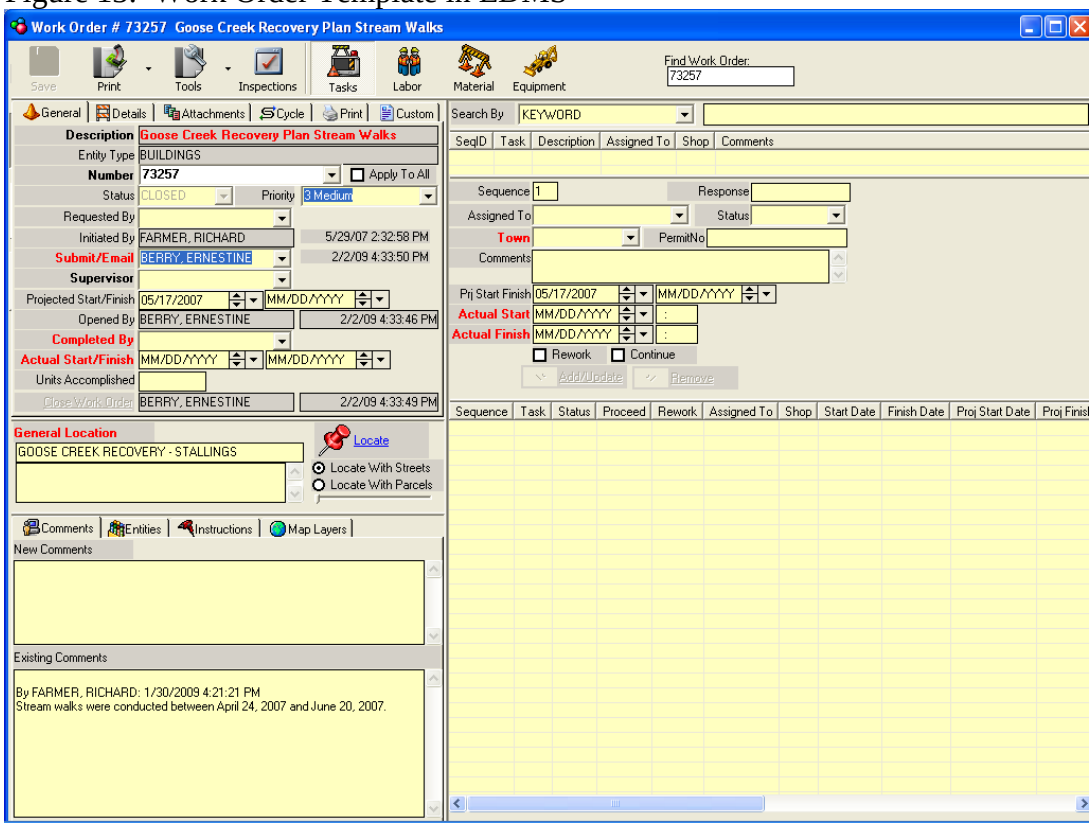


Storm drain inlets and outlets will be updated in EDMS as new development occurs based on data submitted to Mecklenburg County by builders and developers. This is a requirement prior to the final approval of construction activities.

4.1.3 Documentation of WQRP Activities

Written reports will be completed to document the activities performed and BMPs employed to restore water quality conditions in compliance with State standards. These reports will be entered into EDMS on Work Order forms contained in software called Cityworks. These Work Orders include “Comment” fields and attachments to describe activities completed. Figure 13 illustrates a Work Order template in EDMS.

Figure 13: Work Order Template in EDMS



4.2 Reports

An annual report summarizing the activities associated with the WQRP and its overall effectiveness will be prepared and submitted to the WQRP Advisory Group described in Section 2.4 above by July 15th of each year, which is two (2) weeks following the end of the fiscal year. These annual reports will include the following sections:

1. Water Quality Data Assessment: Assessment of data collected through the water quality monitoring program established for the WQRP, including current status and trends toward meeting the State standard for fecal coliform.
2. BMP Assessment: Description of the BMPs employed during the fiscal year and an assessment of their effectiveness as well as BMP measures that will be implemented next fiscal year to restore water quality conditions in compliance with State standards.
3. Cost-Benefit Analysis: Analysis of each BMPs cost relative to the amount of fecal coliform bacteria removed.
4. Source Reduction: Description of the water quality problems identified and eliminated and the estimated load reduction.
5. Adaptive Management: Recommended changes to the WQRP to improve compliance with TMDL targets and the State water quality standard.
6. Public Participation and Outreach: Description of the activities performed to educate and involve the public in efforts to restore water quality conditions in Goose Creek.
7. Staff Development: Description of the activities performed to educate and involve staff in efforts to restore water quality conditions in Goose Creek.

SECTION 5.0 PROGRAM EVALUATION

5.1 Assessing the Effectiveness of BMPs and WQRP

The WQRP Advisory Group described in Section 2.4 above was developed in November 2006 for the purpose of reviewing program activities and data and assessing the need for change. This group consists of representatives from the following:

- Mecklenburg County Water Quality Program
- Town of Mint Hill
- Town of Stallings
- Town of Indian Trail
- Union County
- DWQ

In addition, representatives of other jurisdictions interested in the recovery program and private citizens with an interest and knowledge of the TMDL program often participate in discussions and meetings. The MCWQP representative will take the lead in setting up the meetings, establishing agendas and providing all necessary background information. The WQRP Advisory Group will meet at a minimum of annually before August 15th following the release of the WQRP annual report by July 15th (see Section 4.2 above). Additional meetings will be held during the year as deemed necessary by MCWQP or any other member of the WQRP Advisory Group. The purpose of this meeting will be to assess the effectiveness of the BMPs employed during the fiscal year and the overall effectiveness of the WQRP at meeting TMDL targets. The group will also identify additional BMPs or changes in the WQRP needed to ensure the fulfillment of all TMDL objectives. MCWQP staff will review the data presented in the annual report during the meeting of the group after which a discussion will take place for evaluating the overall effectiveness of the BMPs and associated cost-benefit analysis as well as the overall WQRP.

5.2 Cost-Benefit Analysis

The cost-benefit analysis is an integral component of the process for evaluating the WQRP. The costs associated with the completion of both structural and non-structural BMPs will be carefully documented throughout the fiscal year. In addition, the removal efficiencies for these BMPs as described in Section 3.4 will be tracked. At the end of each fiscal year, this data will be compiled to identify the estimated cost associated with the removal of fecal coliform bacteria for each BMP employed. This data will be summarized and included in the annual report completed and submitted the WQRP Advisory Group and DWQ by July 15th of every year. This data will be carefully evaluated during the annual meetings of the WQRP Advisory Group for identification of the BMPs to be employed the next fiscal year.

For FY09, cost data was available for the retrofit BMP projects (bioretention systems) installed at Mint Hill Park on Fairveiw Road and the non-structural BMP implemented through the septic system survey. The total fecal coliform load removed as a result of theses BMPs was also estimated to identify the benefit of these BMPs. The results of this analysis are as follows:

BMP Cost vs. Benefit

- Estimated annual fecal coliform removal from the 2 rain gardens = 869 billion colonies
- The estimated cost of the 2 rain gardens = $249,000
- Cost per billion colonies removed = $286

Septic System Survey Cost vs. Benefit

- Estimated annual fecal coliform removal from septic system inspections = 135 billion colonies
- The estimated cost of the septic system inspections = $8,989 (includes inspection costs only and the cost to the owner of the repair)
- Cost per billion colonies removed = $67 (based on the assumption that all the fecal bacteria from the failing system reaches the creek)

Based on the above cost-benefit analysis, septic system inspections are approximately four (4) times more cost effective at the removal of fecal coliform bacteria than retrofitted-structural BMPs in the Goose Creek Watershed. In other words, for every $1 spent on the septic system inspection program at least $4 would have to be spent on structural BMP retrofits to achieve the same pollutant removal load. Therefore, maximum effort should be focused on the completion of the septic system survey and the implementation of the survey in Indian Trail and Stallings.

SECTION 6.0 ADAPTIVE MANAGEMENT

6.1 Assessing the Need for Change

During the annual meeting of the WQRP Advisory Group held in August of every year as discussed in Section 5.1 above, MCWQP staff will explain the overall effectiveness of the BMPs and WQRP at complying with the State water quality standard and lead a subsequent discussion regarding the changes that are needed to maximize the cost-benefit ratio. The purpose of this discussion will be to identify specific changes and/or additions to the BMPs and WQRP Plan that are necessary in order to more effectively comply with the TMDL targets and State water quality standard in a cost efficient manner.

6.2 WQRP Plan Updates

MCWQP will record comments and input received during the annual WQRP Advisory Group meeting regarding the effectiveness of the BMPs and WQRP as well as the changes necessary to improve compliance with the TMDL targets and State water quality standard. MCWQP staff will carefully consider these comments and update the WQRP Plan accordingly. In addition, the annual report will be modified if the WQRP Advisory Group believes that data and information presented in the annual report is inaccurate or incomplete. The updated WQRP Plan and annual report will be provided to DWQ no later than August 30th of every year. As required by Part II, Section A, Paragraph 11 (e) of the Phase II Permit, following any review and comment by DWQ regarding the WQRP, MCWQP will incorporate any necessary changes into the WQRP Plan. The WQRP Plan will be incorporated into the Storm Water Management Program Plan by August 30th of every year and implementation of the new Plan will begin immediately. The revised WQRP Plan and Storm Water Management Program Plan will be placed on the website. An email will be sent to the WQRP Advisory Group informing them that the revised WQRP Plan has been finalized and making them aware of its location on the website.

As the WQRP Plan is changed, the version and date are to be changed on the front cover of the document. Only the current version is to be located on the website under the name “Goose Creek WQRP V_.doc.” The blank after WQRP Plan is to include the version number such as 1, 2, 3, 4, etc. The current version of this Plan is also to be maintained on the LAN in the following folder: G:\WQ_Xfer\WQ\Goose Recovery Plan. Old versions of the WQRP Plan are to be maintained on the LAN in the following folder: G:\WQ_Xfer\WQ\Goose Recovery Plan\Archived WQRPs.

6.3 Program Analysis and Adaptive Management Schedule

Provided below is the schedule for program assessment and adaptive management as described in Sections 5.1 and 6.1 above.

1. By July 15th of every year: MCWQP to complete annual report including a cost-benefit analysis of BMPs and provide to members of the WQRP Advisory Group.
2. By August 15th of every year: MCWQP to hold a meeting of the WQRP Advisory Group to review the annual report, assess the effectiveness of BMPs and modify and/or add to the WQRP Plan and/or BMPs as deemed appropriate.

3. By August 30th of every year: MCWQP to complete modifications to the WQRP Plan, BMPs and annual reports and submit to DWQ.
4. By August 30th of every year: MCWQP to place revised WQRP Plan, Storm Water Management Program Plan, annual report, and all monitoring data on the website and send an email to the WQRP Advisory Group informing them that the revisions and making them aware of its location on the website. All changes to the WQRP will become effective on August 30th of each year.

SECTION 7.0 SCHEDULE

Table 22 provides the WQRP activities to be performed and the associated schedule.

Table 22: WQRP Schedule

Activity	Initiation Date	Completion Date	Measure of Success
Program Development			
Develop a Water Quality Recovery Plan (WQRP) for the Goose Creek Fecal Coliform TMDL	August 2006	April 2007	WQRP Plan developed, implemented & incorporated into Storm Water Management Program Plan with updates ongoing.
Develop WQRP Advisory Group	November 2006	Ongoing	Active group established and ongoing with meetings at least annually in August.
Develop WQRP Website	April 2007	Ongoing with a minimal of annual updates	Website developed, including at a minimum the WQRP Plan, Annual Reports and Monitoring Data.
Develop WQRP Monitoring Plan	April 2007	Ongoing	Monitoring plan developed and incorporated into WQRP Plan.
Develop a Plan & Schedule for Identification of Storm Water Outfalls	April 2007	April 2007	Plan and schedule developed and incorporated into WQRP Plan.
Program Implementation			
Identification of Storm Water Outfalls	May 2007	July 2007	Outfalls identified and made available to staff through GIS. Updates to the database will be provided by contractors/ developers as new development occurs.
Implementation of Monitoring Program	May 2007	Ongoing	Monitoring conducted in accordance with Plan in Section 2.6. Data evaluation & pollution sources identified and eliminated immediately upon receipt of data.
Identification & Implementation of BMPs	April 2007	Ongoing	BMP study completed to identify BMPs some of which were implemented in FY09 as discussed in Section 3. BMPs to be implemented during FY10 are listed in Section 3.4.
Implementation of Public Participation & Outreach Efforts	May 2009	Ongoing	Brochures for proper maintenance of septic systems. FY10 activities and schedules included in Section 3.3.

Activity	Initiation Date	Completion Date	Measure of Success
Staff Development	April 2007	Ongoing	Staff training and updates on WQRP during staff meetings. FY10 activities and schedules included in Section 3.3
Data Collection & Documentation			
Data Collection	May 2007	Ongoing	Data collection occurs during monitoring and BMP implementation.
Reports	July 9, 2008	Ongoing	Data summarized and provided in annual report submitted to WQRP Advisory Group and DWQ by July 15th of every year. Also placed on website.
Program Evaluation			
Assessing the Effectiveness of BMPs & WQRP	August 4, 2009	Ongoing	Occurs at a minimum of annually in accordance with Section 5.
Cost-Benefit Analysis	August 4, 2009	Ongoing	Occurs at a minimum of annually in accordance with Section 5.
FY09 Program Evaluation	May 2009	August 4, 2009	Occurs at a minimum of annually in accordance with Section 5.
Adaptive Management			
Assessing the Need for Change	August 4, 2009	Ongoing	Occurs at a minimum of annually in accordance with Section 6.
WQRP Updates	August 4, 2009	Ongoing	Occurs at a minimum of annually in accordance with Section 6.

SECTION 8.0 REFERENCES

Mecklenburg County Water Quality Program, 2009, Illicit Discharge Detection and Elimination (IDDE) Policies and Procedures. 700 North Tryon Street, Charlotte, N.C.

Thomas Jefferson Planning District Commission. 2005. Moore's Creek Fecal Coliform TMDL Implementation Plan. 401 East Water Street, Charlottesville, VA.

Northern Virginia Regional Commission. 2004. Implementation Plan for the Fecal Coliform TMDL (Total Maximum Daily Load) for Four Mile Run, Virginia. 7535 Little River Turnpike, Suite 100, Annandale, VA.

Virginia Department of Conservation and Recreation. 2006. Water Quality Implementation Plan for Blacks Run and Cooks Creek (Fecal Coliform and Aquatic Life TMDLs). 44 Sanger Lane, Suite 102, Staunton, VA.

Water Environment Research Foundation. 1999 – 2000. American Society of Civil Engineers (ASCE) / Environmental and Water Resources Institute (EWRI), the American Public Works Association (APWA), the Federal Highway Administration (FHWA), and U.S. Environmental Protection Agency (EPA), 1999 – 2007, International Storm Water Database, www.bmpdatabase.org.

Jones, Jonathan E., Earles, Andrew, Fassman, Elizabeth A., Doerfer, John T. and Carroll, John E.: 2004. *Grant Ranch Stormwater-Quality Management Program*, Stormwater Magazine. Forester Media Inc., Santa Barbara, CA.

Urban Drainage and Flood Control District. 1992. *Urban Storm Drainage Criteria Manual*, Denver, CO.

Rusciano, G.M., C.C. Obropta. 2005. Rusciano, G.M. Efficiency of Bioretention Systems to Reduce Fecal Coliform Counts in Stormwater. Proceedings of The North American Surface Water Quality Conference and Exposition, Orlando, Florida, July 18-25, 2005. Forrester Communications, Inc., Santa Barbara, CA.

Birch, G.F., C. Matthai, M.S. Fazeli, and J. Suh. 2004. Efficiency of a Constructed Wetland in Removing Contaminants from Stormwater. *Wetlands*.

Kadlec, R.H. and R.L. Knight. Pathogens. 1996. In *Treatment Wetlands*. CRC Press, Inc.: Boca Raton, FL

Davies, C.M. and H.J. Bavor. 2000. The Fate of Stormwater-Associated Bacteria in Constructed Wetland and Water Pollution Control Pond Systems. *Journal of Applied Microbiology*.

Southwest Florida Water Management District. 1999. *Removal of Microbial Indicators From Storm Water Using Sand Filtration, Wet Detention, and Alum Treatment Best Management*

Practices presented at the Sixth Biennial Storm Water Research & Watershed Management Conference September 14-17, 1999. 2379 Broad Street, Brooksville, FL.

North Carolina State University. 2007. City of Charlotte Pilot BMP Monitoring Program Pierson Pond Final Monitoring Report, City of Charlotte Pilot BMP Monitoring Program Shade Valley Wet Pond Final Monitoring Report, City of Charlotte Pilot BMP Monitoring Program Edwards Branch Wetland Final Monitoring Report, City of Charlotte Pilot BMP Monitoring Program Bruns Ave. Elementary School Wetland Final Monitoring Report, City of Charlotte Pilot BMP Monitoring Program Morehead Dry Detention Basin Final Monitoring Report, City of Charlotte Pilot BMP Monitoring Program University Executive Park Dry Detention Basin Final Monitoring Report, and City of Charlotte Pilot BMP Monitoring Program Hal Marshall Bioretention Final Monitoring Report. Raleigh, NC.

Appendix 1: Goose Creek TMDL Notification from N.C. Division of Water Quality

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Water Quality

Michael F. Easley, Governor

William G. Ross, Jr., Secretary
Alan W. Klimek, P.E., Director

August 10, 2006

RECEIVED
AUG 14 2006
LUESA

Mr. Rusty Rozzelle
Mecklenburg County
700 North Tryon Street
Charlotte, North Carolina 28202

Subject: NPDES Permit Number NCS000395
County of Mecklenburg and the Town of Mint Hill

Dear Mr. Rozzelle:

Pursuant to the terms and conditions of your NPDES Permit, Number NCS000395, Part II, Final Limitations and Controls for Permitted Discharges, Section A, Program Implementation, Paragraph 11 (a), Mecklenburg County is subject to an approved Total Maximum Daily Load (TMDL).

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. This list, referred to as the 303(d) list, is submitted to the U.S. Environmental Protection Agency (EPA) for review. The 303(d) process requires that a TMDL be developed for each of the waters appearing on the 303(d) list. The 2002 list identified the 17.0 mile segment of Goose Creek from its source to the Rocky River as impaired due to elevated fecal coliform concentrations. In response to the high level of interest in this TMDL a stakeholder group was formed in 2003. The TMDL approved by EPA July 8, 2005, encompasses all stream segments listed in the 2002-303(d) list for this watershed. Mecklenburg County can identify the impaired stream segments by referencing the current version of the N.C. Water Quality Assessment and Impaired Waters List (305(b) and 303(d) Report, available on the website of the Division of Water Quality Modeling and TMDL Unit at:

http://h2o.enr.state.nc.us/tmdl/General_303d.htm

The objective of a TMDL is to allocate allowable pollutant loads to known sources so that actions may be taken to restore the water to its intended uses. Thus the implementation of fecal coliform controls will be necessary to restore uses in Goose Creek. The involvement of local governments and agencies will be needed in order to develop implementation plans.

1617 Mail Service Center, Raleigh, North Carolina 27699-1617
512 N. Salisbury St., Raleigh, North Carolina 27604
Phone: 919-733-7015 / FAX: 919-733-2496 / Internet: h2o.enr.state.nc.us

Pursuant to the terms and conditions of your NPDES Permit, Number NCS000395, Part II, Final Limitations and Controls for Permitted Discharges, Section A, Program Implementation, Paragraph 11, Mecklenburg County shall establish a TMDL Water Quality Recovery Program within two years after receiving this notice.

Within two years after receiving this notice, Mecklenburg County shall identify potential sources of fecal coliform and develop a monitoring plan for fecal coliform. Mecklenburg County shall include the location of all known MS4 outfalls with the potential of discharging fecal coliform, the schedule for discovering and locating unknown MS4 outfalls with the potential of discharging fecal coliform, and the monitoring plan, in the first Stormwater Plan annual report due no earlier than two years after notification of the applicability of a TMDL. Following any review and comment by the Division on the TMDL Water Quality Recovery Program, the Mecklenburg County shall incorporate necessary changes into the program and incorporate the revised TMDL Water Quality Recovery Program into their Stormwater Management Plan.

The permit requirements for a TMDL in Part II Section (A) paragraph (11), should be coordinated with requirements in Part II, Section (D) (illicit discharges), Section (F) paragraph (2) paragraph (c) and other Best Management Practices (BMPs). The schedule developed under the TMDL requirements does not modify the implementation schedule requirements in Part II, Section (D), Section (F) or other BMPs prescribed in your permit.

If you have any questions, please contact Mike Randall at telephone number 919/733-5083 ext. 545.

Sincerely,

Alan W. Klimek, P.E.

cc: Mike Mitchell, EPA Region IV
Central Files
Stormwater and General Permit Unit Files
DWQ Mooresville Regional Office

Appendix 2: Water Quality Recovery Program Guidance Document

Notification

Pursuant to the terms and conditions of their NPDES Permit, Part II, Final Limitations and Controls for Permitted Discharges, Section A, Program Implementation, Paragraph 11 (a), Mecklenburg County was notified that they are subject to an approved Total Maximum Daily Load (TMDL).

Permit Requirements

Program Development

No later than September 1, 2008, Permittee shall:

- Establish a TMDL Water Quality Recovery Program (WQRP).
- Identify the locations of all currently known MS4 outfalls within its jurisdictional area with the potential of discharging the pollutant(s) of concern to the impaired segments, to their tributaries, and to segments and tributaries within the watershed contributing to the impaired segments.
- Develop and submit a schedule to discover and locate all other MS4 outfalls within its jurisdictional area that may be discharging the pollutant(s) of concern to the impaired stream segments, to their tributaries, and to segments and tributaries within the watershed contributing to the impaired segments.
- Develop a monitoring plan for each pollutant of concern and submit for DWQ review and approval.

<u>Annual Report (No later than September 1, 2008):</u>

Include the location of all currently known MS4 outfalls with the potential of discharging the pollutant(s) of concern, the schedule for discovering and locating currently unknown MS4 outfalls with the potential of discharging the pollutant(s) of concern, and the monitoring plan.

<u>Annual Reports (No later than September 1, 2009 and thereafter):</u>

- Include an assessment of data collected for each pollutant of concern.
- Include an assessment of the effectiveness of the BMPs employed and propose additional BMP measures that may be necessary to return the impaired segments to compliance with state water quality standards.

Implementation

- The permitee shall implement appropriate BMPs to control pollutants of concern to the maximum extent practicable.
- Following any review and comment by the Division on the TMDL Water Quality Recovery Program, the permitee shall incorporate any necessary changes into the

program. The permittee shall incorporate the revised TMDL WQRP into the Storm Water Management Plan.

Suggested Minimum Elements of a Water Quality Recovery Program

- Identify the purpose and goals of a TMDL WQRP.
- Establish a TMDL advisory group. group.
- Establish a website to document and disseminate information and results.
- Identify the location of all currently known MS4 outfalls with the potential of discharging the pollutant(s) of concern.
- Develop a schedule for discovering and locating currently unknown MS4 outfalls with the potential of discharging the pollutant(s) of concern.
- Develop and implement a monitoring plan.
- An assessment of the available data for pollutant of concern.
- Identify BMPs, time frames, and costs necessary to achieve reduction.
- An assessment of the effectiveness of the BMPs employed, to determine what, if any, additional BMP measures may be necessary to return the impaired segments to compliance with State water quality standards.
- Implement appropriate BMPs to control the pollutants of concern to the maximum extent practicable.
- Incorporate the TMDL WQRP into the Permittee's Storm Water Management Plan.
- Documentation.
- Public Participation and Outreach Activities.
- Staff Development
- Cost-Benefit Analysis.

Monitoring Plan

The monitoring plan shall include the sample location by verbal description and latitude and longitude coordinates, sample type, frequency, any seasonal considerations, and a monitoring implementation schedule for each pollutant of concern. Where appropriate, the permittee may reduce the monitoring burden by proposing to monitor outfalls that the Division would consider substantially similar to other outfalls. The permittee may also propose in-stream monitoring where it would complement the overall monitoring plan. The monitoring plan shall be adjusted as additional outfalls are identified in accordance with the schedule required above and as accumulating data may suggest.

Documentation

Documentation of progress toward fulfilling the source reduction targets and the resulting water quality improvements is extremely important at several levels including:

- The public/local citizens interested in water quality improvement.
- Local agencies responsible for components of the implementation
- State agencies responsible for assessing water quality and adjusting programs to address concerns.

- Federal agencies, primarily the USEPA, responsible for oversight of State programs and ultimately responsible for TMDL implementation.

To ensure effective documentation and communication of results at all levels, data will be collected and summarized and made available to the general public via the website and to NCDENR and the S.C. Department of Health and Environmental Control 9SCDHEC) via written reports. This reporting regimen will ensure adequate assessment of the TMDL WQRP and the timely implementation of TMDL modifications for maximum effectiveness.

The following documentation methods and reporting will be used to measure TMDL effectiveness and report results:

- "TMDL Monitoring Reports" including data collected from source and in-stream compliance monitoring activities posted monthly on website.
- "Source Reduction Reports" for each of the major pollutant(s) of concern sources included in the TMDLs. This information will be posted annually on the website and a written copy will be made available to NCDENR and SCDHEC.
- "Water Quality Reports" that use the annual Source Reduction Reports to summarize water quality information regarding compliance with the TMDLs for pollutant(s) of concern. This information will be posted on the website and a written copy will be made available to NCDENR and SCDENR.

Public Participation and Outreach Activities

Workshops for the general public, publicized through media releases, will be held for the purpose of explaining efforts that are being undertaken to reduce pollutant(s) of concern.

Staff Development Phase

Staff will need to be adequately informed of the specific requirements of the WQRP. Staff will also need to be informed of their specific duties and responsibilities toward fulfilling the WQRP.

Cost-Benefit Analysis

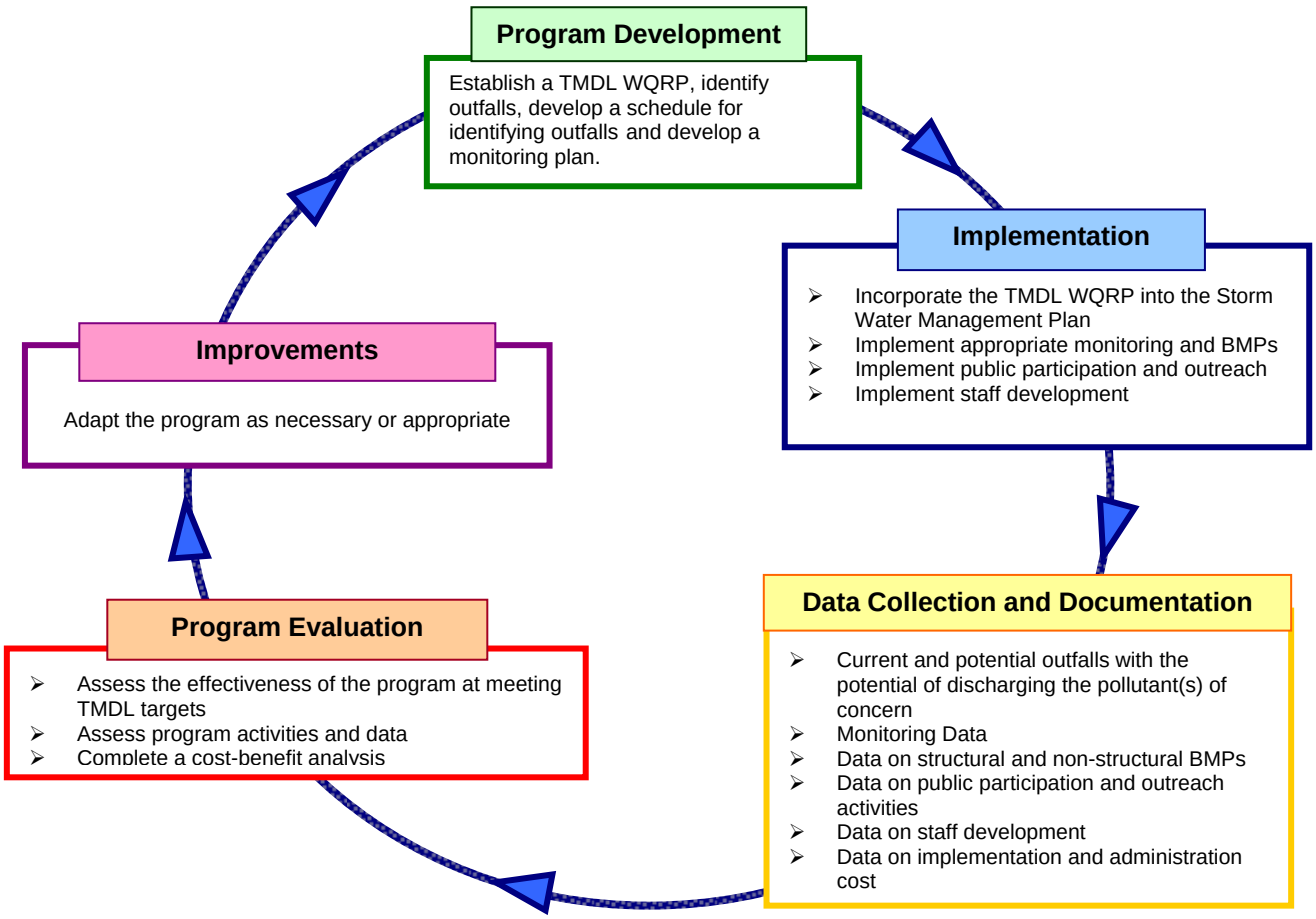
Using the data collected through stream monitoring and assessments, a cost-benefit analysis of the elimination of the various sources for each pollutant of concern should be conducted. The purpose of this analysis will be to determine the most cost effective method of eliminating sources of the pollutant(s) of concern detected through direct stream evaluation. Established loading rates for each pollutant of concern will be compared to the costs to eliminate sources, which might include illicit discharges, septic system failures, sanitary sewer overflows, illicit connections, domestic animals, and leaking sanitary sewer lines. The results of the analysis will be used to prioritize limited funds for elimination of the greatest load for the least expenditure for each pollutant(s) of concern.

Assessing the Need for Change

A TMDL work group will be developed for the purpose of reviewing program activities and data and assessing the need for change and to assess the effectiveness of the program at meeting TMDL targets and changing the strategy as necessary to ensure the fulfillment of all TMDL objectives.

The TMDL work group will adapt the TMDL WQRP as necessary to ensure that source reduction targets are effectively and efficiently fulfilled and that progress is being made toward achieving the ultimate goal of compliance with the N.C. water quality standard for each pollutant(s) of concern. All changes will be communicated to the agencies responsible for the implementation of the TMDL in the form of an annual report. This report will be posted on the web and made available to both NCDENR and SCDHEC for comment and input.

Water Quality Recovery Program Life Cycle



Appendix 3: Septic System Inspection Form Used in the Goose Creek Watershed

Groundwater & Wastewater Services
700 N. Tryon St., Suite 211
Charlotte, NC 28202
Ph: 704-336-5103

Septic System Inspection Form

Inspection Date: _____Inspection Completed By: _____

Site Parcel Id #: _____Site Address: _____

GWS File #: _____Watershed: _____ Catchment Id: _____

Septic System Information:

System Classification: ☐ II ☐ III ☐ IV ☐ V ☐ VI

☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g

System Description: _____
(Ex: pump to 25% reduction)

Year Operation Permit Issued: _____ *(If no permit record is available use built date year from POLARIS.)*

System Age: Years _____ ☐ Actual ☐ Estimated

Inspection Information:			**Comments**
Site accessible for inspection:	☐ Yes	☐ No	_____
Owner present:	☐ Yes	☐ No	_____
Drain field probed:	☐ Yes	☐ No	_____
System malfunction observed:	☐ Yes	☐ No	_____
Notice of Violation required:	☐ Yes	☐ No	_____
System located <200 ft. from surface water body:	☐ Yes	☐ No	_____
System located <50 ft. from stormwater BMP or diversion:	☐ Yes	☐ No	_____
Trees/vegetation in drain field:	☐ Yes	☐ No	_____
Irrigation on drain field:	☐ Yes	☐ No	_____
Well(s) located on property:	☐ Yes	☐ No	_____

General comments/observations: _____

_____

_____

_____

photos taken: _____ Dye Pack Left: ☐ Yes ☐ No Signature: _____

Checklist:

1. Perform file review for inspection site in the office (system type, age, location, etc.)
2. Conduct field inspection & complete inspection form before leaving the site
3. Take photos (2 minimum) of the drain field/tank(s) area from multiple locations
4. Leave project brochure & literature on door
5. Create a work order in Cityworks for each inspection completed
6. Attach each work order to a septic GIS feature (permitted or pre-existing layers). If a GIS feature does not exist the system should be registered in WASPS as a pre-existing, active system and then attached to the work order.
7. Complete all work order sections, including the required CUSTOM fields (remember to upload the pictures taken as attachments!)
8. When finished submit the work order to Trevor Thomason for review & place the completed inspection form in his mailbox.

*All scanned files and related photos should be saved to the following location on the network share drive:

\\Hmcfs01\attachments\GWS\WorkOrders\SepticSystemInspections\

Make sure to save the files in the appropriate watershed folder (Ex: Goose Creek)

All wells identified during the inspection should be checked in GIS. If the wells are not visible in GIS they must be registered in WASPS.

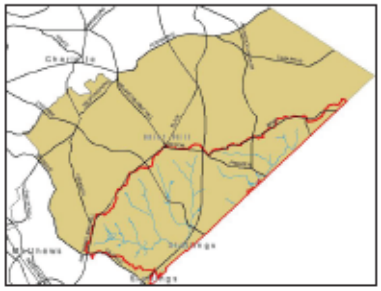
Appendix 4: Septic System Educational Material Distributed During Goose Creek Inspections

About your watershed

The Goose Creek watershed is made up of 42 square miles in Union and Mecklenburg counties and includes parts of Mint Hill. The watershed is home to the Carolina heelsplitter mussel which was was added to the federal endangered species list in 1993.

In order to protect the water quality and habitat needed to sustain and recover the Carolina heelsplitter population, a set of management rules were developed and approved by the N. C. Department of Environment & Natural Resources (NC DENR).

In order to comply with the rules put forth by the State, the Town of Mint Hill and Mecklenburg County established a Water Quality Recovery Plan (WQRP) for fecal coliform in the Goose Creek Watershed. The main goal of the WQRP is to identify and remove sources of fecal coliform in the Watershed.



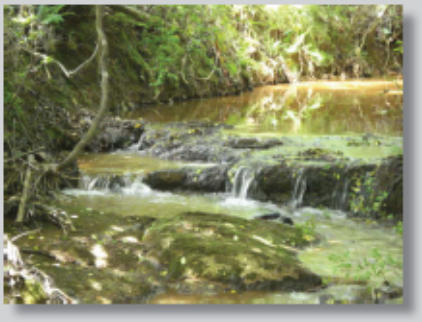
Storm Water Services has conducted field surveys of the watershed including the sampling and identification of all storm water outfalls, in-stream sampling and stream walks of the entire watershed. These efforts have not been successful in identifying sources of fecal coliform. The one remaining potential source that has yet to be thoroughly investigated is septic systems. Septic systems are being targeted because the vast majority of the Goose Creek Watershed does not have a municipal sanitary sewer system.

For questions concerning septic sytems, wells and groundwater issues contact
Groundwater & Wastewater Services
704-336-5103
wellreg@mecklenburgcountync.gov

For questions concerning the Water Quality Recovery Plan of the Goose Creek Watershed contact
David Kroening
704-336-5448
david.kroening@mecklenburgcountync.gov

A Guide for Homeowners

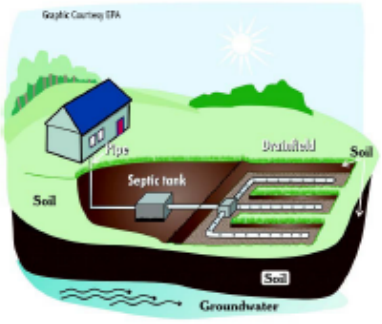
Septic Systems in Goose Creek Watershed



To protect your ground and surface water resources

About your septic system

A typical septic system has four main components: a pipe from the home, a septic tank, a drainfield, and the soil. Microbes in the soil digest or remove most contaminants from wastewater before it eventually reaches groundwater.



Homeowners are responsible for the care and maintenance of their septic systems. With reasonable use and periodic maintenance, your system should last a long time. Some things you should do to insure your system remains in good working order are:

- Do regular pumping of the septage from the septic tank.
- Locate the septic tank lid and keep it marked.
- Know what the minimum maintenance requirements are for your type of septic system.
- Respond to a failing system with required maintenance, particularly when surfacing of effluent occurs or odors are apparent.
- Keep records of the system design, location and maintenance activities (including pumping dates).

Keeping your system functioning properly prevents the spread of infection and disease and protects water resources.

About your inspection

Prior to this field inspection, the inspector reviewed the permit issued for installation of the system and looked at recent aerial photography to identify the location of the system.
The inspector may have 'probed' the area of the drain field to determine the location of the tank and drain lines and any repair areas. The inspector looked for signs of a malfunctioning system.

Your septic system was inspected on:

_____

Inspector's name:

_____

Inspector's contact number:

_____

Your inspection showed:

- ☐ No problems, system functioning normally
- ☐ Pooling sewage on the land surface
- ☐ Trees growing in the drain field
- ☐ Irrigation of the drain field
- ☐ _____

Please call the above inspector directly if you have questions or concerns about the inspection of your septic system.

Tips for a healthy system

Although a conventional septic system has no moving parts and normally does not require weekly or monthly maintenance, attention must be paid to some general principles of maintenance. Important maintenance practices include the following:

1 Minimize water usage.

- Repair leaky faucets and toilets promptly.
- Run dishwashers & washing machines only with full loads.
- Turn water off while shaving, brushing teeth, washing dishes, etc.
- Install low-flow faucets and water-saving showerheads.

2 Provide adequate site drainage.

- Direct gutters and downspouts away from the septic tank and drainfield.
- Do not drive over or park on the drainfield.

3 Use proper landscaping.

- A healthy grass cover should be maintained over the drainfield to prevent soil erosion.
- Trees and shrubs should not be planted too close to the drainfield.
- No structures, sheds, pools, patios, or paved surfaces should be constructed over the septic tank or drainfield area.

4 Use sound waste disposal practices.

The following substances should NOT be disposed of through the household plumbing system:

- Coffee grounds
- Dental floss
- Disposable diapers
- Cat litter
- Sanitary napkins
- Tampons
- Cigarette butts
- Plastics
- Facial tissues
- Paper towels
- Fat, grease, or oil
- Household hazardous wastes

For more tips on septic systems visit http://groundwater.charmeck.org.

Appendix 5: Prioritization Scheme for Septic System Inspections
March 16, 2009

Factors used to determine the order (priority) that septic systems will be inspected:

1. Catchment basin (14 total)
2. Proximity to stream (200 ft. buffer)
3. Age of septic system (estimated from CAMA development data)

Catchments will be prioritized from 1 to 14 by the Water Quality (WQ) program and provided to Groundwater & Wastewater Services (GWS). GWS will then develop an inspection schedule for each catchment based on the following matrix:

Tier	Proximity to stream	Septic System Age (yrs.)
1	<= 200 ft.	29+ (Pre-1980)
2	<= 200 ft.	0-28 (1981-2009)
3	> 200 ft.	29+ (Pre-1980)
4	> 200 ft.	14-28 (1980-1995)
5	> 200 ft.	0-13 (1996-2009)

Time estimation per inspection:

Task	Estimated Time (hrs.)	Comments:
Inspection	0.50	Complete inspection form
Documentation	0.50	File review & CW data entry
*Travel Time	0.25	Inspections will be assigned in clusters.
Total Time	1.25	

Estimate of 1.25 hours for each inspection performed.

Travel time is estimated based on the following:

1. Inspections will be assigned in grouped clusters
2. Inspections will be completed in batches (5 or more inspections)
   Example: Travel time to site from Hal Marshall = 30 minutes
   Travel time from site to Hal Marshall = 30 minutes
   Travel time between inspection sites = 5 minutes
   10 inspections conducted during one trip = 50 minutes
   110 minutes/10 inspections = 11 minutes/inspection

Total time analysis for **10** inspections:

1. 0.5 hrs. x 10 inspections = 5 hours for inspection
2. 0.5 hrs. x 10 inspections = 5 hours for file review & work order completion
3. 0.25 hrs. x 10 inspections = 2.5 hours of travel time

Field/travel = 7.5 hours
Office/documentation = 5 hours