Storm Water Management Master Plan
Final Report

For the
University of North Carolina at Charlotte

Charlotte, North Carolina

Prepared for
UNC Charlotte Facilities Management
Real Estate and Land Use Department

Prepared By
Stewart Engineering, Inc.

and
Biohabitats, Inc.

September 10, 2012

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Prepared for:

UNC Charlotte Facilities Management
Real Estate and Land Use Department

Prepared by:

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Stewart Project No. X11024

September 10, 2012

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EXECUTIVE SUMMARY

This is the final report for the "MS4 Permit Application/Storm Water Management Master Plan" project for the University of North Carolina at Charlotte.

The purpose of this report is to guide the University in implementing storm water best management practices (BMPs) to meet the Post-Construction requirements of the Storm Water Management Program included in the University's National Pollutant Discharge Elimination System (NPDES) Small Municipal Separate Storm Sewer System (MS4) Permit.

This report proposes a regional approach to addressing storm water management that is focused on selected areas of campus.

During the preliminary phase of the Storm Water Management Master Plan project, locations were identified on campus in which construction of Best Management Practices (BMPs) would achieve the water quality and peak control requirements of the University's NPDES permit for the largest areas with the most reasonable and practical land use and financial investment. Target areas for BMP locations were based on the Campus Sectors described in the Campus Master Plan, prepared by Ayers Saint Gross, dated May 12, 2010. Two Campus Sectors were selected for the focus of this report; the Charlotte Research Institute (CRI) Sector and South Village Sector. This report includes schematic designs for regional storm water BMPs in the CRI and South Village sectors.

This report also includes design parameters for additional future BMPs for the remainder of campus, along with a method for tracking development of built upon area on campus relative to BMP treatment capacity on campus.

This report is not meant to be a design manual for storm water BMPs; however it does describe the design requirements. Development of the University's BMP Design Manual will be part of the implementation of the University's NPDES Permit.

Appendix 1 of this report include information on the background and process for the development of this report, including meetings, field reconnaissance, and storm water infrastructure due diligence, as recorded in the following documentation;

- Storm Water Practice Palette, March 1, 2012
- Preliminary Storm Water Management Master Plan Report, March 7, 2012
- MS4 Program Management Structure Considerations, June 29, 2012
- Notes from meetings with NCDENR and City of Charlotte representatives
    - With NCDENR, March 23, 2012
    - With NCDENR and City of Charlotte, August 1, 2012
- Storm Water Retrofit Study, August 13, 2012

Additional sources that were used to develop this report include the Campus Master Plan, prepared by Ayers Saint Gross, dated, May 12, 2010; and the Interviews and Audit memorandum, prepared by Biohabitats and STEWART, dated January 31, 2012.

INTRODUCTION

One of the goals for the Storm Water Management Master Plan was to develop a regional approach to managing storm water through the use of BMPs across the main campus along with a method of tracking built-upon-area relative to the capacity of the regional storm water BMPs. The reason for this goal was so that the University may construct BMPs that would be sized for the build-out of the Campus Master Plan, and then track the progress of development relative to the capacity of the BMPs.

Another goal for the Storm Water Management Master Plan was to implement this regional approach to water quality in such a way that would allow compensatory treatment, or treatment sharing, between basins. The reason for this goal was so that the University may provide an accounting for water quality treatment of new impervious areas in parts of campus where construction of new BMPs will not be practicable.

Based on discussions with the State, NCDENR's acceptance of this regional approach was contingent upon only allowing compensatory treatment between basins that are connected without flowing across any other property and/or public right-of-way. In addition, NCDENR will review the University's attempts to implement BMPs and/or green infrastructure for ALL areas of campus to the maximum extent practicable as part of their NPDES MS4 permit.

REGULATORY JURISDICTION

The State Construction Office Manual states that State-owned projects must comply with local zoning requirements. The main campus of the University is located within the city limits of the City of Charlotte. Therefore, until the issuance of the University's NPDES permit, the University must comply with the requirements of City of Charlotte's Post-Construction Controls Ordinance. Once the University's NPDES permit is approved, the University will be responsible for setting and meeting the requirements of its own Campus Storm Water Management Master Plan.

DEVELOPMENT DENSITY

The City of Charlotte's Post-Construction Controls Ordinance uses the following criteria for determining whether a project has to meet high or low density design requirements;

- Percent Built Upon Area
- Vegetated Storm Water Conveyance
- Stream Buffers

The referenced Preliminary Storm Water Management Master Plan Report states that the percent built upon area of the main campus is less than the City's threshold for classification as "High Density". However, due to the proliferation of piped storm water conveyance across the campus, both the City of Charlotte and NCDENR have classified the campus as "High Density".

DESIGN BASIS

Any of the Best Management Practices described in either the North Carolina Division of Water Quality Storm Water Best Management Practices Manual or the Charlotte-Mecklenburg BMP Design Manual may be used on campus. Best Management Practices should be designed using the methodology described in the respective manual.

Innovative and/or proprietary BMPs may also be used. If such methods are to be used, then it is recommended that the designer prepare detailed operation and maintenance instructions for the BMP that include measurable performance criteria and a program for monitoring those criteria.

The referenced "Storm Water Practice Palette" (March 1, 2012) describes many such innovative practices.

PERFORMANCE CRITERIA

Storm Water BMPs shall be designed to provide either of the following for the increased imperviousness of the project area;

(1) Provide 85 percent total suspended solids (TSS) removal from first inch of rainfall for entire project; or

(2) Provide one-year, 24-hour volume control and ten-year, six-hour peak control for entire project.

The "pre-developed" condition; which shall be used as the baseline for determining the increased imperviousness of the project area, shall be the condition as of July 1, 2008. Re-developed existing impervious surfaces do not count as increased imperviousness.

STREAM BUFFERS

In addition to constructing BMPs, the University must provide stream buffers for all perennial and intermittent streams on campus in accordance with the requirements of the City of Charlotte's Post Construction Controls Ordinance, effective October 2011. The stream buffer requirements are as follows;

Intermittent and perennial streams shall be delineated by a certified professional using U.S. Army Corps of Engineers and N.C. Division of Water Quality methodology and shall be included in the University's GIS map data along with all buffer areas. All perennial and intermittent streams draining less than 50 acres shall have a minimum 50-foot undisturbed buffer. All perennial and intermittent streams draining greater than or equal to 50 acres shall have a 100-foot undisturbed buffer, plus the entire floodplain. All buffers shall be measured from the top of the bank on both sides of the stream.

The function of the buffer is to protect the integrity of the stream ecosystems. As such, the buffer is to remain undisturbed; no cutting or clearing is allowed. The buffer areas may be used for flood control structures, bank stabilization, utility installation, and road crossings only. Areas disturbed due to approved activities must be stabilized.

PROJECT AREA

The main campus of the University of North Carolina at Charlotte currently has a land area of approximately 891 acres. Future expansion of the main campus will increase the land area to approximately 898 acres.

The "project area" includes the areas within the main campus that drain to either Toby Creek or Mallard Creek without crossing another property and/or public right-of-way. The project area is all of Watershed 1 described in the Campus Master Plan; which is approximately 583 acres in size. The remainder of the main campus property; Watersheds 2 and 3, flows across other property and/or public right-of-way prior to discharging to Toby Creek or Mallard Creek, and therefore, cannot be included in the compensatory treatment for Watershed 1, and must be treated separately.

The project area is shown on Map #1 included in Appendix 2.

The referenced "Storm Water Retrofit Study" (August 13, 2012) includes recommended storm water BMPs for portions of campus located outside of the project area.

IMPERVIOUSNESS

The project area was further subdivided into sub-basins and an accounting was made of the impervious area within each sub-basin. Sub-basins were delineated based on topography, streams, wetlands, and existing storm water conveyance systems.

The imperviousness of the project area was evaluated at two points in time;

- Impervious area constructed or approved prior to July 1, 2008, and
- Build out of the Campus Master Plan (ASG, 2010).

The impervious area as of July 1, 2008 within the project area is approximately 125 acres, and will be the "existing" or pre-development condition for the schematic BMP designs included in this report. The total impervious surface within the project area described in the Campus Master Plan at build-out is approximately 168 acres. That is the impervious surface area within Watershed 1 will increase by approximately 43 acres from July 1, 2008 to build-out. And, re-development of existing impervious area **does not** count as "increased" impervious area.

The sub-basins and impervious areas are shown on Map # 2 in Appendix 1. The impervious area within the project area is tabulated in Table 1 in Appendix 2.

EXISTING BMPS

The project area includes seven (7) existing BMPs; each associated with a specific project, as follows;

- EPIC: sand filter (BMP-1)
- EPIC: three (3) rain gardens (BMPs 2, 3, and 4)
- EPIC: underground detention (BMP 5)
- South Village: wet detention pond (BMP 8)
- Science and Technology Building: dry detention pond (BMP 13)

These existing BMPs are included in the tabulation for tracking of available BMP capacity for the project area included in Table 3 in Appendix 2.

There are also three (3) additional water features on campus that may be retrofitted to act as BMPs. They are as follows;

- Hechenbleikner Lake (BMP 6)
- Davis Lake (BMP 9), and
- University Lake (BMP 10)

The schematic designs for renovations to Davis Lake and University Lake are included in this report as recommended BMPs. Hechenbleikner Lake was being renovated during the preparation of this report. Renovations include regarding the slopes and installation of an outfall structure.

SCHEMATIC DESIGN

The Charlotte Research Institute (CRI) and the South Village were the two (2) campus sectors selected by the University for the focus of this report and for the location of proposed BMPs to be designed to a schematic level as part of this report. This report includes the schematic design of one (1) BMP in the South Village sector, and three (3) BMPs in the CRI sector. To achieve the maximum practical benefit, wet detention was selected as the BMP type. These BMPs are, respectively, as follows;

- BMP 9 – Davis Lake Retrofit for Wet Detention
- BMP 10 – University Lake Retrofit for Wet Detention
- BMP 11 - Football Practice Field Wet Detention
- BMP 12 – North CRI Wet Detention

Location and Sizing

The locations of the proposed BMPs were selected based on the following criteria;

- Near the bottom of a sub-basin,
- Relatively large amount of untreated storm water runoff,
- Outside areas of future campus development, and
- Outside of regulated floodways.

Opportunities for renovating or retrofitting existing BMPs were considered to add the benefit of maintaining old or damaged control structures, pipes, and berms.

The proposed BMPs were sized to provide 85% TSS removal from the first inch of rainfall from the entire sub-basin tributary area of the BMP, and account for the imperviousness within the referenced tributary area at build-out. Each wet detention pond fore-bay and normal pool surface area was designed and sized to meet the requirements included in the Charlotte-Mecklenburg BMP Design Manual for each BMP.

Wet Detention Pond Sizing worksheets are included in Appendix 3.

With regard to tracking the BMP capacity versus imperviousness within a given sub-basin; the existing impervious area that is treated in the BMP is added to the pool of compensatory treatment area that is available for new impervious area in another sub-basin within project area for which construction of a BMP and/or green infrastructure is not practicable.

A summary of BMP performance is included in Table 4 in Appendix 3.

Grading & Topographic Impacts

The schematic design of the referenced BMPs takes into account existing topography based on available Mecklenburg County GIS contour data.

Schematic site plans for BMPs 9 through 12 are shown in the Maps in Appendix 3. These maps show **schematically** the locations of the fore-bays, the size of the normal pool water surface, and the limits of the grading to tie the pond berms down to existing ground surface.

Outlet Design and Sizing

Outlet structures, weirs, risers, orifices and outlet pipes were **schematically** designed in accordance with the drawdown requirements included in the Charlotte-Mecklenburg BMP Design Manual. Stewart used PondPack V8i (Bentley) software to model hydraulic routing through the BMPs and respective outlet structures. Outlet structure schematic design and sizing is summarized in Table 5 in Appendix 4.

Phasing Analysis

In order to protect the water quality within Toby Creek and Mallard Creek, BMPs should be implemented on campus before any new untreated impervious area is constructed. The regional approach outlined in this report provides a means to address storm water runoff from future construction before it is needed.

As stated above, the Campus Master Plan anticipates the addition of approximately 43 acres of impervious area with the project area. Implementation of the referenced BMPs 9, 10, 11, and 12 will treat approximately 46.10 acres of impervious area; which includes enough existing impervious area to provide compensatory for the entire project area; Watershed 1.

However, the three (3) new BMPs in the CRI sector do not provide enough compensatory treatment for all of the new impervious area in CRI, and most of the capacity of these BMPs is based on impervious area at campus build-out. On the other hand, BMP 9 in the South Village sector provides treatment for a very large already developed portion of campus. Therefore, it would benefit the University most to construct BMP 9 first.

The next BMP to be constructed should be BMP 11, because most of its tributary area, although not counted as “pre-development”, is already built out.

BMPs 10 and 12 should be implemented as CRI grows either to the south or north, respectively.

Planning Level Construction Cost Estimates

The following construction cost estimate is based on the schematic design of each of the BMPs and may be used for planning purposes.

- BMP 9 - $146,000
- BMP 10 - $145,000
- BMP 11 - $116,000
- BMP 12 - $90,000

Storm Water Fee Credits

Storm water fee credits for the implementation of the referenced BMPs 9, 10, 11, and 12 were estimated using the City of Charlotte Storm Water Services Credit Application Instruction Manual, dated June 2008. The current storm water fee rate in the City of Charlotte is $145.55 per acre of impervious area per month. The impervious area controlled by the referenced BMPs totals approximately 59.69 acres. The monthly storm water services fee for this impervious area before credit for implementation of the BMPS is approximately $8,687.88. If a credit application is approved for the referenced BMPs, then the monthly fee for this area of campus may be lowered to approximately $5,296.72; a reduction of about 39% or $3,391.15 per month.

Storm water fee credit estimation computations are included in Appendix 3.

Appendix 1

BACKGROUND INFORMATION

- **Storm Water Practice Palette, March 1, 2012**
- **Preliminary Storm Water Management Master Plan Report, March 7, 2012**
- **MS4 Program Management Structure Considerations, June 29, 2012**
- **Notes from meetings with NCDENR and City of Charlotte representatives**
    - **With NCDENR, March 23, 2012**
    - **With NCDENR and City of Charlotte, August 1, 2012**
- **Storm Water Retrofit Study, August 13, 2012**

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Date: March 1, 2012

To: Peter Franz and David Jones, UNC Charlotte
James Baysinger and Jeff Oden, Stewart

From: Jon Hathaway, PhD, PE and Jennifer Zielinski, PE

Re: UNC Charlotte MS4 Permit Application / Storm Water Management Master Plan
Task 2.2 Stormwater Management Master Plan

Subj: Stormwater Practice Palette for the UNC Charlotte Campus

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This memorandum summarizes the stormwater practice palette applicable to the UNC Charlotte campus, with a particular emphasis on the Charlotte Research Institute (CRI), Campus Core and the South Village. Many opportunities exist throughout the UNC Charlotte campus for the integration of stormwater best management practices (BMPs) in the landscape. These may be constructed as retrofits of drainage infrastructure to manage runoff from existing development, or they may be implemented as new development takes place. Specific types of BMPs that are most applicable to the campus include:

- Landscape Conversion / Impervious Removal
- Stormwater Ponds and Wetlands
- Rainwater Harvesting
- Underground Detention
- Green Roofs
- Bioretention
- Bioswales
- Outfall Treatment

These are described in more detail on the following pages. All of these practices are applicable to the three sectors being studied. However, these three sectors vary greatly in terms of density, age of development, and existing drainage patterns and infrastructure. The **Charlotte Research Institute** has the highest potential for large facilities given the large area available near Toby Creek. Targeted BMPs in this sector include stormwater ponds and wetlands, outfall treatments, bioretention and bioswales. The **Campus Core** is densely developed, leaving minimal space for large BMPs. Targeted BMPs in this sector include retrofitting existing ponds, bioretention, bioswales, rainwater harvesting, green roofs and underground detention. The **South Village**, although less dense than the Campus Core, still has limited space for BMPs. However, future plans to redevelop this sector will allow for the integration of green infrastructure throughout. Targeted BMPs for this sector include outfall treatments combined with stream restoration, bioretention, bioswales, green roofs and rainwater harvesting.

Landscape Conversion / Impervious Removal

Landscape conversion is the conversion of a high maintenance landscape, land cover or impervious area to something that is more stormwater friendly. Four primary applications exist:

- reforestation of grass areas near riparian corridors
- conversion of turf to native vegetative cover
- conversion of high maintenance, non-native landscape plantings to native vegetative cover
- removal of impervious area and replacement with landscaping

Pros:

- Reduce maintenance of landscaped areas
- Reduced impervious area in stormwater calculations

Cons:

- Impervious surface may be considered valuable by some
- Aesthetics will be modified on campus – may not be desired by some

BEFORE

AFTER (ILLUSTRATIVE)

Stormwater Ponds and Wetlands

Stormwater ponds and wetlands include creating a new facility or retrofitting an existing one to enhance water quality treatment.

Pros:

- Provides detention of larger storms
- Provides full water quality treatment per the City of Charlotte
- Can modify existing systems to get credit
- High ecological value

Cons:

- Large area may be required
- May not be integrated into the overall campus landscape like other BMPs

BEFORE

AFTER (ILLUSTRATIVE)

Green Roofs

Green roofs typically refer to rooftop vegetation, but may also include the creation of vegetative canopy cover through the use of trellises, canopies, or planter boxes.

Pros:

- No campus footprint lost to BMP installation
- Aesthetic improvement that can be viewed from adjacent buildings
- Reduced heat island effect
- Benefit to building energy

Cons:

- May be expensive
- Structural support of rooftop must be sufficient to handle additional load

BEFORE

AFTER (ILLUSTRATIVE)

Rainwater Harvesting

Harvested rainwater is collected from a rooftop, plaza, or parking lot. Water can be stored in above ground cisterns or underground storage tanks. The water collected can be used for lawn and garden watering, indoor uses such as toilet flushing, and as water to supply cooling demand.

Pros:

- Stormwater is used as resource for irrigation / toilet flushing / cooling demand
- Storage can take place underground or above ground

Cons:

- Must be a demand for captured water to be effective
- May be difficult to retrofit if stormwater drainage for buildings is “internal”

BEFORE

AFTER (ILLUSTRATIVE)

Underground Detention

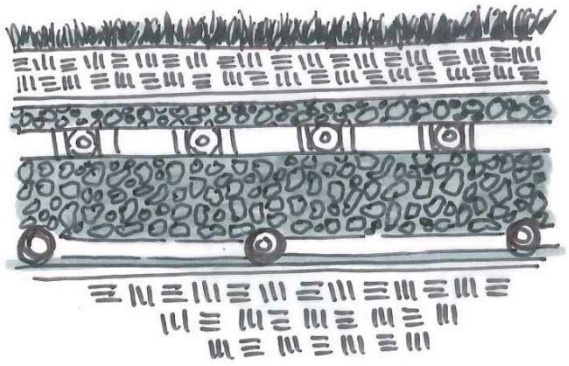
Underground detention is typically provided by large underground cisterns or gravel reservoirs.

Pros:

- No campus footprint lost to BMP installation
- Control of larger storms is possible

Cons:

- No water quality improvement provided
- No aesthetic / greening contribution to campus



Bioretention

Bioretention areas are designed to be integrated into landscaped areas to receive and filter stormwater runoff.

Pros:

- Can be designed to provide high water quality improvement
- Can be integrated into the campus landscape
- Can aid in managing small and moderately sized storms
- Can take on numerous aesthetics, sizes, and locations depending on project needs

Cons:

- Cannot be used to control large storm events







BEFORE


AFTER (ILLUSTRATIVE)

Bioswales

Bioswales are opportunities to use vegetated swales and channels to convey and filter stormwater runoff. These opportunities are generally found where more conventional drainage ditches or eroding swales are conveying stormwater and present opportunities for improvement.

Pros:

- Can utilize existing stormwater infrastructure easement
- Can achieve high WQ improvements
- Potential reduction of high maintenance landscaped areas

Cons:

- If removing existing gray infrastructure, may be costly

BEFORE

AFTER (ILLUSTRATIVE)

Outfall Treatment

Outfall treatment is recommended for existing outfalls and drainage chutes where there is erosion and space available for improvements. Regenerative Stormwater Conveyance (RSC) is recommended for these areas, which would convey, filter, and infiltrate runoff. Please note that this is not simply outfall stabilization (e.g., with riprap), but rather a vegetative regenerative design that is creating a more stable stream-like system to help convey, filter, and provide habitat.

Pros:

- Provide water quality enhancement while addressing a maintenance issue
- Install BMP in location of low value for development
- High ecological enhancement

Cons:

- Negotiations may be required to get "credit" for system

BEFORE

AFTER (TYPICAL)

MEMORANDUM

STEWART

TO: Peter Franz and David Jones

COMPANY: UNC Charlotte

FROM: Jamey Baysinger, PE

DATE: March 7, 2012

REFERENCE: UNC Charlotte MS4 Permit Application / Storm Water Management Master Plan
Task 2.2 Storm Water Management Master Plan: Preliminary Storm Water Maser Plan Report, and Sub-Area Selection Criteria

STEWART PROJECT NUMBER: X11024.00

MESSAGE:

This memorandum summarizes the findings of the mapping and due diligence phase of the project and presents a preliminary storm water master plan report. The purpose of this report is to assist UNC Charlotte in the selection of two (2) subareas for focus in the final storm water management master plan.

Mapping and Due Diligence

STEWART prepared an "Existing Condition" storm water management master plan base map from existing condition data and current project data collected from the following sources;

- UNC Charlotte Facilities Management (Parking Deck H, Housing Ph III, campus utilities, parking areas, campus map)
- Bulla Smith (Housing Ph XI)
- Kleinfelder (Hechenbleikner Dam/Lake)
- LandDesign (Parking Deck I, South Village Dining Hall, EPIC, Football, PORTAL, Recreation fields 8 and 9, Tennis)
- Little (Parking Deck J, RUP 4)
- Mecklenburg County (aerial photography, planimetrics, topography, flood mapping, soil survey, tax parcels, public rights-of-way)
- STEWART (Campus Master Plan, Housing Ph IX and X, Motorsports 2)
- Biohabitats (Campus Master Plan)

STEWART also prepared a "Future Condition" base map using the Campus Master Plan map prepared by Ayers Saint Gross, dated May 12, 2010, and updated using the "Existing Condition" base map described above.

The base maps include drainage areas, natural features, streams, wetlands, discharge points, conveyance systems, and impervious areas.

The referenced base maps are attached to this memorandum.

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STEWART

Field Reconnaissance

STEWART and Biohabitats performed on-site field walks with during the due diligence phase to confirm and verify that the information and map data provided is sufficient for the preparation of the NPDES MS4 permit application and the Storm Water Management Master Plan report.

At this time, we believe that the available information, as presented in this memorandum (including attachments), is sufficient for the referenced application and report.

Analysis

Using the storm water management master plan base maps described above, STEWART delineated the watersheds (or basins) both on and surrounding the UNC Charlotte Campus that contribute storm water runoff to the section of Toby Creek and other tributaries to Mallard Creek that traverse the campus. The same watershed delineations were used for both the "Existing" and "Future" conditions.

STEWART then delineated and tabulated the impervious areas within each of the watersheds for "Existing" and "Future" base maps.

The referenced maps and tabulated areas are attached.

Storm Water Retrofit Study

Based on above base map information, it appears that development of the UNC Charlotte Campus has not followed the Campus Master Plan. Therefore, implementation of the "Storm Water Retrofit Study" that was included in the Campus Master Plan, dated September 15, 2009 not possible. Furthermore, the "Retrofit Study" included recommended BMP's for specific projects that were not constructed in conjunction with those projects. STEWART and Biohabitats will revise the "Storm Water Retrofit Study" for the final storm water management master plan report, accordingly.

Built Upon Area Comparison

Both North Carolina and the City of Charlotte use percent built upon area (BUA%) as a threshold for determining density (high or low); which in turn, dictates whether or not storm water quality BMP's must be constructed. However, the State and the City use different threshold percentages;

City of Charlotte:	10%
North Carolina:	24%

Furthermore, the City and State measure BUA differently. The state bases the BUA% on the total area of a piece of property. The City bases the BUA% on only the amount of the property that was not already impervious prior to July 2008 plus any existing impervious area that is being redeveloped.

According to Mecklenburg County tax maps, the area of the UNC Charlotte main campus is currently approximately 891 acres. In the "Future Condition", the

campus grows to approximately 898 acres. Based on the "Built Upon Area Map", sheet C-BUA, dated October 5, 2009, prepared by LandDesign®, the Pre-July 2008 impervious area on the campus is/was 161 acres. And, the BUA% for the campus is as follows;

Current Condition

- Impervious Area = 215 Acres
- BUA% = 24% (7.2% PCCO)

Future Condition

- Impervious Area = 242 Acres
- BUA% = 27% (10.9% PCCO)

Based on this information, the campus exceeds the State's BUA% threshold in the current condition and will exceed the City's BUA% threshold in the future condition. Therefore, water quality BMP's will be required for the entire campus. When they will be required depends on which requirements (State's, City's, or other) the campus must follow.

Preliminary Approach to Storm Water Quality and Quantity

Biohabitats' memorandum "Stormwater Practice Palette for the UNC Charlotte Campus", dated March 1, 2012, describes the recommended preliminary approach to addressing storm water quality and quantity for the following three (3) sectors of the UNC Charlotte main campus;

- Charlotte Research Institute (CRI)
- Campus Core
- South Village

The watershed and impervious area delineation described above was based on the topography and storm water conveyance systems on the campus. The sector delineation included in the Campus Master Plan does not overlay with the watersheds. Therefore, STEWART adjusted the sector boundaries to match the watersheds using the following criteria;

- Portions of the Campus Core sector discharge to points within the South Village sector. Therefore, those sub-basins were added to the South Village sector, because the BMP for that sub-basin will be located in South Village.
- Other portions of the Campus Core sector discharge to the East Village sector. Similarly, those sub-basins were added to the East Village Sector.
- Where sub-basins extended beyond the sector limits, but not into another sector, the sector was extended to the sub-basin limits.

The above sectors are shown on the attached maps. The referenced memorandum is also attached.

STEWART

The information in Biohabitats' memorandum includes descriptions of storm water control measures (Best Management Practices, BMPs) and characteristics to consider when ultimately selecting a BMP for use on campus, including;

- Function
- Size
- Maintenance
- Cost/Benefit
- Pros/Cons

STEWART and Biohabitats used the base maps and the "Retrofit Study" to filter the available BMP types down to those that might provide the most benefit to the University within each sector with consideration to the following;

- Location Availability
- Regional Approach
- Impact to Campus Life
- Impact to Campus Operations
- Student Safety
- Phasing of Master Plan
- Connection to Other Projects

The following section lists the BMP types that we believe are most suited for each of the referenced sectors, along with specific characteristics of each sector.

CRI Campus

- Highest potential for large facilities
- Large spaces available near Toby Creek
- Targeted BMPs:
  - Storm water wetlands / Ponds
  - Outfall treatments
  - Bio-retention / Bio-swales

South Village

- Lower density development
- Limited space for large BMPs
- Targeted BMPs
  - Retrofit / expansion of existing ponds
  - Outfall treatments / stream restoration
  - Bio-retention / Bio-swales

Campus Core

- Densely developed
- Minimal space for large BMPs
- Targeted BMPs:
  - Retrofit / expansion of existing ponds (small number)
  - Bio-retention / Bio-swales
  - Water Harvesting
  - Green Roofs
  - Underground Detention

The locations of the above BMPs are shown on the attached maps.

Focus Area Selection

STEWART and Biohabitats compared the BMP opportunities of each of the three referenced sectors based on BUA% and runoff characteristics of peak flow and volume using the 2-year storm.

The analysis is included in the attached information and the "Preliminary Approach" section of this memo. The sectors with the most runoff available for capture and the most opportunities for large regional BMPs were considered to be most desirable.

Based on the analysis, it is our opinion that, of the three (3) sectors, the CRI and South Village sectors provide the best opportunities for regional BMPs. Therefore, we recommend that these two (2) sectors be selected as the focus of the Final Storm Water Management Master Plan Report.

Potential Storm Water Fee Credits

Charlotte-Mecklenburg Storm Water Services (CMSWS) currently allows storm water fee credits for only peak rate and/or volume controls up to 100% of the storm water fee.

CMSWS is considering a change in the fee credit program that will allow credit for water quality measures, as well, but is reducing the maximum fee credit to 75% for new projects. At this time, there is an ongoing debate among stakeholders as to whether or not existing storm water controls will be "grandfathered" under the existing system.

Under the current system, storm water fee credits are allocated as follows;

- Volume Control – 60%
- Peak Rate Control – 40%

The proposed fee credit structure currently under consideration is as follows;

- Storm Water control facilities that control volume, reduce pollution:
  - 1-inch control – 5%
  - 1-year control – 15%
- Storm Water control facilities that control peak, reduce flooding:
  - 10-year control – 25%
  - 25-year control – 15%
  - 100-year control – 15%

Based on analysis of fee credit trends for existing non-single family storm water accounts in Mecklenburg County and the City of Charlotte provided by CMSWS;

- The current average fee credit is 49.3%
- Once converted, the average will be 30%
- Sites meeting the Post Construction Controls Ordinance will typically be eligible for a 60%-75% credit.

Conclusion

This concludes the Preliminary Storm Water Management Master Plan Report. To proceed to the next phase of the project, the University must select the sectors to be included in the final report and begin negotiations with regulatory agencies.

Schematic design of BMPs in the selected sectors cannot begin until the negotiations with the agencies are complete, because the negotiations will include establishing which BMP types are acceptable and what the design criteria for those BMPs will be. The design criteria that must be established will generally include, but may not be limited to the following;

- Design storm frequency and duration
- Detention and draw down time
- Minimum dimensions (depth, length, width, freeboard)

Thank you for the opportunity to prepare and present this information to the University of North Carolina at Charlotte. STEWART and Biohabitats are ready to assist the University in proceeding to the next phase.

Biohabitats
SOUTHEAST BIOREGION
Incorporated

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Date: June 29, 2012

To: Peter Franz and David Jones, UNC Charlotte
James Baysinger and Jeff Oden, Stewart

From: Jennifer Zielinski, PE and Jon Hathaway, PhD, PE

Re: UNC Charlotte MS4 Permit Application / Storm Water Management Master Plan
Task 1.4 Program Management Structure

Subj: MS4 Program Management Structure Considerations

This memorandum sets forth a matrix of MS4 programmatic structure consideration for UNC Charlotte (Attachment A). The various program requirements (referred to as Best Management Practices (BMPs) and Measurable Goals) are arranged per required "Minimum Control Measures" in the NPDES Stormwater Permit Application Form (Application) and Stormwater Management Program Report (Report). In the matrix, the program requirements have been organized by activities that more closely align with on-going efforts within Facilities Management and Environmental Health and Safety:

- Program Management
- Education
- Employee Training
- Mapping & Tracking
- Stormwater Management Planning
- Pollution Prevention
- Good Housekeeping
- Maintenance & Inspections

The matrix summarizes the following for each BMP:

- The BMP ID, per the NPDES Application and Report
- The current implementation status of the BMP (e.g., the University is already in compliance, enhancement of an existing activity or program is required, or this is a new activity or program)
- The measurable goal, or activity the University must perform
- Expected deadline for compliance, per the NPDES Application and Report

- Biohabitats' recommended start date for BMP planning and development, which takes into consideration NCDENR's expectations, the current implementation status, and staggered implementation of BMPs
- University departments and groups that will be largely responsible for BMP implementation
- Resources that will be needed for BMP implementation
    - Labor – estimated annual staff hours needed for BMP planning and implementation, above and beyond current activities
    - Materials & Equipment –the BMP may require purchase of materials and equipment that the University does not currently own
    - Consulting Support – the BMP is conducive to initial consulting support for program start up

It should be noted that the matrix includes "Stormwater Manager" under Departmental Involvement. It is recommended that the University hire a staff person dedicated to running the stormwater management program. This staff person can manage and coordinate all activities under the permit. In the interim, several tasks are conducive to consulting support, namely:

- Development of educational and staff training materials.
- Development of a stormwater practice location, inspection and maintenance tracking approach.
- Stormwater management planning, including campus-wide stormwater master planning, development of University design guidelines, and initial plan review.
- Development of a stormwater practice operation and maintenance program.

Next Steps

If the University intends to pursue an MS4 Permit, next steps are:

- UNC Charlotte will submit the final Application and Report to North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ)
- NC DWQ will issue the draft permit
- UNC Charlotte will review and respond to the draft permit
- NC DWQ will finalize the permit and submit to U.S. EPA for review
- The permit will be revised as necessary
- A public comment period will be initiated by NC DWQ and will extend for 30 days
- NC DWQ will issue the final permit to the University

Once under permit, the University will be required to submit an annual report detailing progress towards implementing the BMPs and meeting the measurable goals in the MS4 Permit Application. The NC DWQ provides online annual reporting. The first annual report is time consuming to complete on-line due to the amount of information and data that must be

entered. However, the system repopulates in following years so only updates are needed. A template of the on-line report is provided in Attachment B. Alternatively, if preferred, a written annual report can be submitted. This would generally consist of a copy of the Stormwater Management Program Report that was submitted with the MS4 Application, with a cover letter and documentation of what BMPs have been implemented and progress towards meeting measurable goals.

Attachment A

UNC Charlotte MS4 Permit Application
Programmatic Structure Considerations
Completed by Biohabitats, Inc.
June 29, 2012

PROGRAM MANAGEMENT

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
1.9, 2.6	N	Evaluate program	Estimate and record the extent of exposure for each BMP implemented under this Minimum Measure	S D					X								M		X

EDUCATION

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
1.1	N	Describe target pollutants /stressors	Identify target pollutant sources/stressors.	S D					X								L		X
1.2	N	Determine goals and objectives	Define education and outreach program goals and objectives.	S D					X								L		X
1.3	E	Distribute education materials	Add a section on stormwater runoff issues to UNC Charlotte's sustainability newsletter.	S D					X	X							L		X
1.4	E	Distribute education materials	Add a section on stormwater runoff issues to UNC Charlotte's annual campus sustainability report.	S D					X	X							L		X
1.5, 3.10	E	Promote and maintain informational website	Add information on stormwater runoff issues (including illicit discharges) to the sustainability portal page on UNC Charlotte's website.	S D					X	X							M		X
2.1	C	Involve students/staff/faculty	Conduct a campus clean-up semi-annually.	S D					X								L		X
1.6, 3.11	E	Conduct outreach activity	Integrate stormwater pollution prevention education (including illicit discharges) into new student orientation.	S	D				X								M		X
1.7, 3.12	E	Conduct outreach activity	Integrate stormwater pollution prevention education (including illicit discharges) into new employee orientation for all new UNC Charlotte staff and faculty.	S	D				X								M		X
2.2	E	Involve students/staff/faculty	Integrate stormwater pollution awareness into UNC Charlotte's annual sustainability week.	S	D				X	X							L		X
2.3	E	Involve students/staff/faculty	Expand the "Adopt a Spot" program and provide information on stormwater pollution issues will be provided to all participants.	S	D				X		X						M		X

LEGEND

- **BMP ID = The Best Management Practices (BMP) and Measurable Goal ID, per the NPDES Stormwater Permit Application Form (Application) and Stormwater Management Program Report (Report)**
- **C/E/N = BMP complete or University already in compliance / Existing activity that needs to be enhanced / New activity**
- **S = Recommended start-up for BMP planning and development**
- **D = Deadline for full compliance, per MS4 Permit Application**
- **Labor = estimated annual staff hours needed for BMP planning and implementation, above and beyond current activities, where**
  - **L = less than 40 hours per year**
  - **M = between 40 and 80 hours per year**
  - **H = more than 80 hours per year**
- **Materials & Equipment = X indicates the BMP may require purchase of materials and equipment that the University does not currently own**
- **Consulting Support = X indicates the BMP is conducive to initial consulting support for program start up**

EMPLOYEE TRAINING

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
1.8, 3.13	N	Train targeted population	Provide annual stormwater pollution prevention education for staff within Facilities Management and Environmental Health and Safety.	S	D				X							X	H		X
6.3	N	Spill Prevention and Response	Provide annual spill training to employees that covers proper handling procedures and emergency actions.	S				D	X						X	X	H		
6.4	E	Employee Training	Provide training to all employees who maintain the drainage system with a focus on floatable, grit, sediment, and disposal of pollutants removed from the drainage system.	S				D	X						X		L		
6.5	E	Employee Training	Provide training to all employees who manage and apply chemicals to address safe storage, application, and disposal of residue chemicals. Provide information on reducing the frequency and amount of nutrient application.	S				D	X						X	X	M		

MAPPING & TRACKING

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
5.5	N	Create inventory of post-construction structural stormwater control measures	Develop a stormwater practice location, inspection and maintenance tracking mechanism.	S	D							X			X		M		X
3.1	E	Map outfalls	Develop a system map showing outfalls and receiving streams.	S				D				X			X		M		

LEGEND

- **BMP ID = The Best Management Practices (BMP) and Measurable Goal ID, per the NPDES Stormwater Permit Application Form (Application) and Stormwater Management Program Report (Report)**
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STORMWATER MANAGEMENT PLANNING

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
5.1	N	Develop post-construction stormwater program	Develop a campus-wide stormwater master plan that addresses post-construction stormwater runoff.	S	D				X	X			X				H		X
5.2	N	Strategies which include BMPs appropriate for the MS4	Adopt the DWQ BMP Design Manual or certify that the University's BMP design guidance meets or exceeds it.	S	D				X	X			X				M		X
5.3	N	Conduct plan reviews	Conduct plan reviews of all post-construction stormwater management plans.	S	D				X	X			X	X			H		X

GOOD HOUSEKEEPING

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
6.1	E	Waste Management	Implement a plan to place closed-top, side opening dumpsters at newly constructed buildings and replace top opening dumpsters with closed-top dumpsters as existing dumpsters are replaced.	S				D			X						M	X	
6.11	E	Recycling and Solid Waste Reduction	Continue to evaluate and operate a recycling program.	S				D			X						L		

MAINTENANCE & INSPECTIONS

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
5.4	N	Ensure long-term operation and maintenance of structural BMPs.	Develop a stormwater practice operation and maintenance program.	S	D				X						X		H	X	X
6.1	C	Implement preventive maintenance programs	Implement preventive maintenance programs for facility (common-use) equipment, including emergency generators and cooling towers.		S			D	X						X		L		
6.6	E	Visual Inspections	Perform visual inspections of the University's storm sewer system including drains, inlets, and outfalls.		S			D	X						X		H		
6.9	E	Inspection and Evaluation of Facilities and Operations	Conduct annual inspections of potential sources of polluted runoff, stormwater controls, and conveyance systems; document deficiencies and corrective actions.		S			D	X						X	X	H		
6.15	C	Landscape Services	Provide for area maintenance, including landscape inspection, maintenance, and leaf collection programs.		S			D							X		L		
6.16	E	Landscape Services	Manage a program for inspecting and cleaning drain inlets, including yard drains and curb inlets.		S			D	X						X		H		

LEGEND

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- **Consulting Support = X indicates the BMP is conducive to initial consulting support for program start up**

POLLUTION PREVENTION

BMP ID	C/E/N	BMP	Measurable Goal	Implementation Schedule					Departmental Involvement								Resource Needs		
				YR 1	YR 2	YR 3	YR 4	YR 5	Stormwater Manager	Real Estate & Land Use	Housekeeping & Recycling	Information Systems	Capital Projects	Design Services	Facilities Operations	Environmental Health & Safety	Labor	Materials & Equipment	Consulting Support
6.7	E	Visual Inspections	Conduct inspections to identify areas where exposures have the potential to introduce hazardous pollutants to the storm sewer system.	S				D	X							X	M		
6.14	E	Hazardous Waste Program	Maintain a program to collect chemical wastes, including hazardous wastes and used oils, from University laboratories and shops.	S				D								X	H		
6.13	E	Hazardous Materials Response	Maintain agreements with the local Fire Department for response to chemical incidents.	S				D								X	L		
6.12	E	Hazardous Materials Response	Maintain an approved safety plan related to spill response and the use, storage, and disposal of hazardous materials.	S				D								X	M		
6.8	C	Inspection and Evaluation of Facilities and Operations	Maintain an inventory of all facilities and operations owned and operated by the University with the potential for generating polluted stormwater runoff.	S				D								X	M		
6.2	E	Spill Prevention and Response	Maintain material storage procedures that include provision of secondary containment; development of spill prevention, containment, and control plans and/or safety plans; and preferred sheltering of all chemicals and other hazardous substances.	S				D	X						X	X	M		
2.4, 3.8	N	Promote and maintain hotline (reporting mechanism)	Explore the feasibility of setting up a separate hotline (telephone and website) for stormwater related reporting.		S	D			X						X	X	H		
3.2	N	Prohibit illicit discharges	Develop a standard operating procedure prohibiting illicit discharges.		S			D	X						X	X	L		
3.3	E	Detect illicit discharges	Indentify priority areas on the campus where there may be a higher incidence of illicit discharges, illicit connections, or illegal dumping.		S			D	X						X	X	M		
3.4	N	Detect illicit discharges	Develop standard operating procedures for conducting field investigations to detect potential illicit discharges.		S			D	X						X	X	L	X	
3.5	N	Conduct investigations into the source of all identified illicit discharges	Develop standard operating procedures for tracing an illicit discharge to its source.		S			D	X						X	X	L		
3.6	N	Conduct investigations into the source of all identified illicit discharges	Develop standard operating procedures for removing or eliminating an illicit discharge.		S			D	X						X	X	L	X	
3.7	N	Track investigations and document illicit discharges	Develop a tracking and documentation mechanism for all illicit discharge investigations.		S			D	X							X	L		
2.5, 3.9	N	Promote and maintain hotline (reporting mechanism)	Promote and maintain a separate hotline or the current system of using campus police as clearing house for phone calls.				S	D	X						X	X	H	X	

LEGEND

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Attachment B

Stormwater Management Program Assessment

North Carolina Division of Water Quality
512 N. Salisbury St. Raleigh, NC 27604

Contained In This Report:

- Permit Number: NCS000458

Background Information

SW100010 APPLICANT STATUS INFORMATION

SW100020 Name of Public Entity Seeking Permit Coverage

SW100060 Jurisdictional Area (square miles)

SW100070 Population Permanent

SW100080 Population Seasonal (if available)

SW100110 RPE / MS4 SYSTEM INFORMATION

SW100120 Storm Sewer Service Area (square miles)

SW100130 River Basin(s)

SW100150 Estimated percentage of jurisdictional area containing the following four land use activities

SW100160 Residential

SW100170 Commercial

SW100180 Industrial

SW100190 Open Space

SW100210 Do you have an inventory of storm water inlets, pipes, ditches, and open channels?

SW100220 Do you know how many outfalls your city discharges to and where they are located?

SW100260 EXISTING LOCAL WATER QUALITY PROGRAMS

SW100270 "Complete a table below for each river basin within the MS4 service area. The web sites and resource contacts listed below under Information Sources will help you locate the information you need. Storm water programs should be designed to address the specific needs of the community and water resources they are intended to protect. If you haven't done so already, collect information on your city's receiving waters and what pollutants and sources are impacting those waters. You should also know the various uses of your receiving waters so you can design a program to protect those uses. Complete a table below for each river basin within the MS4 service area. The web sites and resource contacts listed below under Information Sources will help you locate the information you need. "

SW100280 River Basin

SW100283 Program 1

SW100290 Receiving Stream Name

SW100300 Stream Segment

SW100310 Water Quality Classification

SW100320 Use Support Rating

SW100325 TMDL

SW100331 Program 2

SW100332 Receiving Stream Name

SW100333 Stream Segment

SW100334 Water Quality Classification

SW100335 Use Support Rating

SW100336 TMDL

SW100337 Program 3

SW100338 Receiving Stream Name

SW100339 Stream Segment

SW10033A Water Quality Classification

SW10033B Use Support Rating

SW10033C TMDL

SW10033D Program 4

SW10033E Receiving Stream Name

SW10033F Stream Segment

SW10033G Water Quality Classification

SW10033H Use Support Rating

SW10033I TMDL

SW100340 Local Nutrient Sensitive Waters Strategy

SW100350 Local Water Supply Watershed Program

SW100360 Delegated Erosion and Sediment Control Program

SW100370 CAMA Land Use Plan

SW100400 Your river basin table should list the primary streams that receive stormwater runoff from the MS4 jurisdictional area. Primary streams are those that are shown on a USGS topo maps or SCS map. Streams that are shown on the USGS or SCS maps but do not have a name shall be listed as an unnamed tributary to the nearest named downstream receiving water body.

SW100440 River basin you are in: http://h2o.enr.state.nc.us/basinwide/whichbasin.htm

SW100450 Stream Index Numbers: http://h2o.enr.state.nc.us/bims/Reports/reportsWB.html

SW100460 Water Quality Classifications: http://h2o.enr.state.nc.us/bims/Reports/reportsWB.html

SW100470 Basinwide Water Quality Plans: http://h2o.enr.state.nc.us/basinwide/index.html

SW100480 303(d) List: http://h2o.enr.state.nc.us/mtu/download.html

SW100490 CO-PERMIT APPLICATION STATUS INFORMATION (Complete this section only if co-permitting)

SW100500 Do you co-permit with a permitted Phase I entity?

SW100510 If so, provide the name of that entity:

SW100550 Other Entity

SW100560 Have legal agreements been finalized between the co-permittees?

SW100570 RELIANCE ON ANOTHER ENTITY TO SATISFY ONE OR MORE OF YOUR PERMIT OBLIGATIONS

SW100580 Do you intend that another entity perform one or more of your permit obligations?

SW100590 If yes, identify each entity and the element they will be implementing

SW100600 Name of Entity

SW100610 Element they will implement

SW100620 Contact Person

SW100630 Contact Address

SW100640 Contact Telephone Number

SW100650 Are legal agreements in place to establish responsibilities?

SW100660 PERMITS AND CONSTRUCTION APPROVALS

SW100700 State or NPDES Stormwater Permit Number (s) issued to the permittee

SW100920 MS4 CONTACT INFORMATION

SW100930 Provide the following information for the person/position that will be responsible for day to day implementation and oversight of the stormwater program.

SW100940 Name

SW100950 Title

SW100960 Street Address

SW100970 PO Box

SW100980 City

SW100990 State

SW101000 Zip

SW101010 Telephone

SW101020 Fax

SW101030 E-Mail

SW101040 "Permittee's Website"

SW101050 BMPs

SW101060 Do you plan to add any new BMPs?

SW101070 Do you plan to amend any existing BMPs?

SW101080 If yes, please provide a BMP description, measurable goal, and implementation schedule for each new or amended BMP. If further space is needed, attach additional sheets.

Co-Permitting Information

SW101570 Contract Operations

SW101630 Does the Stormwater Management Program identify contract operations (i.e., Transit Authorities, Pesticide Application, Construction Projects, Street Washing, Maintenance of right-a-ways, GIS Mapping, Monitoring, Stream Restorations, Litter or Solid Waste Pickup, Recycling, Household Waste)?

Construction Site Stormwater Runoff Control

SW104190 Construction Site Stormwater Runoff Control

SW104200 Does the permittee rely on the NCDENR Division of Land Resources (DLR) Erosion and Sediment Control Program to comply with this minimum measure for private development? (If no, go to SW104220)

SW104210 If the permittee relies on the NCDENR Division of Land Resources (DLR) Erosion and Sediment Control Program to comply with this minimum measure for private development, than the NCDENR Division of Land Resources Erosion and Sediment Control Program effectively meets the requirements of the Construction Site Runoff Controls by permitting and controlling development activities disturbing one or more acres of land surface and those activities less than one acre that are part of a larger common plan of development.

SW104220 Does the permittee rely on rely on a locally delegated program to meet the minimum measure for private development requirements? (If no, go to SW104300)

SW104230 If the permittee relies on a local government to comply with this minimum measure, does the permittee conduct random inspections of local land disturbing activities that have a sediment and erosion control permit, issued by local government?

SW104250 If the permittee relies on a local government to comply with this minimum measure, does the permittee report sites that are not in compliance with their sediment and erosion control permits to the local government?

SW104260 If the permittee relies on a local government to comply with this minimum measure, does the permittee report unresolved concerns to the local government?

SW104270 If the permittee relies on a local government to comply with this minimum measure, does the permittee maintain a record of unresolved concerns reported to the local government?

SW104300 Does the permittee have a delegated program to meet the requirements of an Erosion and Sediment Control Program for private development? (If no go to SW104450)

SW104310 Does the Stormwater Management Program summarize what best management practices will be used, the frequency of the BMP, the measurable goals for each BMP, the implementation schedule, and the responsible person or position for implementation?

SW104320 Does the Stormwater Management Program describe the mechanism (ordinance or other regulatory mechanism) the permittee will use to require erosion and sediment controls at construction sites and why the permittee chose that mechanism?

SW104330 If permittee needs to develop this mechanism, the permittee's plan should describe the plan and a schedule to do so.

SW104340 Does the Permittee conduct site plan review(s), including the review of pre-construction site plans, which incorporate consideration of potential water quality impacts?

SW104350 The Stormwater Management Program must describe procedures and the rationale for how permittee will identify certain sites for site plan review, if not all plans are reviewed and describe the estimated number and percentage of sites that will have pre-construction site plans reviewed.

SW104360 Does the Stormwater Management Program describe the permittee's plan to ensure compliance with the permittee's erosion and sediment control regulatory mechanism, including the sanctions and enforcement mechanisms permittee will use to ensure compliance?

SW104370 The Stormwater Management Program must describe the permittee's procedures for when the permittee will use certain sanctions. Possible sanctions include non-monetary penalties (such a stop work orders), fines, bonding requirements, and/or permit denials for non-compliance.

SW104380 Does the Stormwater Management Program describe the permittee's procedures for site inspection and enforcement of control measures, including how the permittee will prioritize sites for inspection?

SW104430 Does the Stormwater Management Program require construction site operators to implement erosion and sediment control BMPs and to control construction site wastes that may cause adverse water quality impacts?

SW104440 Does the Stormwater Management Program require construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality?

SW104450 Does the permittee provide and promote a means for the public to notify the appropriate authorities of observed erosion and sedimentation problems?

SW104460 Consider coordinating this requirement with the permittee's public education program. Publicize the procedures and contact information. The procedures must lead directly to a site inspection or other timely follow-up action. The permittee may implement a plan promoting the existence of the NCDENR, Division of Land Resources "Stop Mud" hotline to meet the requirements of this paragraph.

SW104470 Staff Training and Certification

SW104480 The number of training and certification programs offered to staff.

SW104490 The number of trained staff inspectors.

SW104500 The number of certified staff inspectors.

SW104510 The number of certified contractors by permittee.

SW104520 Inspection and Enforcement

SW104530 The number of plans reviewed greater than one acre.

SW104590 The number of enforcement actions or NOVs taken.

Illicit Discharge Detection and Elimination

SW103190 Illicit Discharge Detection and Elimination

SW103200 Does the Stormwater Management Program summarize what best management practices will be used, the frequency of the BMP, the measurable goals for each BMP, the implementation schedule, and the responsible person or position for implementation?

SW103210 Stormwater Map

SW103220 Has the permittee will developed or the in the process of developing a storm sewer map showing the location of all outfalls and the names and location of all receiving waters?

SW103260 Does stormwater mapping include drainage areas?

SW103270 Does stormwater mapping include receiving streams?

SW103280 Does stormwater infrastructure mapping include outfalls?

SW103290 Estimated or actual number of outfalls.

SW103300 Does stormwater infrastructure mapping include sewer pipes?

SW103310 Does stormwater infrastructure mapping include structures (e.g., detention ponds and other structural BMPs?

SW103320 Estimated or actual number of structural BMPs?

SW103330 Percent of outfall mapping complete.

SW103340 Does the Stormwater Management Program describe the mechanism (ordinance or other regulatory mechanism) the permittee will use to effectively prohibit illicit discharges into the MS4 and why the permittee chose that mechanism?

SW103350 Does the Stormwater Management Program describe the permittee's plan to ensure appropriate enforcement procedures and actions such that the permittee's illicit discharge ordinance (or other regulatory mechanism) is implemented?

SW103360 Does the Stormwater Management Program describe the permittee's plan to detect and address illicit discharges to the permittee's system, including discharges from illegal dumping and spills?

SW103370 The permittee must implement an inspection program to detect dry weather flows at system outfalls and, at a minimum, must address the following:

SW103380 Procedures for locating priority areas.

SW103390 Procedures for tracing the source of an illicit discharge, including the specific techniques permittee will use to detect the location of the source.

SW103400 Procedures for removing the source of the illicit discharge.

SW103410 Procedures for evaluation of the plan to detect and eliminate illicit discharges.

SW103420 Does the Stormwater Management Program address the following categories of non storm water discharges or flows (i.e., illicit discharges) only if permittee identify them as significant contributors of pollutants to the permitteenulls small MS4:

SW103430 landscape irrigation;

SW103440 water line flushing;

SW103450 diverted stream flows;

SW103460 uncontaminated groundwater infiltration;

SW103470 discharges from potable water sources;

SW103480 air conditioning condensate (commercial/residential);

SW103490 springs;

SW103500 footing drains;

SW103510 residential and charity car washing;

SW103520 dechlorinated swimming pool discharges;

SW103530 rising groundwaters;

SW103540 uncontaminated pumped groundwater;

SW103550 foundation drains;

SW103560 irrigation waters (does not include reclaimed water as described in 15A NCAC 2H .0200);

SW103570 water from crawl space pumps;

SW103580 lawn watering;

SW103590 flows from riparian habitats and wetlands;

SW103600 street wash water;

SW103610 flows from emergency fire fighting.

SW103620 The permittee may also develop a list of other similar occasional, incidental non-storm water discharges that will not be addressed as illicit discharges.

SW103630 These non-storm water discharges must not be reasonably expected (based on information available to the permittees) to be significant sources of pollutants to the Municipal Separate Storm Sewer System, because of either the nature of the discharges or conditions the permittee has established for allowing these discharges to the permittee's MS4 (e.g., activity with appropriate controls on frequency, proximity to sensitive waterbodies, BMPs).

SW103640 Does the Stormwater Management Program document local controls or conditions placed on discharges and a provision prohibiting any individual non-storm water discharge that is determined to be contributing significant amounts of pollutants to the permittee's MS4?

SW103650 In addition to conducting training for selected staff on detecting and reporting illicit discharges," does the Stormwater Management Program describe how the permittee plans to inform businesses and the general public of hazards associated with illegal discharges and improper disposal of waste?

SW103700 Does the Stormwater Management Program establish and publicize a reporting mechanism for the public to report illicit discharges?

SW103710 Does the Stormwater Management Program establish an illicit discharge management tracking system?

SW103720 Does the Stormwater Management Program establish a stormwater incident response program?

SW103730 Does the Stormwater Management Program provide for an illicit discharge brochure, poster or other educational material development and distribution?

SW103740 Does the Stormwater Management Program provide for a septic system program in conjunction with the Health Department?

SW103750 Does the Stormwater Management Program provide street sweeping, inspecting and cleaning inlets and outfalls?

SW103760 Does the Stormwater Management Program establish procedures to coordinate efforts to eliminate illicit discharge cross connections between sanitary and storm sewers?

SW103770 Does the Stormwater Management Program establish procedures to maintain the sanitary sewer system?

SW103780 Does the Stormwater Management Program establish a Household Waste Recycling Program?

SW103850 Identifying Illicit Connections

SW103860 The number of sites prioritized for inspection.

SW103870 The number of illicit connections reported by citizens.

SW103880 The number of illicit connections found.

SW103890 The number of illicit connections repaired/replaced.

SW103900 The number of illicit connection referrals.

SW103910 Illegal Dumping

SW103930 The number of illegal dumps reported by citizens.

SW103940 The number of penalties enforced upon the participants of illegal dumps.

SW103950 The number of illegal dump or sit-out clean-ups completed.

SW103970 Industrial or Business Connections

SW103980 The number of dry weather tests/inspections completed.

SW103990 The number of high-risk connections prioritized.

SW104000 The number of illicit connections reported by employees or businesses.

SW104010 The number of illicit connections found.

SW104020 The number of illicit connections repaired/replaced.

SW104030 Recreational Sewage

SW104040 The number of pump-out stations.

SW104050 The number of no-discharge areas created.

SW104060 The number of new signs added to inform users of dumping policies and alternatives.

SW104070 The number of enforced cases of recreational dumping.

SW104080 The number of citizen complaints made reporting illegal action.

SW104090 Sanitary Sewer Overflows (SSO)

SW104100 The number of overflows reported.

SW104110 The number of overflow causes that were identified during inspections.

SW104120 The number of sites repaired.

SW104130 Wastewater Connections to the Storm Drain System

SW104140 The number of rerouted connections.

SW104150 The number of dry weather monitoring activities performed.

SW104160 The number of unwarranted connections reported.

SW104170 The number of unwarranted connections found.

SW104180 The number of unwarranted connections repaired/replaced.

Information specifically regarding the permit

SW101460 Permitting Information

SW101490 Does the Stormwater Management Program provide an organizational chart that shows where the responsible parties fit into the structure of the permittee's organization?

Ordinance, Legal or Regulatory Authority

SW107050 Ordinance, Legal or Regulatory Authority

SW107060 Illicit Discharge Detection & Elimination

SW107070 Erosion & Sediment Control

SW107080 Post-Development Stormwater Management

SW107090 Stormwater Ordinance

SW107100 Unified Development Ordinance

SW107110 Flood Damage Protection Ordinance

SW107120 Other:

SW107130 Other:

SW107140 Other:

Pollution Prevention/Good Housekeeping for Municipal Operations

SW105750 Pollution Prevention/Good Housekeeping

SW105760 Does the Stormwater Management Program summarize what best management practices will be used, the frequency of the BMP, the measurable goals for each BMP, the implementation schedule, and the responsible person or position for implementation?

SW105770 Does the Stormwater Management Program list the permittee’s municipal operations that are impacted by this operation and maintenance program?

SW105780 The permittee must also include a list of industrial facilities the permittee owns or operates that are subject to NPDES Stormwater General Permits or individual NPDES permits for discharges of storm water associated with industrial activity that ultimately discharge to the permittee’s MS4, including the permit number and certificate of coverage number for each facility.

SW105790 Municipal Operations include:

SW105800 Transfer Station

SW105810 Fleet Maintenance

SW105820 Airport

SW105830 Animal Shelters

SW105840 Waste Water Treatment Plan

SW105850 Water Plants

SW105860 Construction Debris Site

SW105870 Transit Authority

SW105880 Public Works Operations

SW105890 Prisons

SW105900 Emergency Service Facilities

SW105910 Fire Stations

SW105920 Landfills

SW105930 Schools

SW105940 Parks

SW105950 Waste Recycling Centers

SW105960 Vehicle Maintenance Operations

SW105970 Vehicle Wash Operations

SW105980 Pump Stations or Lift Stations

SW105990 Other:

SW106000 In addition to conducting staff training on stormwater pollution prevention and good housekeeping procedures, does the Stormwater Management Program describe any government employee training program the permittee will use to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance?

SW106010 Does the Stormwater Management Program describe any existing, available training materials the permittee plans to use?

SW106030 Does the Stormwater Management Program describe maintenance activities, maintenance schedules, and long-term inspection procedures for controls to reduce floatables and other pollutants to the permittee's MS4?

SW106050 Does the Stormwater Management Program describe the permittee's procedures for the proper disposal of waste removed from the permittee's MS4 and the permittee's municipal operations, including dredge spoil, accumulated sediments, floatables, and other debris?

SW106110 Industrial Activities

SW106120 Did the permittee conduct annual review of the industrial activities with a Phase I NPDES stormwater permit owned and operated by the permittee?

SW106130 Did the permittee review the Stormwater Pollution Prevention Plan, the timeliness of any monitoring reports required by the Phase I permit, and the results of inspections and subsequent follow-up actions at the facilities.

SW106160 Does the permittee have a Used Oil Recycling Program?

SW106170 Does the permittee have a street sweeping program?

SW106180 Does the permittee have a program to clean catch basins, storm lines, and ditches?

SW106190 Does the permittee review fertilizer and pesticide use programs?

SW106200 Does the permittee have spill prevention plans at city facilities?

SW106210 City Facilities Inspections

SW106220 Does the permittee inspect vehicle washing fueling, storage and maintenance areas?

SW106230 Does the permittee inspect material storage areas (i.e., storage areas for sand, salt, fertilizers, pesticides and other chemicals)?

SW106240 Does the permittee inspect stormwater outfalls?

SW106250 Does the permittee inspect culverts?

SW106260 Does the permittee inspect swales/ditchs?

SW106270 Does the permittee inspect catch basins, inlets, and grates?

SW106280 Does the permittee inspect MS4 pipes?

SW106290 Does the permittee inspect solid and hazardous waste management facilities and recycling centers?

SW106300 Does the permittee inspect animal shelters and pounds?

SW106310 Does the permittee inspect parking lots?

SW106320 Does the permittee inspect parks and open spaces?

SW106330 The number of inspections conducted.

SW106400 Automobile Maintenance

SW106410 The number of employees trained in preventing pollution from automobile maintenance activities.

SW106420 The number of sites rewarded as being a “clean site” under a rewards program.

SW106430 The number of spills reported.

SW106440 The number of educational materials distributed at garages, auto shops, and other automobile-related businesses.

SW106450 Hazardous Materials Storage

SW106460 The total number of storage facilities equipped to store hazardous materials.

SW106470 The number of regularly inspected storage units.

SW106480 The number of employees trained in hazardous material storage and maintenance.

SW106490 Illegal Dumping

SW106500 The number of “no dumping” signs posted.

SW106510 The number of educational materials distributed.

SW106520 The number of reports of illegal dumping received.

SW106530 The number of dump sites and/or illegal sit-outs cleaned up.

SW106540 The number of sites improved to eliminate as target dumping spots.

SW106550 The number of enforcement actions pertaining to illegal dumping.

SW106560 Landscape and Lawn Care, and Pest Control

SW106570 The number of stores/gardens participating in education programs.

SW106580 The number of residents trained by the permittee in safe landscaping, lawn care, and pest management techniques.

SW106590 The number of classes/seminars offered by the permittee in landscaping and lawn care.

SW106610 The number of municipal employees trained in integrated pest management.

SW106620 Parking Lot and Street Cleaning

SW106630 The number of parking lots.

SW106640 The number of scheduled parking lot and/or road cleanings.

SW106650 Pet Waste

SW106660 The number of dog parks.

SW106670 The number of "pooper-scooper" stations installed

SW106680 The number of educational materials distributed.

SW106690 Road Salt Application and Storage

SW106700 The number of storage facilities included in a regular inspection and maintenance program.

SW106710 The number of employees trained in road salt application.

SW106720 The quantity of salt applied to roadways (in tons).

SW106730 The quantity of alternative products used (in tons).

SW106800 Spill Response and Prevention

SW106810 The number of leak detection devices installed at municipal facilities.

SW106820 The number of preventative maintenance procedures performed on tanks, valves, pumps, pipes, and other equipment.

SW106830 The number of personnel trained in spill response.

SW106840 The number of regularly inspected high-risk facilities.

SW106850 The number of educational materials distributed to municipal employees.

SW106860 Storm Drain System Cleaning

SW106870 The number of outfalls cleaned regularly.

SW106880 The number of storm drains cleaned regularly.

SW106890 The amount of trash, sediment, and other pollutants removed during cleaning (in tons).

SW106900 Used Oil Recycling

SW106910 The number of gallons of used oil collected from municipal operations.

SW106920 The number of recycling facilities that collect oil from municipal operations.

SW106930 The number of educational materials distributed to municipal employees.

SW106940 Vehicle Washing

SW106950 The number of educational materials distributed to municipal employees.

SW106960 The number of designated municipal vehicle washing areas.

Post-Construction Storm Water Management in New Development and Redevelopment

SW104890 Post-Construction Storm Water Management in New Development and Redevelopment

SW104900 Does the Stormwater Management Plan summarize what best management practices will be used, the frequency of the BMP, the measurable goals for each BMP, the implementation schedule, and the responsible person or position for implementation?

SW104910 Does the Stormwater Management Program describe how the permittee will develop an ordinance or other regulatory mechanism to implement and enforce a program to address post construction runoff from new development and redevelopment projects?

SW104920 The permittee's ordinances, and subsequent modifications, will be reviewed and approved by DWQ prior to implementation. The approval process will establish subsequent timeframes when DWQ will review performance under the ordinance(s). The reviews will occur, at a minimum, every five years. Regulated public entities without ordinance making powers must demonstrate similar actions taken in their post construction stormwater management program to meet the minimum measure requirements.

SW104930 Does the Stormwater Management Program describe how the permittee will ensure the long-term operation and maintenance (O&M) of BMPs?

SW104940 Options to help ensure that future O&M responsibilities are clearly identified include an agreement between the permittee and another party, such as the post-development landowners or regional authorities.

SW105000 Does the Stormwater Management Program explain how the permittee will control the sources of fecal coliform to the maximum extent practicable?

SW105010 Do new development and redevelopment codes allow for the following:

SW105020 Bioretention basins?

SW105030 Alternative pavers?

SW105040 Buffer zones?

SW105050 Dry ponds?

SW105060 Wet ponds?

SW105070 Alternatives to curb and gutter?

SW105080 Grass swales?

SW105090 Grassed filter strips?

SW105100 Green parking lots?

SW105110 In-line storage systems?

SW105120 Infiltration basins?

SW105130	Infiltration trenches?
SW105140	Manufactured products installed in storm water inlets?
SW105150	Developments and redevelopments that use narrow streets?
SW105160	On-lot treatment?
SW105170	Open space design?
SW105180	Sand and organic filters?
SW105190	Porous pavement?
SW105200	Stormwater wetlands?
SW105210	Urban forestry?
SW105220	Does the Stormwater Management Program, in coordination with the County Health Department, ensure proper operation and maintenance of on-site wastewater treatment systems for domestic wastewater?
SW105230	Does the Stormwater Management Program provide training for staff and developers/builders?
SW105260	BMP Inspection and maintenance
SW105270	Are annual inspection reports required of permitted structural BMPs performed by a qualified professional?
SW105280	The number of BMP inspections and/or maintenance activities.
SW105290	The number of problems that were identified and remedied.
SW105300	New Development and Redevelopment BMP Summary
SW105310	The number of development/redevelopment projects regulated for post-construction stormwater control.
SW105550	Evaluation of Post-construction Stormwater Management Program Measures
SW105560	Model Practices: For those areas within the jurisdictional area of the permittee that are not subject to the post-construction stormwater management provisions of another existing state stormwater management program, does the permittee's Post-construction Stormwater Management Program equal or exceed the stormwater management and water quality protection provided by the following model practices:
SW105570	Does the permittee issue local stormwater management permits to new development or redevelopment projects as either a low density project or a high density project?
SW105580	Do projects permitted as a low density projects meet the following criteria:
SW105590	No more than two dwelling units per acre or 24% built-upon area; and,
SW105600	Use of vegetated conveyances to the maximum extent practicable?
SW105610	Are projects permitted as high density projects meet the following requirements:
SW105620	The stormwater control measures control and treat the difference between the pre-development and post-development conditions for the 1-year 24-hour storm. Runoff volume draw-down time must be a minimum of 24 hours, but not more than 120 hours;
SW105630	All structural stormwater treatment systems are designed to achieve 85% average annual removal of total suspended solids; and
SW105640	Stormwater management measures comply with the General Engineering Design Criteria For All Projects requirements listed in 15A NCAC 2H .1008(c);
SW105650	Are deed restrictions and/or protective covenants required by the locally issued permit and incorporated by the development to ensure that subsequent development activities maintain the development (or redevelopment) consistent with the approved plans?
SW105660	Are all built-upon areas at least 30 feet landward of perennial and intermittent surface waters?
SW105670	Watershed Protection Plans: Has the Permittee developed, adopted, and implemented a comprehensive watershed protection plan to meet part, or all, of the requirements for post-construction stormwater management?

SW105680 Areas within the jurisdictional area of the permittee that are already subject to the existing state stormwater management programs are deemed compliant with the post-construction stormwater management model practices identified in (a). The programs are: the Water Supply Watershed protection programs for WS-I – WS-IV waters, the HQW and ORW waters management strategies, the Neuse River Basin Nutrient Sensitive Waters (NSW) Management Strategy, the Tar-Pamlico River Basin Nutrient NSW Strategy, and the Randleman Lake Water Supply Watershed program.

SW105690 A regulated entity may develop its own comprehensive watershed plan, use the model ordinance developed by the Commission, design its own post-construction practices based on the Division's guidance and engineering standards for best management practices, or incorporate the post-construction model practices to satisfy, in whole or in part, the requirements for post-construction stormwater management.

SW105700 Additional Requirements for Trout Waters: Has the permittee developed, adopted, and implemented an ordinance (or similar regulatory mechanism) to ensure that the best management practices selected do not result in a sustained increase in the receiving water temperature?

SW105710 Additional Requirements for Nutrient Sensitive Waters

SW105720 Has the permittee developed, adopted, and implemented an ordinance (or similar regulatory mechanism) to ensure that the best management practices for reducing nutrient loading is selected?

SW105730 Has the permittee developed and included a nutrient application (fertilizer and organic nutrients) management program in the Post-construction Stormwater Management Program?

SW105740 In areas where the Environmental Management Commission has approved a Nutrient Sensitive Water Urban Stormwater Management Program, the provisions of that program fulfill the nutrient loading reduction requirement.

Program Accomplishments

SW106970 Staff and Capital Improvement Projects

SW106980 The number of staffed stormwater management position(s).

SW106990 The number of new stormwater management position(s) created or staffed for the reporting year.

SW107000 Total annual budget (excluding Capital Improvement Projects) for the NPDES stormwater management program for the reporting year.

SW107010 The number of Capital Improvement Projects planned.

SW107020 The number of Capital Improvement Projects active.

SW107030 The number of Capital Improvement Projects completed.

SW107040 Total annual budget for Capital Improvement Projects for the reporting year.

Public Education and Outreach

SW101690 Public Education and Outreach

SW101700 Does the Stormwater Management Program summarize what best management practices will be used, the frequency of the BMP, the measurable goals for each BMP, the implementation schedule, and the responsible person or position for implementation?

SW101710 Does the Stormwater Management Program identify the target audiences likely to have significant storm water impacts (including commercial, industrial and institutional entities) and why those target audiences were selected?

SW101720 Does the Stormwater Management Program identify what target pollutant sources the permittee's public education program is designed to address and why those sources are an issue?

SW101730 Does the Stormwater Management Program describe the permittee'ls outreach program (i.e., how the permittee plans to inform individuals and households about the steps they can take to reduce storm water pollution and how the permittee plans to inform individuals and groups on how to become involved in the storm water program?

SW101750 Has the permittee develop general stormwater educational material to appropriate target groups? Instead of developing its own materials, the permittee may rely on state-supplied Public Education and Outreach materials, as available, when implementing its own program.

SW101760 Does general stormwater educational material include information on the following topics:

SW101770 Household Hazardous Waste

SW101780 Pet Waste

SW101790 Septic Systems

SW101800 Lawn and Gardening

SW101810 Vehicle Washing

SW101820 Erosion

SW101830 Stream Buffers

SW101840 Flooding

SW101850 Litter

SW101860 List any additional topics not identified above.

SW101870 Does the permitteenulls outreach program include:

SW101880 Distributing printed educational material to general public through utility mail outs?

SW101890 Distributing printed educational material to general public through special events (i.e., Information booth at festivals and fairs)?

SW101900 Distributing printed educational material to business / industry?

SW101910 Presentations to local community groups?

SW101920 Stormwater programs/presentations for elementary or middle schools?

SW101930 Local TV or radio spots?

SW101940 Print Media - Ads / Articles / Newsletters?

SW101950 Posters?

SW101960 Storm drain stenciling

SW101970 Other environmental education programs (i.e., Designate a "Keep SW Clean" month)?

SW101980 Workshops

SW101990 Stream basin signage?

SW102000 Has the permittee developed an internet web site for newsletter articles on stormwater, information on water quality, stormwater projects and activities, and ways to contact stormwater management program staff?

SW102020 Does the permittee maintain an internet web site for newsletter articles on stormwater, information on water quality, stormwater projects and activities, and ways to contact stormwater management program staff?

SW102060 Classroom Outreach

SW102070 The number of educational materials distributed to schools.

SW102080 The number of schools that participate in municipal-sponsored storm water workshops or activities.

SW102090 The number of students that participate in municipal-sponsored storm water workshops or activities.

SW102100 The number of workshops held for teachers.

SW102110 The number of certificates or other rewards given out to schools, classes, or students participating in storm water education.

SW102120 The number of students receiving storm water education as a regular part of the school curriculum.

SW102130 Displays, Signs, Presentations, Welcome Packets, and Pamphlets

SW102150 The number of stormwater related displays at special events or meetings.

SW102160 The number of people at events who saw the display or took a pamphlet/booklet.

SW102170 Number of new homeowner welcome packets containing storm-water-related information.

SW102180 The number of signs and billboards with stormwater related messages.

SW102190 The number of stormwater related presentations at special events or meetings.

SW102200	Commercial Outreach
SW102210	The number of educational materials that were distributed to business owners and operators.
SW102220	The number of businesses trained under the stormwater program.
SW102310	Pet Waste Management
SW102320	The number of "clean up after your pet" signs posted in parks and neighborhoods.
SW102330	The number of dog-walking designated areas in parks.
SW102340	The number of posters/brochures put up in pet supply stores.
SW102350	The number of educational materials given out to pet owners.
SW102360	Promotional Giveaways
SW102370	The number of items given out.
SW102380	The number of events attended (to give out items).
SW102390	The number of partnerships for promotions (radio, TV, Businesses).
SW102400	Proper Disposal of Household Hazardous Waste
SW102410	The number of household hazardous waste curbside pickup days.
SW102420	The number of educational materials distributed to homeowners.
SW102430	The number of partnerships established with businesses.
SW102440	Outreach Programs to Minority and Disadvantaged
SW102450	The number of brochures/posters created in non-English languages.
SW102460	The number of educational materials distributed in non-English languages.
SW102470	The number of partnerships established with minority organizations.
SW102480	The number of educational materials distributed to low-income neighborhoods.
SW102490	Attendance at workshops or public meetings held in low-income or minority neighborhoods.
SW102540	Using the Media
SW102550	The number of public service announcements made on radio and TV.
SW102560	The number of stormwater related press releases/advertising.
SW102570	The number of stormwater related articles published.
SW102580	Water Conservation for Home Owners
SW102590	The number of partnerships established with local water utilities.
SW102600	The number of water conservation or stormwater related utility inserts that are distributed with utility bills.
SW102610	A survey of homeowners about their water conservation behavior before and after the message is delivered.

Public Involvement and Participation

SW102620	Public Involvement and Participation
SW102630	Does the Stormwater Management Program summarize what best management practices will be used, the frequency of the BMP, the measurable goals for each BMP, the implementation schedule, and the responsible person or position for implementation?
SW102640	Does the Stormwater Management Program identify the target audiences of the permitteenulls public involvement program, including a description of the types of ethnic and economic groups engaged?
SW102650	Permittee are encouraged to actively involve all potentially affected stakeholder groups, including commercial and industrial businesses, trade associations, environmental groups, homeowners associations, and educational organizations, among others.
SW102660	Does the Stormwater Management Program describe how the permittee will involve the public in the development and implementation of the permittee's storm water management program and the types of public involvement activities included in the permittee's program that the permittee plans to use to educate local community groups?

SW102670 Has the permittee provided for the means to involve the public in the development and implementation of the permittee's storm water management program through:

SW102680 Public Hearings, stakeholder meetings, or other meetings?

SW102690 A Stormwater Steering Committee (or similar advisory group)?

SW102700 Stream clean-up events?

SW102710 Adopt-a-stream, Adopt-a-drain, Adopt-a-highway or Adopt-a-trail program?

SW102720 Reforestation programs or wetland planting programs?

SW102730 A stormwater hotline?

SW102740 Volunteer monitoring programs?

SW102750 Storm drain stenciling?

SW102760 Encourage neighborhood coordinators to become active in the program?

SW102770 Regional workshops?

SW102780 Telephone/Web/Mall surveys?

SW102790 Working with citizen volunteers willing to educate others about the program?

SW102830 Adopt-A-Stream Program

SW102840 The number of participants in Adopt-A-Stream, Adopt-a-drain, Adopt-a-highway or Adopt-a-trail programs.

SW102850 The quantity of trash and debris removed by Adopt-A-Stream, Adopt-a-drain, Adopt-a-highway or Adopt-a-trail volunteers (in tons).

SW102860 Surveys

SW102870 The number of citizens solicited to complete surveys.

SW102880 The number of completed surveys.

SW102890 Hotlines

SW102900 The number of calls received by a hotline(s).

SW102910 The number of problems/incidents remedied as a result of hotline calls.

SW102920 Reforestation Programs

SW102930 The number of volunteer tree planters.

SW102940 The number of trees planted.

SW102950 The number of acres planted with trees.

SW102960 Public Hearings, stakeholder meetings, or other meetings

SW102970 The number of meetings held.

SW102980 The number of attendees.

SW102990 The number of actions taken as a result of stakeholder meetings.

SW103000 Storm Drain Stenciling

SW103010 The percent of drains stenciled.

SW103020 The number of stenciling volunteers.

SW103030 The number of drains stenciled.

SW103040 Stream Cleanup

SW103050 The number of stream cleanups.

SW103060 The number of cleanup participants.

SW103070 The quantity of waste collected as a result of cleanup efforts (in tons).

SW103080 The number of stream miles cleaned.

SW103090 Volunteer Monitoring

SW103100 The number of volunteers participating in monitoring programs.

SW103110 The frequency of monitoring in the watershed (D-Daily, W-Weekly, B-Bimonthly, M-Monthly, Q-Quarterly and A-annually).

SW103120 The number of volunteer monitoring stations established in the watershed.

SW103130 The number of volunteer monitoring training sessions held.

SW103140 The number of actions that were taken as a result of the monitoring data -collected by volunteers.

SW103150 Wetland Plantings

SW103160 The acres of land planted.

SW103170 The number of volunteers that participated in planting.

SW103180 The number of planting events held.

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Date: March 29, 2012

To: Peter Franz and David Jones, UNC Charlotte
James Baysinger and Jeff Oden, Stewart

From: Jennifer Zielinski, PE and Jon Hathaway, PhD, PE

Re: UNC Charlotte MS4 Permit Application / Storm Water Management Master Plan
Task 1.3 Permit Facilitation

Subj: Meeting Notes, March 23, 2012

Biohabitats staff met with staff from UNC Charlotte, Stewart, and the North Carolina Division of Environment and Natural Resources (NCDENR) on March 23, 2012, to discuss the NPDES Stormwater Permit Application Form prior to submittal.

At the conclusion of the meeting with NCDENR, staff from UNC Charlotte concluded that UNC Charlotte will pursue its own MS4 permit. In addition, UNC Charlotte will meet the City of Charlotte's post-construction controls ordinance (PCCO) on a campus/watershed/regional basis (e.g., sizing will be per the PCCO, but will be implemented per a stormwater master plan).

Notes from this meeting are provided below, organized by the agenda for the meeting provided by Stewart.

1. **Introduction**
   - Attendees:
     - Mike Randall – NCDENR
     - Peter Franz, David Jones, Elizabeth Frere – UNC Charlotte
     - Jamey Baysinger – Stewart
     - Jennifer Zielinski, Jon Hathaway – Biohabitats
   - NCDENR works closely with other universities in North Carolina including North Carolina State University (stormwater research) and the University of North Carolina at Chapel Hill (model ordinances)

2. **Does UNC Charlotte need to obtain an MS4 Permit?**
   - Per federal regulations, public entities are required to obtain an MS4 permit
   - North Carolina Session Law allows local governments to enforce permit requirements on

state entities broadly through "stormwater ordinances"

- UNC Charlotte has options in meeting federal regulations:
  - Public entities can agree to comply with another entity (e.g., the City of Charlotte) whereby that entity reviews plans
  - Public entities can develop their own program and review plans internally
- Example programs include North Carolina State University and the University of North Carolina at Chapel Hill

3. Overview of the NPDES process

- The general MS4 permitting process per NCDENR is:
  - Application
  - Draft permit
  - University response to draft permit
  - Discuss University responses, finalize permit
  - Application proceeds to U.S. EPA for review
  - Permit is revised as needed
  - Public comment (30 days)
  - Permit is issued
- UNC Charlotte does not have to submit an application fee until after the permit is finalized, before it is submitted to U.S. EPA for review

4. State's expectations for each of the six minimum measures

- Public education and outreach
  - Education and outreach will revolve around community of students, faculty, and staff
- Public involvement and participation
  - Similar to education and outreach, these efforts will revolve around the campus community
  - No public meeting is required
- Construction site runoff
  - The construction site runoff controls currently used on campus will not change – sediment and erosion control permitting will go through the state
- Illicit discharges
  - Activities currently undertaken on campus will count toward this measure, such as maintaining grease traps on a regular schedule
  - Other activities may include outfall monitoring through visual inspection; stream walks; and informing staff of what an illicit discharge looks like and whom to contact in case one is noticed
  - UNC Charlotte should identify outfall locations and prioritize outfalls that should be checked
  - The program may be phased in over the first five years of the permit
- Pollution prevention / good housekeeping
  - Will include current activities, such as inspection of areas where materials are stored
  - Maintaining streets, parking lots and the stormwater drainage system is required;

this may include retrofitting inlets, street sweeping, collecting leaves and trash, etc.
  - Identify areas where pollution is occurring or has high potential of occurring
- Post-construction runoff
  - The state's interest in the MS4 permit is to address water quality whether a regional or site-specific approach is selected
  - The state has interest in Low Impact Development (LID) techniques including reducing impervious cover (parking decks instead of surface lots), providing tree canopy, and utilizing small, localized practices – this is largely met through he University's master plan
  - The University can prepare a stormwater master plan that meets stormwater criteria on a campus or watershed basis (as opposed to building by building)
  - The University is required to follow the State's stormwater criteria; however, the City will have an opportunity to comment on the permit, and the State will defer to the City if the local requirements are more stringent or locally applicable than the State requirements
  - UNC Charlotte will be encouraged to follow City of Charlotte ordinances for post-construction runoff
  - The master plan can be phased in with the NPDES program; it should meet the needs of the University
  - If NOT pursuing an MS4 permit, the University can try to work with the City to develop and approve a stormwater master plan for the campus
  - If pursuing an MS4 permit, the University can work with the State to develop and approve a stormwater master plan for the campus
  - Stormwater plan review may be done internally by University staff; DENR staff can provide training
  - 401 / 404 permitting is at the federal level and is independent of the MS4
  - If there is an impaired stream receiving runoff from the campus, it may be necessary to tailor the program to that impairment – a given pollutant may be targeted or BMP selections may vary based on ability to remove pollutant
  - UNC Charlotte may be involved in any future TMDL development

5. Expectations for Educational Institutions

- No additional expectations are present for educational institutions

Misc.

- Records keeping as part of the permit will include maintenance activities, street sweeping, cleaning, and other related items; these items can potentially be recorded in ArchiBus
- The MS4 permit may be more cost effective if UNC Charlotte no longer has to pay the city of Charlotte's stormwater utility fee
  - NCDOT does not pay a fee
  - North Carolina State University pays a reduced fee to the City of Raleigh
  - A resource for these questions may be the University of North Carolina Environmental Finance Center
- UNC Charlotte will have five years to develop the program

  - It is anticipated that one full time employee will be required to manage this program and act as a reviewer; UNC Charlotte can work with NCDENR to train the employee
- Other NPDES permits in place at UNC Charlotte:
  - NCGO8 – vehicle fueling
  - Hazardous materials
  - Composting – UNC Charlotte does have a permit

MEETING NOTES

STEWART

PROJECT NAME:	UNC Charlotte MS4 Permit and Storm Water Master Plan
STEWART PROJECT NUMBER:	X11024.00
MEETING DATE/TIME:	August 1, 2012/09:00 am
LOCATION:	Charlotte Government Center, Conference Room #136 600 East Fourth Street, Charlotte, North Carolina
SUBJECT:	UNCC Campus Master Plan Charlotte Mecklenburg Utilities (CMU) **[Revised 8/13/2012]**
STEWART REP:	Jamey Baysinger
ATTENDEES:	Peter Franz, UNC Charlotte Elizabeth Frere, UNC Charlotte Mike Randall, NCDENR Daryl Hammock, City of Charlotte Mike MacIntyre, City of Charlotte

PURPOSE:

The purpose of this meeting was to discuss the "DRAFT Schematic Design Assumptions and Post Construction Framework" memorandum prepared by STEWART, and dated April 9, 2012, and to review comments prepared by the City of Charlotte, included in an email from Daryl Hammock, dated July 26, 2012.

NOTES:

Mike Randall began the discussion with a request for clarification on two points; (1) How the University plans to manage development of the campus, and (2) How STEWART developed the "Schematic Assumptions".

Peter Franz responded with a discussion of the Campus Master Plan prepared in 2008 that included planning for regional storm water "treatment", and that funding for storm water infrastructure projects on campus will be primarily from student fees, and partially from exactions from capital construction projects, but not from State appropriations.

Jamey Baysinger continued with a discussion of the design assumptions that were distilled from State DWQ rules and City PCCO. Jamey explained that the goal of the assumptions is to set up a reasonable, responsible, and uncomplicated system for tracking impervious area relative to storm water "treatment" capacity on campus.

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STEWART

The University wants to exclude accounting for redevelopment of built upon area that was built or approved prior to July 1, 2008 from BMP design and development tracking. Mike MacIntyre stated the City's goal of improving water quality by requiring treatment for redevelopment in the PCCO. The University will be improving water quality by the nature of the redevelopment being from existing parking lots to buildings. Therefore, the University believes that the City's request for treatment of redevelopment on the UNC Charlotte campus is unreasonable.

Mike Randall followed the discussion with a request that the storm water master plan be included in the permit narrative, and that the narrative also address at what point in time BMPs will be functional relative to development on campus.

Jamey Baysinger then began a point-by-point discussion of the "Schematic Design Assumptions" memorandum.

The City agreed that the University has the necessary characteristics for designation as a Transit Station Area; therefore pre-developed conditions will be defined as that which was built or approved prior to July 1, 2008.

The University agreed to design BMPs in accordance with the Charlotte-Mecklenburg BMP Design Manual, including;

- **Water quality protection volume (1" rainfall), OR**
- **Channel protection volume (1 year/24 hour storm) and the 10-year storm peak flow control.**
- **Built Upon Area that was built or approved prior to July 1, 2008 does not need to be treated. If it is treated, then it can be counted as compensatory treatment (aka treatment trade).**

Peak flow control will be provided for only new impervious area (excluding redevelopment) that was neither built nor approved prior to July 1, 2008.

All agreed to allow the adjustment of run-off curve numbers (CN) for areas that are restored from impervious to pervious surface, if the University amends the soils. Mike Randall requested that the University's landscape site preparation specification be included with the permit narrative. Newly constructed (after July 1, 2008) pervious areas that were impervious areas built or approved prior to July 1, 2008, do not need to be treated. If newly constructed pervious areas are designed to act as a BMP, then the City agrees to count it as a BMP.

Mike Randall stated that the University would need to comply with the City's buffer requirements. Mike MacIntyre stated that the University will meet the City's PCCO natural area requirement by simply observing the City's buffer requirements. Peter Franz acknowledged that this was already the University's policy.

All agreed to using a regional approach to storm water "treatment", including compensatory "treatment" with the following caveats;

STEWART

(1) The University must show that it is implementing BMPs and/or green infrastructure to the maximum extent practicable in areas that are being offset by compensatory "treatment" located elsewhere
(2) Both the area being offset and the area providing the compensatory "treatment" must drain to Mallard Creek or Toby Creek without crossing another property and/or public right-of-way.

Daryl Hammock stated that the City would count pervious concrete as green infrastructure.

Mike Randall stated that the State would use the City's BUA determination methodology and thresholds, but would conclude that the University was still high density, because storm water was piped and not transported by vegetated conveyance.

Peter Franz asked if the State would accept BMPs that discharged into piped systems. Mike Randall stated that he would.

All agreed to looking at the BUA% of the campus as a whole as described in the memorandum with the caveat that the campus area must all drain to Mallard Creek or Toby Creek without crossing another property or public right-of-way. Mike MacIntyre requested that the University continue to use and update the BUA map that was previously submitted to the City.

All agreed that existing BMPs could be included in the record-keeping of "treatment" capacity provided.

All agreed that if the University needed to modify an existing BMP that had been constructed to meet 401/404 permit requirements, then the University would apply for a modification to the permit prior to any making modifications to the BMP that might cause it to be out of compliance.

CAVEAT:

The information provided above is based on my recollection. Please notify me of any corrections or clarifications at 704-334-7925.

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Date: August 13, 2012

To: Peter Franz and David Jones, UNC Charlotte
James Baysinger and Jeff Oden, Stewart

From: Jennifer Zielinski, PE

Re: UNC Charlotte MS4 Permit Application / Storm Water Management Master Plan
Task 2.2 Stormwater Management Master Plan

Subj: Updated Stormwater Retrofit Study

This memorandum presents an update to the stormwater retrofit study prepared by Biohabitats in support of UNC Charlotte's master plan in 2010. An overview of the benefits of stormwater retrofits is presented, followed by a description of the stormwater retrofit and green infrastructure opportunities on the campus. Then, a recommended green infrastructure approach for the campus is set forth and more detail is provided on treatment opportunities.

Introduction to Stormwater Retrofits

Stormwater retrofits refer to a variety of practices designed to help restore watersheds by providing stormwater treatment in locations on campus where practices previously did not exist or were not effective. Retrofits provide important water quality and volume reduction benefits that can result in improved in-stream and surrounding ecosystem conditions.

The art of retrofitting in a campus setting is to effectively integrate the practices so that they provide a desirable aesthetic. In addition, stormwater retrofits offer further benefits to the campus, including the following:

- **Beneficial use of rainwater –** Collecting rainwater for landscape irrigation will reduce potable water demand on campus.
- **Education –** Toby Creek and its associated riparian corridor lie at the center of the campus. Other smaller tributaries throughout most of central campus also drain to the Creek, providing a very real and daily reminder of hydrologic and ecological elements in the campus landscape. BMPs such as rain gardens and turf conversion provide educational and stewardship opportunities to discuss the significance of upland hydrology as well as native vegetation.

- **Sustainability –** BMPs are an important component of a shift from active to passive landscape management. For example, after an initial establishment period, rain gardens require little maintenance except weeding, debris removal, and occasional plant replacement, as with any garden. Irrigation is not needed except in extended dry periods, and rain gardens thrive without fertilizer and chemical treatments. Distributed stormwater management also has the potential to lower maintenance requirements for the existing stormwater infrastructure, such as inlets and storm drains. A campus-wide sustainability strategy might prioritize areas that are currently irrigated with potable water. These areas could be partially replaced with native landscape plantings or rain gardens. Alternatively, cisterns could be installed to collect and store rainwater for irrigation of turf or planted areas. The approaches will vary by site, but each approach has the potential to reduce potable water demand and treat stormwater runoff.
- **Habitat and Microclimates –** Creating more diverse open space areas on campus that are also managing water provides valuable habitat for birds and insects. Areas planted with trees and shrubs (e.g., rain gardens) also have the ability to provide shade to offset heat island effects and provide small microclimate pockets across campus which contributes to greater ecological diversity.

Even in areas that are slated for redevelopment, the benefits provided by retrofits may be worth the capital investment, especially if redevelopment will not occur for several years.

Stormwater Retrofit Opportunities

Field work was conducted at the UNC Charlotte campus in April and June 2008 to identify and assess opportunities in the campus landscape for stormwater retrofits. Candidate sites were initially identified using aerial photos and maps of impervious cover, soils information, topography, known storm drain infrastructure, and hydrology. Each candidate site was visited and assessed for retrofit potential. This involved an assessment of the site's drainage area, impervious cover, and land use; an evaluation of existing stormwater management and drainage patterns at the site; and identification of site constraints that may impede implementation, such as utilities and permitting factors. The goal was to identify a variety of retrofits opportunities and to become aware of the general character of the landscape and drainage patterns in order better provide suggestions for stormwater management as part of planning efforts for future development potential.

Good candidate retrofit sites on campus generally had one or more of the following characteristics:

- High ecological habitat value
- Located at a current nuisance flooding location
- Large amount of impervious cover in the drainage area
- Insufficient existing drainage infrastructure or stormwater practices
- Potential as a demonstration project

Over 90 sites were assessed and 76 stormwater retrofit opportunities were identified across the campus during this initial effort (Figure 1). The retrofit opportunities identified can be categorized broadly as the following palette of practices: landscape conversion, functional landscapes, rooftop vegetation, permeable pavement, rainwater harvesting, underground filters, bioswale conveyances, outfall treatment, stormwater ponds/constructed wetlands.

In August 2012, Biohabitats re-evaluated these stormwater retrofit opportunities and identified those that complement both existing conditions and proposed build-out of the proposed master plan (Figure 2 and Attachment A). These 55 opportunities represent locations on the campus where stormwater practices may be implemented to provide water quality treatment of stormwater runoff from existing development as well as future planned campus development.

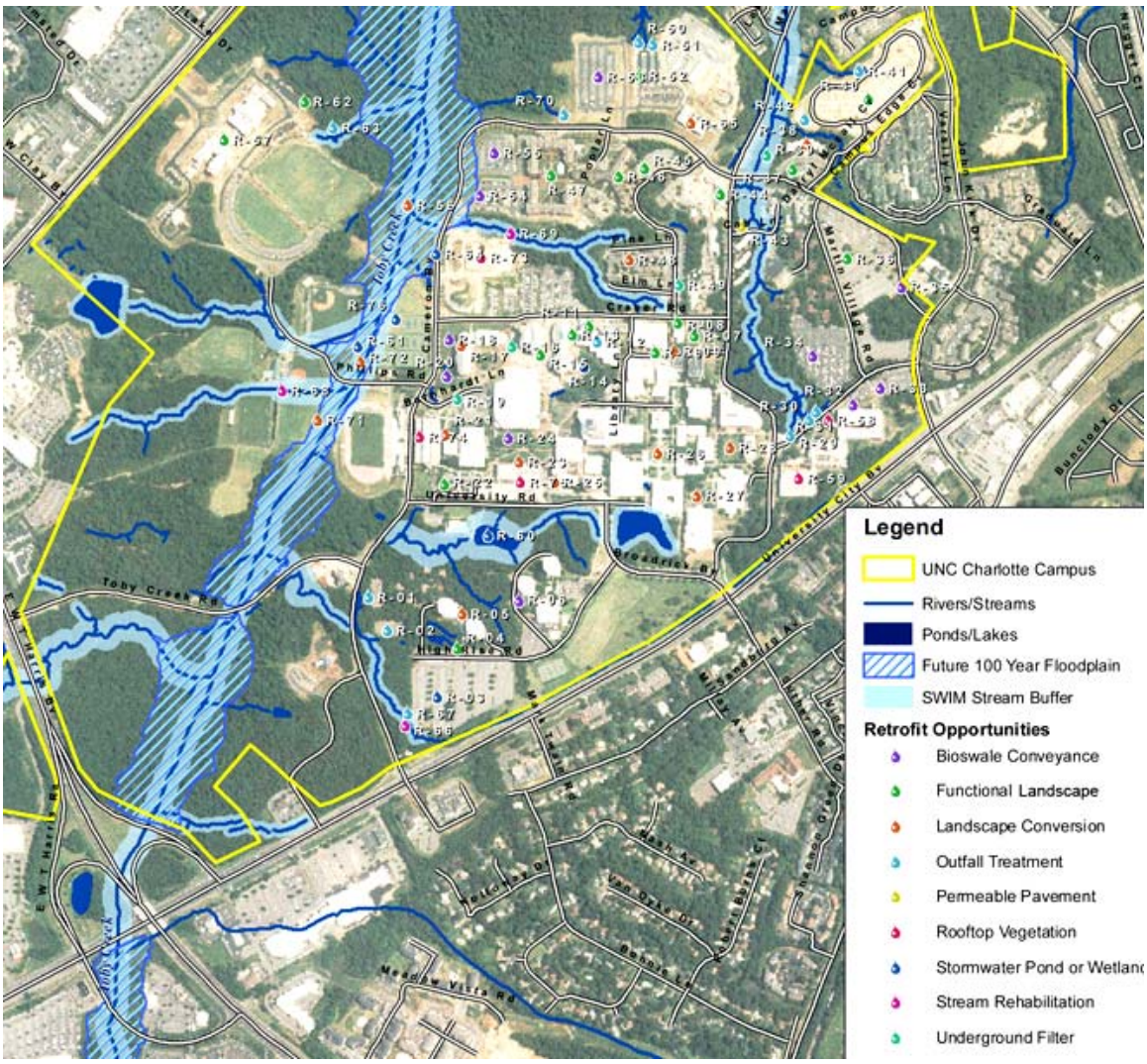


Figure 1. Stormwater retrofit opportunities, per work completed in 2010.

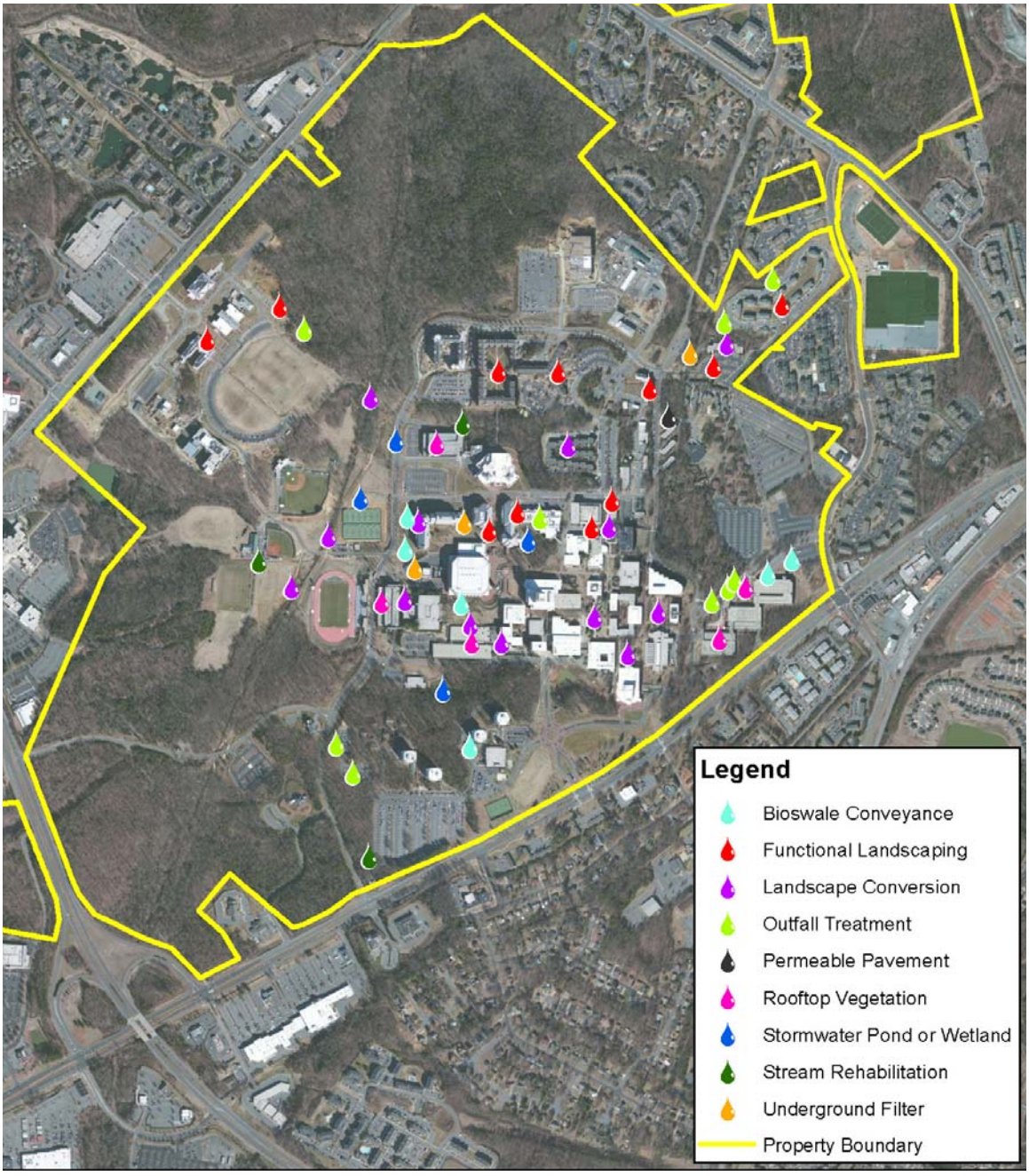


Figure 2. Updated stormwater retrofit opportunities.

Green Infrastructure Opportunities

Green infrastructure principles can be addressed in a holistic approach across the campus landscape, integrating natural function into the concepts for future campus buildout. This approach combines stormwater management opportunities with the broader vision of connection and regeneration of landscape ecological function, in the context of an active campus landscape. The most challenging but also the most interesting areas are those where the natural interfaces with the built landscape, opening up new opportunities for campus programming, research, and curricular connections to the natural resources that are found throughout this campus.

In support of UNC Charlotte's master plan in 2010, Biohabitats identified green infrastructure opportunities, expressed as recommended land covers targets for the campus (Figure 3). These land covers are still applicable to the campus and include manicured landscapes, natural landscapes, functional landscapes, green roofs, and native groundcover.

Natural landscapes are recommended for the Toby Creek corridor, stream buffers, currently undisturbed forested areas on the north and south sides of the campus, and the Botanical Gardens. These natural areas will serve as wildlife habitat, ecological corridors, and hydrologic sinks on the campus. Converting existing turf cover to native groundcover is recommended along the perimeters of the natural landscapes. These will provide a critical transition zone between the built environment and the interior forested areas. Manicured landscapes provide limited ecological functions, but do provide much needed green space for outdoor activities. These are noted for proposed athletic fields as well as in potential student gathering areas.

Functional landscapes are recommended within and along the perimeter of the built environment. These provide important green spaces, but also serve an important stormwater treatment function. These are critical as the density of the central campus does not allow for large stormwater BMPs, such as ponds. A distributed approach to treating runoff within landscapes will be necessary to meet future stormwater management requirements. Green roofs are recommended for all new rooftops proposed under the master plan. As with functional landscapes, these will help meet future stormwater management requirements.

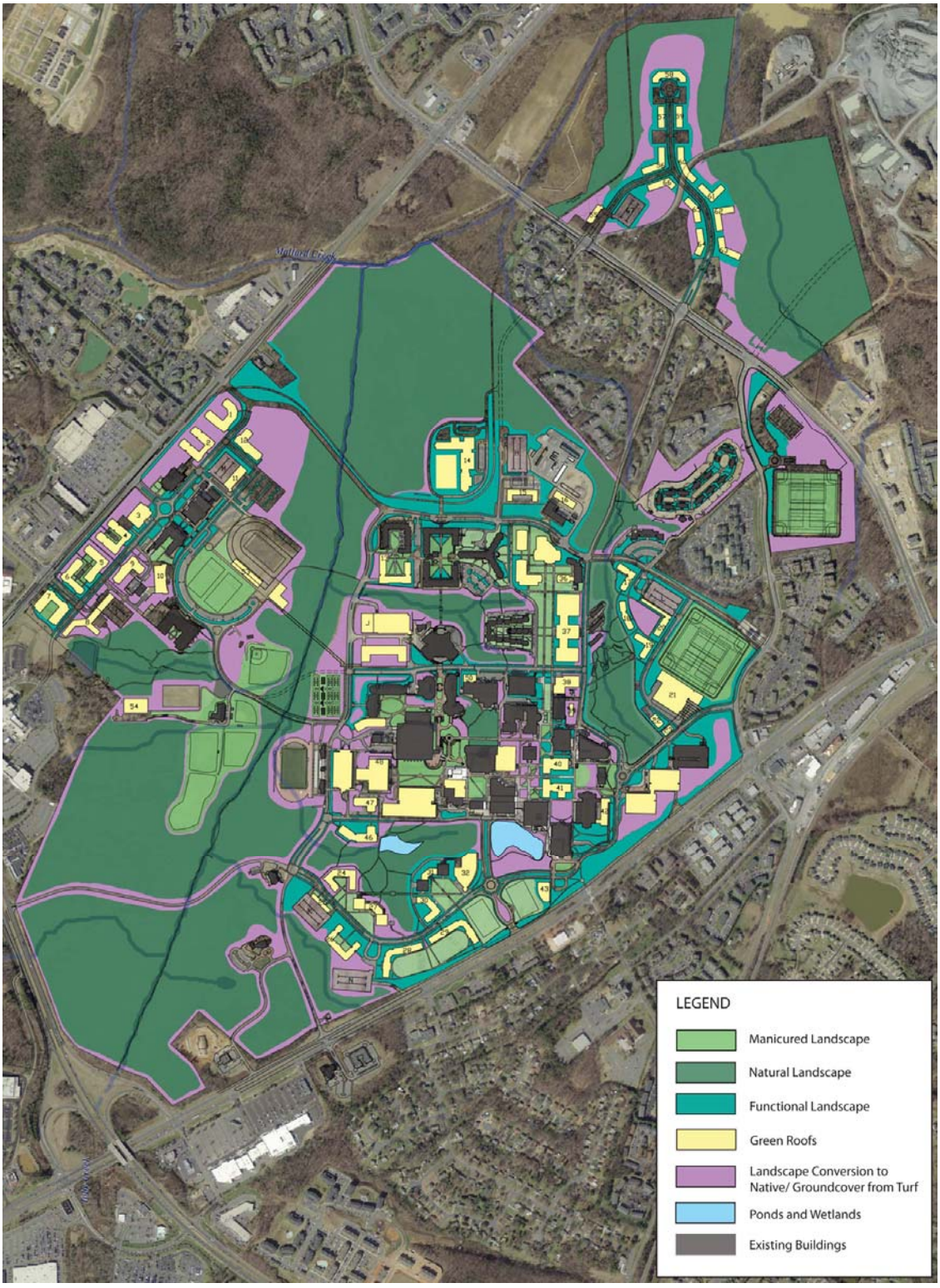


Figure 3. Green infrastructure opportunities, expressed as land covers targets for the campus.

Recommended Green Infrastructure Approach

A green infrastructure approach highlights the application of native landscape systems and practices. Creating more sustainable green infrastructure means transitioning from practices that degrade the environment toward creating working landscapes that perform important ecological functions. Examples of these functions include: receiving, retaining, and filtering stormwater runoff; creating natural habitats for diverse ecosystems; providing educational opportunities; providing natural areas for passive recreation and respite; and reducing the overall operation and maintenance burden for campus staff.

Key aspects of the recommended green infrastructure approach for UNC Charlotte are highlighted below:

- Identify and preserve undisturbed natural areas – streams, wetlands, buffers, forested area, etc.

- Maintain or preserve existing landscape ecological connections and corridors – The Toby Creek corridor acts as a critical ecological corridor connecting the campus to Mallard Creek. This ecological linkage, along with smaller tributary corridors on the campus, should be maintained and restored, and protected. These corridors provide a critical link to forested habitat areas in the vicinity of the campus, including the Reedy Creek Nature Preserve to the south of the campus.

- Disconnect and reduce impervious surface – Applicable BMPs include green roofs, porous pavement, bioswales, stormwater planters, and the removal of under served paved areas.

- Limit new disturbance – To the greatest extent possible, locate new impervious surfaces (buildings, parking lots) on existing disturbed areas. For example, consolidate surface parking and replace with structured or underground parking and redevelop the reclaimed area. This will minimize the growth of the impervious footprint of the campus, lower regulatory burdens, and minimize additional impacts on already-stressed waterways. Avoid encroaching on the edges of forested areas if at all possible. Bear in mind regulatory buffer requirements during the planning process.

- Create opportunities for multi-functional landscapes – Create integrated landscapes that have multiple functions, including providing micro-habitats, ecological stepping stones, and educational and stewardship opportunities.

- Treat stormwater runoff close to the source – Mimic the natural, undisturbed infiltration capacity of the land to the maximum extent practicable using a distributed stormwater management approach. A priority should be placed on using BMPs that emphasize vegetative filtering, uptake, and infiltration, following innovative design approaches and techniques that go above and beyond state or local guidance. Finally, concept plans and

designs should proceed in a manner that provides treatment as close to the generating source as possible.

- Provide control for larger storm flood control, as needed – Constructed wetlands can offer control in larger events as well as providing water quality treatment. Flood control practices should be pursued in a coordinated way, whereby volume reduction benefits associated with a distributed BMP approach are pursued concurrently such that the size of constructed wetlands and ponds can be significantly reduced.

- Balance initial costs with long-term benefits – Initial costs can be higher for a distributed approach, but this approach has other benefits that are not captured by a first-cost analysis, such as improved campus aesthetics, an overall reduction in maintenance, improved water quality, and opportunities to educate the University community about sustainability principles and natural systems function.

Treatment Opportunities for Stormwater Management and Ecosystem Health

The potential for the application of a wide range of BMPs and green infrastructure exists under current conditions as retrofit opportunities, as well with the proposed future development. This section will give further explanation of the palette of BMPs that would be most appropriate.

Opportunities can be categorized by where they are found in the landscape (i.e., landscape position) as well as how they fit into set, or planned, programming for the University. This section will also discuss the recommended natural areas designations, as part of a broader holistic treatment of strengthening green infrastructure while addressing regulatory requirements. Many of these practices can be integrated to explore the unique opportunities that the UNC Charlotte campus holds for integrated regenerative planning and design.

Palette of Stormwater BMPs

Landscape conversion is the conversion of a generally high maintenance landscape (e.g., turf) to a landscape cover that is more desirable from a stormwater quality perspective (e.g., xeriscaping – plantings that reflect a need for less irrigation like native meadow and grassland palettes). There are three primary applications across the campus: reforestation of grass areas near riparian corridors; conversion of turf to native vegetative cover; conversion of high maintenance, non-native landscape plantings to native vegetative cover. These practices should not be confused with functional landscape change.

Functional landscapes include elements that require a greater level of design than landscape conversion to provide benefits and functions such as stormwater treatment. Treatment features such as bioretention, rain gardens, and street tree pits are examples of functional landscapes that are designed to be integrated into landscape areas to receive and filter stormwater runoff.

Bioswale conveyances are opportunities to use vegetated swales and channels to convey and filter stormwater runoff. These opportunities are generally found where more conventional drainage ditches or eroding swales are conveying stormwater and present opportunities for improvement.

Permeable pavement includes porous concrete or asphalt, or some other type of geoweb or paver system. Existing paved walkways and courtyards throughout the campus present themselves as retrofit opportunities, particularly if repaving is needed in the future. Soil conditions on campus are generally not favorable for significant infiltration, so careful planning and design is warranted for this type of application.

Underground filters may include underground sand filters or some sort of proprietary filter placed in an existing catch basin. These are recommended for areas that have the potential to contribute high pollutant loads but are limited in space (e.g., loading docks behind buildings)


Outfall treatment is recommended for existing outfalls and drainage chutes where there is erosion and space available for improvements. Regenerative Stormwater Conveyance (RSC) is recommended for these areas, which would convey, filter, and infiltrate runoff. Please note that this is not simply outfall stabilization (e.g., with riprap), but rather a vegetative regenerative design that is creating a more stable stream-like system to help convey, filter, and provide habitat.

Underground detention (large cisterns underground) would be appropriate at the athletics fields and under certain parking lots. This is similar to the farm pond approach – collect the water, store and use for irrigation close to the source. This might only be pragmatic in the Athletics precinct.


Rooftop vegetation may include green roofs, but it may also include the creation of vegetative canopy cover through the use of trellises, canopies, or planter boxes for mitigation of urban heat island and some stormwater management. These can be included in areas where other

buildings overlook them or from pedestrian areas that often used, such as near light rail stops, near the student union, and near other taller buildings.

Stormwater ponds or wetlands include creating a new facility or retrofitting an existing one to enhance water quality treatment. Pictured is the potential retrofit that could be implemented, as a restored wetland at the existing dry pond that lies along Cameron Boulevard.

Rather than treating stormwater as a waste product to be disposed of, **rainwater harvesting** is a technique used to capture and re-use this valuable resource. Harvested rainwater may be collected from any impervious area such as a rooftop, plaza, or parking lot. Water can be stored in above-ground cisterns or underground storage tanks with capacities up to 10,000 gallons. The water collected can be used for lawn and garden watering or indoor uses such as toilet flushing. In some cases it is used to provide aesthetic-driven water features. Storing rainwater also conserves potable water and reduces water utility costs. Gravity flow or pumps can be used to distribute the water.

Finally, **stream rehabilitation** opportunities exist along Toby Creek and some of its tributaries. These opportunities vary and include the removal of a concrete channel, stream channel stabilization, and stream restoration.

Opportunities by Landscape Position

Six landscape positions are commonly found throughout campus, each of which present multiple opportunities for innovative stormwater management strategies utilizing a combination of green infrastructure practices. Together, they have the potential to form the backbone of an integrated green infrastructure network across campus. Descriptions and illustrative graphics of these six areas are presented below.

Rooftops

Rooftop runoff can be treated using rain gardens, stormwater planters, infiltration trenches, cisterns, or small-scale detention devices. These practices are placed adjacent to buildings and should be designed to complement or enhance the existing landscape plantings and design. Green roofs can also provide an opportunity to absorb and slow stormwater runoff from rooftops. Additionally, a planted roof can lower summer cooling needs, provide a reduction in urban heat island effects, provide habitat for certain species, and provide a useable space for study, gardening, food growing, or other activities. Green roofs can also serve some function to capture some rainwater and provide a reduction of heat island effects, as well as provide some habitat for certain species.

Roads

Road runoff can be captured in stormwater tree pits or rain gardens located in curb extensions. These features also promote traffic calming, improving safety for drivers, pedestrians, and bicyclists. Porous pavement can be considered for bike lanes, parking lanes, or infrequently-used roads.

Parking Lots

Runoff from parking lots can be treated by rain gardens placed around the perimeter or in linear islands within the parking lots. If space allows, grass filter strips placed between the parking lot and rain gardens will promote additional infiltration and reduce the pollutant load and velocity entering the rain gardens. Increasing tree canopy both within bioretention islands, and along the perimeter of the lots and combining these areas with stormwater receiving zones to filter water and support plant life provide multiple benefits: decreasing the effects of urban heat islands, capturing and treating runoff from these expansive impervious areas, and providing habitat connections to neighboring forest patches. Replacing all or part of a parking lot with porous pavement or paver blocks is another option. Pavers or colored porous concrete can be used to visually demarcate special parking areas.

Turf

Converting turf to native plantings has multiple benefits including: increasing soil permeability by creating deeper macropores in soil structure, reducing overall mowing maintenance, reducing potable irrigation water demand, increasing canopy cover for rainfall interception and heat island mitigation, and reducing carbon footprints through sequestration and the reduction of fossil fuel use in maintenance regimes.

Courtyards/Quads

Courtyards and quads on campus usually incorporate landscape elements like lawns and garden plantings in combination with hardscape paths and plazas. The peripheral areas of the quads offer an opportunity for conversion from turf to depressional areas for stormwater collection. These areas can be planted with native vegetation that provide aesthetic accents, vibrant colors and texture, and spatial organization. Even when depressional areas are not feasible for bioretention, the turf edge along courtyards may be converted to a natural meadow planting, providing more microhabitat and a reduction in maintenance needs. Hardscape areas can be replaced or augmented with permeable/porous pavement to minimize impervious surfaces.

Riparian Corridors

Riparian areas are an integral part of existing ecological systems and also often provide a buffer between creeks, rivers, wetlands, and neighboring developed areas. Riparian corridors are key

to ecological systems, providing linkages between ecological patches or as linkages for wildlife movement. Through restorative and regenerative practices, riparian corridors can provide habitat, as well as act as a natural amenity for passive recreation and a natural boundary marking the edge of developed areas. Riparian corridor opportunities can include ecological restoration and enhancement, as well as stormwater practices like regenerative stormwater conveyance and bioretention gardens.

Opportunities by Precinct

Retrofit, restoration, and general stormwater management opportunities are best integrated into the campus landscape in a way that responds to the aesthetic and scale of the existing infrastructure, programming of a space, and landscape design. In order to better respond to these characteristics, the campus was broken down into five unique zones, or precincts: Woodland, Academic/Research, Residential/Student Life, Athletics, and Botanic Gardens. Aesthetic and functional qualities of each zone influence the recommended stormwater management approach to be considered in each. (**Figure 4**)

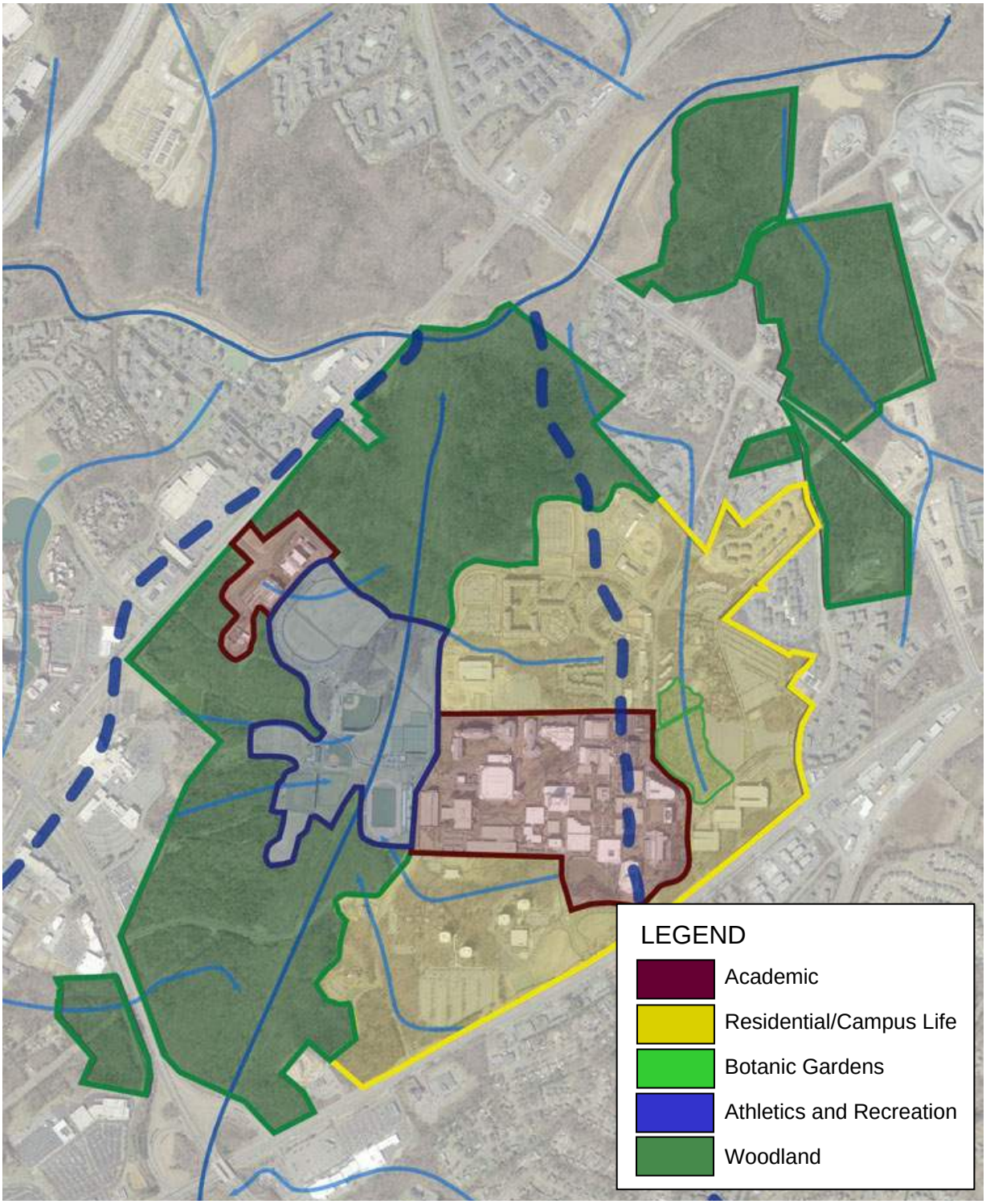


Figure 4. UNC Charlotte campus precincts, per work completed in support of the master plan.

Woodland

Conserving existing forest is a general goal for natural resource sustainability. Forest resources are integral to the campus green infrastructure network, providing habitat; open space and recreational areas; connections to the regional ecosystem; teaching, research, and cultural opportunities; and stormwater management, among other benefits. A vigorous forest cover is also critical to maintaining healthy stream ecosystems and flood control.

Much of the woodland on the UNC Charlotte campus lies along or extends from the Toby Creek corridor, providing a very literal natural spine for the campus. There are also some very important interfaces along woodland edges that meet parking lots, streets, and turf areas associated primarily with athletics. These would each have appropriate practices associated with them to make for a seamless integration between natural and developed areas.

Invasive species control and restoration of native forest species is recommended as a management strategy to maintain the function of the existing forest stands. Along streets and roads, linear bioretention or other conveyance or infiltration systems would be appropriate. As stormwater runoff departs from parking lots, bioretention or bioswale conveyances could be applied to help infiltrate or convey the water. Some the outfalls might also be retrofitted or designed to incorporate Regenerative Stormwater Conveyance (RSC), as mentioned above.

Academic/Research

The Academic/Research Precinct includes most of the academic buildings as well as the research and technology area on the western edge of campus, along North Tryon Street. A relatively traditional campus aesthetic prevails, with cohesive architecture, clear sightlines and east-west axes through the main gathering spaces, and smaller pocket quads and courtyards between campus buildings. The treatment practices suggested for this zone will integrate with the existing look and feel while introducing new landscape elements.

BMPs in this part of campus should predominantly treat rooftop runoff and turf areas, as well as several smaller parking lots and interior campus streets. Rooftop treatment BMPs could include rain gardens and cisterns that would be designed to enhance and complement the existing architecture and environment. Suggested turf conversion would integrate attractive native plantings into public spaces while contributing to stormwater management and habitat enhancement. Street runoff may be treated by stormwater tree pits located strategically along certain streets that might experience high frequency and faster traffic regimes but would be served better with some calming. Quad and courtyard areas may in the future include permeable pavers or areas of native plantings integrated into the formal design of the space.

Residential/ Student Life

The Residential and Student Life precinct is both north and south of the Academic Core, with a small portion along the eastern side of the campus. There are a range of architectural styles represented in the housing options, as well as parking decks and expansive amounts of parking lots. Along the southwestern and northwestern edges, it has an important interface with the existing woodland, where dense tree canopy predominates. As the core area of student habitation and extracurricular activities, the aesthetics of practices implemented here could be less institutional and weave coherently into the residential landscape.

The recommended BMPs in this part of campus are intended to treat rooftop, parking lots, courtyards and quads, and road runoff. They might include green roofs, functional landscapes, wetlands, outfall treatment along parking lots, and bioswale conveyances. There are also several tributaries to Toby Creek that originate and flow through the precinct so riparian treatment practices are appropriate and important considerations, restoring the corridor and treating runoff before it empties into the streams. Turf conversion would also be a very important practice to consider in peripheral areas that may not be used for unprogrammed active recreation.

Athletics

A visual and functional connection between the two portions of the Academic/ Research precinct, the Athletics precinct contains a mixture of open athletics and recreation fields and more densely developed facilities associated with athletics. It provides abundant green infrastructure opportunities. With tennis facilities, large athletics and recreation fields for baseball, softball, practice fields, as well as Irwin Belk Track and Field Center and Wachovia Field House The northern and southern edges of the Athletics Precinct contains forest stands that are valuable as recreational, athletic, and natural resources. This area has high visibility because of its proximity to the Academic/ Research Zone and because of general public attendance associated with athletic events.

High attendance during athletic events provides an opportunity to demonstrate campus green infrastructure and sustainability initiatives to the extended campus community and to out-of-town visitors. At the same time, stormwater treatment and suggested landscape changes should integrate in a way that does not impinge on circulation or public use.

Rooftops, roads and sidewalks, non-athletic turf areas, and athletic fields are the dominant features in this zone. Rain gardens, potentially accompanied by cisterns for irrigation of other landscaped areas, can be placed near buildings to treat roof runoff. Road and sidewalk runoff can be treated by curb extensions or, if the right-of-way is narrow, by stormwater tree pits with structural soil or storage and exfiltration facilities under sidewalks. Open areas adjacent to tennis courts and parking lots can be used for rain gardens or other native landscapes. Finally, underground detention facilities can be considered in association with new athletic fields (located below the fields and integrated with field drainage systems) to provide system-wide storage that helps reduce downstream flooding.

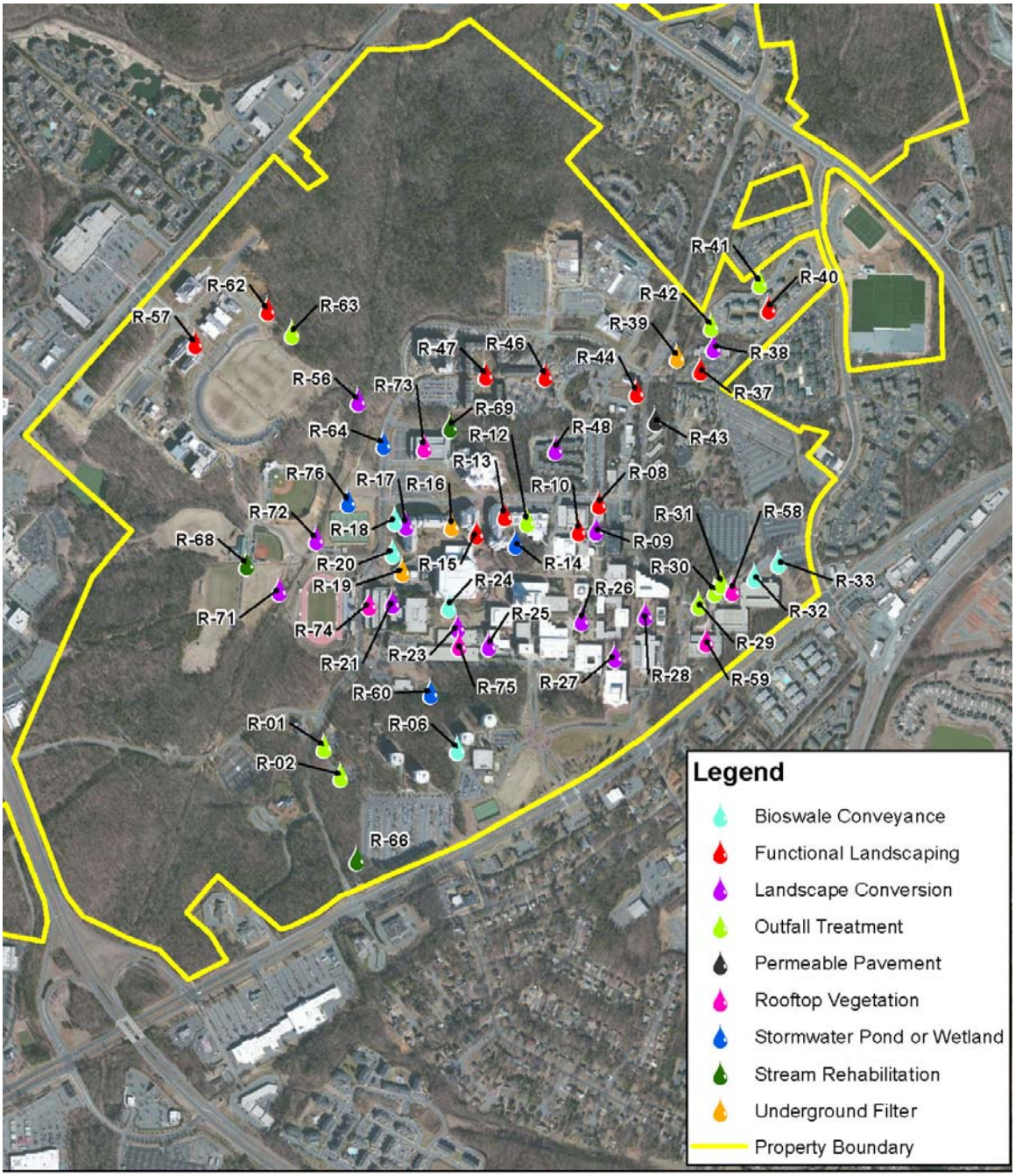
A unique feature of this precinct is its relationship to Toby Creek and the associated riparian corridor. Flowing along the eastern edge of the precinct, the Creek creates a natural spine and visual amenity. Practices implemented along the creek or in drainage areas that flow to the creek could provide further natural amenity and aesthetic benefits, as well as increased habitat value and better management of stormwater runoff.

Botanic Gardens

Tucked in between the Residential/Student Life precinct and the Academic/Research precinct is the University's Botanical Gardens, considered a separate precinct because of its unique aesthetic and vegetative makeup. The Botanical Gardens consist of three main areas: the McMillan Greenhouse complex; the 3-acre Susie Harwood Garden, which features hardy ornamental plants from all over the world; and the 7-acre Van Landingham Glen, which features many plants native to the Carolinas, a rhododendron and azalea collection among them. The three areas are located together, on the east side of the UNC Charlotte campus.

Areas that might be of interest for the application of BMPs would include the rooftops and courtyards associated with the greenhouse and other garden facilities, and treatment of parking lot runoff in the parking areas that border the garden's property. Of most importance would be the continued maintenance of the unnamed stream and its associated riparian corridor. Restoration and adaptive management techniques could be integrated into maintenance regimes for the gardens, increasing habitat as well as experiential quality.

Attachment A



Updated stormwater retrofit opportunities on the UNC Charlotte campus.

Stormwater Retrofit Opportunities on the UNC Charlotte Campus				
Retrofit ID	**Landscape Element**	**General Location**	**Opportunity**	**Comments**
R-01	Parking Lots	Parking Lot 9A	Outfall Treatment	construct bioretention or RSC at existing drainage chute
R-02	Parking Lots	Parking Lot 9 and entry drive	Outfall Treatment	construct bioretention or RSC at existing drainage chute; daylight storm drain
R-06	Roads	Sanford Hall Lane	Bioswale Conveyance	create bioswale / bioretention
R-08	Rooftops and Courtyards	Auxiliary Services Building	Functional Landscaping	rain garden at existing inlet
R-09	Rooftops and Courtyards	Courtyard between Auxiliary Services Building and Cameron Hall	Landscape Conversion	landscape conversion
R-10	Parking Lots	Behind Cameron Hall	Functional Landscaping	bioretention at existing inlet
R-12	Rooftops and Courtyards	Burson	Outfall Treatment	landscape conversion; RSC at roof drain outfall
R-13	Rooftops and Courtyards	Health & Human Services	Functional Landscaping	stormwater planter; perimeter plantings; rain garden; existing medicinal garden
R-14	Riparian Zones	Pond or stream behind Burson	Stormwater Pond or Wetland	existing pond or stream? Opportunity for ecological enhancements
R-15	Rooftops and Courtyards	Courtyard between Health & Human Services and College of Education	Functional Landscaping	landscape conversion; reduced fertilizer/ pesticide use; rain gardens at inlets
R-16	Roads	Service Area between Grigg Hall and College of Education	Underground Filter	underground sand filters at inlets; dumpster containment
R-17	Rooftops and Courtyards	Woodward Hall	Landscape Conversion	landscape conversion

Stormwater Retrofit Opportunities on the UNC Charlotte Campus				
Retrofit ID	**Landscape Element**	**General Location**	**Opportunity**	**Comments**
R-18	Turf Grass	Between Woodward Hall and Cameron Boulevard	Bioswale Conveyance	existing swale drainage; some room for improvement to enhance water quality treatment
R-19	Parking Lots	Parking lot off of Barnhardt Lane	Underground Filter	underground or perimeter sand filters at existing inlets
R-20	Rooftops and Courtyards	Existing swale north of Barnhardt Lane	Bioswale Conveyance	existing swale drainage; some room for improvement to enhance water quality treatment
R-21	Rooftops and Courtyards	Area between West Deck and Belk Gym	Landscape Conversion	landscape conversion
R-23	Rooftops and Courtyards	Central courtyard south of Barnhardt	Landscape Conversion	enhanced landscaping, revegetation
R-24	Rooftops and Courtyards	Existing swale south of Barnhardt	Bioswale Conveyance	existing swale drainage; some room for improvement to enhance water quality treatment
R-25	Rooftops and Courtyards	Courtyard entry to Cone University Center	Landscape Conversion	Planter boxes
R-26	Rooftops and Courtyards	Belk Tower	Landscape Conversion	pavement removal; landscape conversion
R-27	Rooftops and Courtyards	Courtyard north of Robinson Hall	Landscape Conversion	landscape conversion; rain gardens at inlets
R-28	Rooftops and Courtyards	Courtyard north of Storrs	Landscape Conversion	landscape conversion; rain gardens at inlets
R-29	Riparian Zones	Van Landingham Glen	Outfall Treatment	retrofit / stabilize at outfall
R-30	Riparian Zones	Van Landingham Glen	Outfall Treatment	retrofit / stabilize at outfall
R-31	Riparian Zones	Van Landingham Glen	Outfall Treatment	retrofit / stabilize at outfall
R-32	Parking Lots	Parking Lot 4	Bioswale Conveyance	terraced bioretention at existing outfall or modify existing swale

Stormwater Retrofit Opportunities on the UNC Charlotte Campus				
Retrofit ID	**Landscape Element**	**General Location**	**Opportunity**	**Comments**
R-33	Parking Lots	Parking Lot 4A	Bioswale Conveyance	Modify existing swale
R-37	Parking Lots	Parking Lot 13	Functional Landscaping	bioretention or terraced bioretention in landscaped islands
R-38	Rooftops and Courtyards	Hawthorne Hall	Landscape Conversion	residential courtyard landscaping
R-39	Parking Lots	small parking lot leading to Hawthorn Hall	Underground Filter	perimeter sand filter at inlet
R-40	Rooftops and Courtyards	Greek Village	Functional Landscaping	landscape conversion, downspout disconnection, soil stabilization
R-41	Riparian Zones	Greek Village	Outfall Treatment	RSC at existing outfall
R-42	Riparian Zones	Greek Village	Outfall Treatment	RSC at existing outfall
R-43	Roads	Mary Alexander Road	Permeable Pavement	permeable pavement in angled parking stalls
R-44	Rooftops and Courtyards	Student Health Center	Functional Landscaping	rain garden in rear of building; planter boxes along perimeter of building
R-46	Rooftops and Courtyards	Witherspoon Hall	Functional Landscaping	example of disconnected downspouts; possibly raise inlets to create ponding area
R-47	Rooftops and Courtyards	Laurel Hall	Functional Landscaping	convert landscaping; create rain gardens at existing inlets; disconnect downspouts
R-48	Rooftops and Courtyards	Oak Hall	Landscape Conversion	RSC at existing outfalls off of parking lot; downspout disconnection; landscape conversion
R-56	Riparian Zones	along stream	Landscape Conversion	some trees planted; opportunity to plant more trees

Stormwater Retrofit Opportunities on the UNC Charlotte Campus				
Retrofit ID	**Landscape Element**	**General Location**	**Opportunity**	**Comments**
R-57	Rooftops and Courtyards	Grigg Hall and Duke Centennial Hall	Functional Landscaping	Rooftop disconnection with planters or cisterns; courtyard treatment; lots of missed opportunities around all these buildings, but a lot of internal drainage.
R-58	Rooftops and Courtyards	East Deck 3	Rooftop Vegetation	underground parking garage treatment
R-59	Rooftops and Courtyards	East Deck 1 and 2	Rooftop Vegetation	underground parking garage treatment
R-60	Riparian Zones	Pond next to Brocker	Stormwater Pond or Wetland	existing pond, possible opportunities for improvement
R-62	Parking Lots		Functional Landscaping	Perimeter Bioretention; parking lot runoff treatment measure
R-63	Riparian Zones		Outfall Treatment	Regenerative Stormwater Conveyance; uncontrolled runoff will likely cause erosion problems over time
R-64	Riparian Zones		Stormwater Pond or Wetland	Stormwater Wetland; convert existing dry pond to more effective treatment practice.
R-66	Riparian Zones		Stream Rehabilitation	Regenerative Stormwater/Stream Conveyance; may need to be tied to larger stream restoration effort
R-68	Riparian Zones		Stream Rehabilitation	Dechannelize concrete channel; great opportunity with lots of space

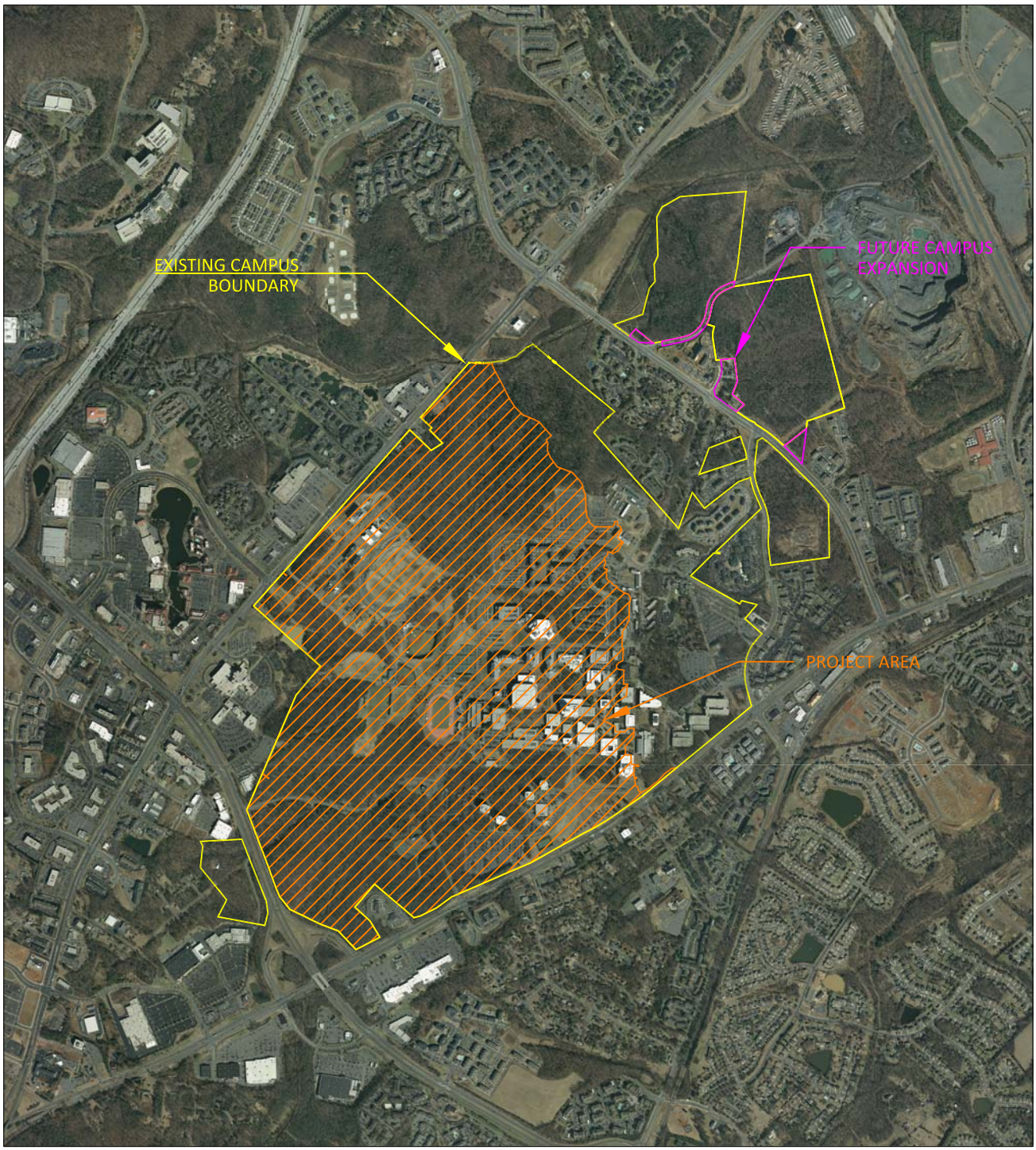
Stormwater Retrofit Opportunities on the UNC Charlotte Campus				
Retrofit ID	**Landscape Element**	**General Location**	**Opportunity**	**Comments**
R-69	Riparian Zones		Stream Rehabilitation	Regenerative Stream Conveyance; challenging reach that is being impacted. Exposed sewer line that is new is at risk.
R-71	Riparian Zones		Landscape Conversion	Buffer Reforestation; opportunities to expand much further than just a buffer. At a minimum require 30 feet on each side.
R-72	Riparian Zones		Landscape Conversion	Buffer Reforestation; opportunities to expand much further than just a buffer. At a minimum require 30 feet on each side.
R-73	Rooftops and Courtyards	Union Deck	Rooftop Vegetation	
R-74	Rooftops and Courtyards	West Deck	Rooftop Vegetation	
R-75	Rooftops and Courtyards	Cone Deck 1 and Cone Deck 2	Rooftop Vegetation	
R-76	Riparian Zones	Tennis courts outfall	Stormwater Pond or Wetland	large diameter HDPE pipe that can be truncated and open turf area used to provide treatment. May need flow splitter.

Appendix 2

MAPS AND TABLES

- **Map 1 – Project Area**
- **Map 2 – Impervious Area**

- **Table 1 – July 1, 2008 Impervious Area**
- **Table 2 – Campus Build-Out Impervious Area**
- **Table 3 – Tracking BMP Capacity in Watershed 1**



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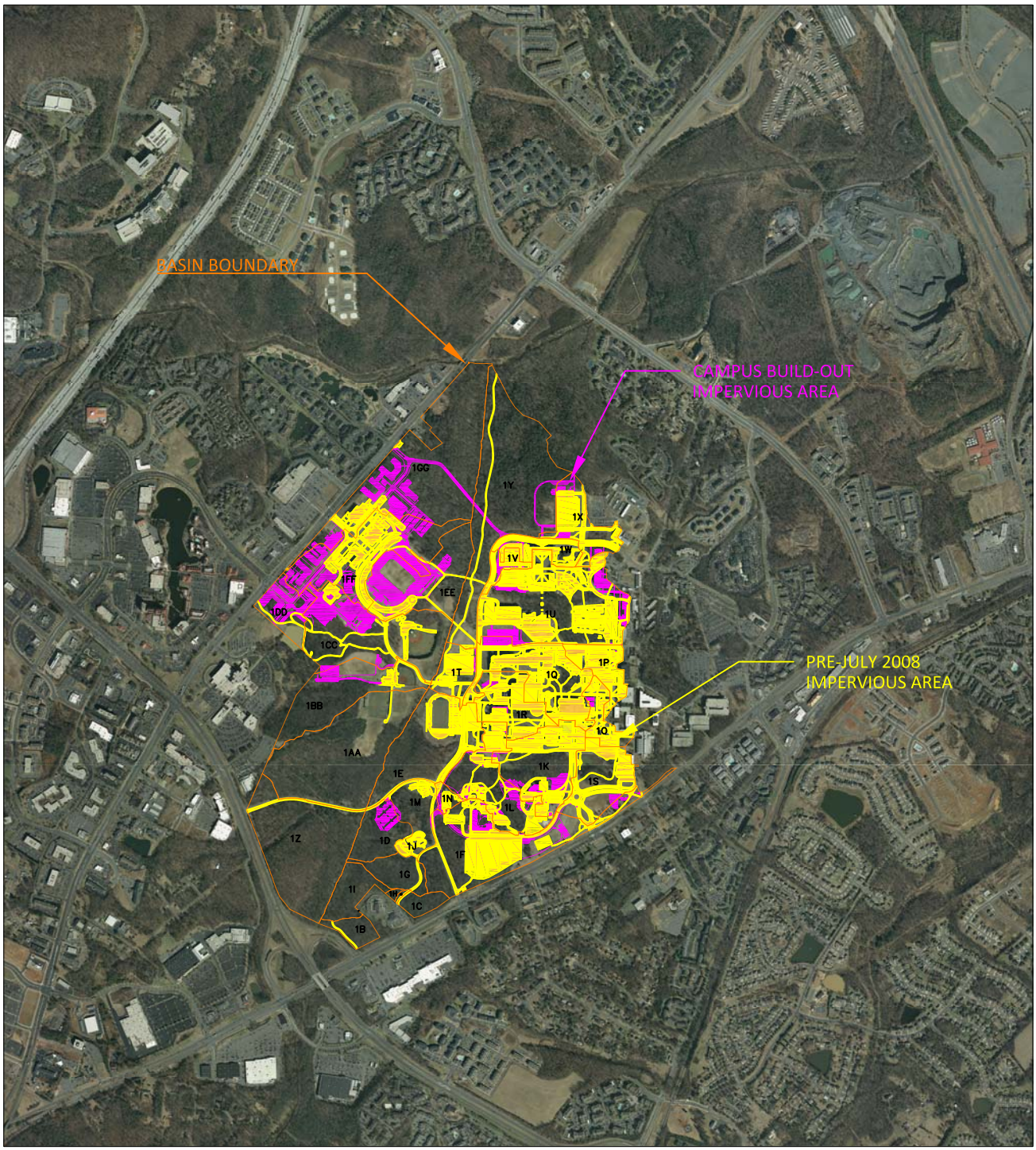
MAP 1
PROJECT AREA

1" = 2000'



MAP 2
IMPERVIOUS AREA

1" = 2000'

UNC Charlotte
Storm Water Master Plan Report
Table 1 - July 1, 2008 Impervious Area

BASIN	TOTAL AREA AC	IMPERVIOUS AREA AC	BUA %
1AA	41.74	0.29	0.70%
1B	4.31	0.16	3.80%
1BB	21.45	1.21	5.63%
1C	3.28	0.09	2.64%
1D	9.33	0.10	1.09%
1E	26.18	5.73	21.89%
1G	7.04	0.24	3.36%
1H	0.43	0.00	0.00%
1I	7.53	0.00	0.00%
1J	1.96	1.17	59.41%
1M	8.40	1.59	18.95%
1T	7.29	3.60	49.34%
1U	42.82	18.17	42.44%
1V	3.29	1.98	60.22%
1W	6.69	3.53	52.82%
1X	12.15	5.62	46.29%
1Y	49.40	1.19	2.41%
1Z	37.51	0.69	1.85%
1CC	33.94	2.98	8.77%
1DD	8.72	0.25	2.88%
1EE	24.09	1.98	8.22%
1FF	28.57	7.54	26.39%
1GG	51.89	2.37	4.56%
1P	8.30	6.39	77.00%
1O	6.18	3.49	56.49%
1Q	23.58	13.77	58.41%
1R	13.41	7.54	56.21%
1F	35.62	11.68	32.80%
1K	21.16	8.89	42.02%
1L	19.45	6.01	30.87%
1N	1.93	0.85	44.13%
1S	15.74	5.86	37.25%
TOTAL	583.39	124.97	21.42%
SOUTH VILLAGE	93.90	33.29	35.46%
CAMPUS CORE A	43.18	24.80	57.45%
CAMPUS CORE B	8.30	6.39	77.00%
CRI	147.22	15.12	10.27%

UNC Charlotte
Storm Water Master Plan Report
Table 2 - Campus Build-Out Impervious Area

BASIN	TOTAL AREA AC	IMPERVIOUS AREA AC	BUA %
1AA	41.74	0.29	0.70%
1B	4.31	0.16	3.80%
1BB	21.45	2.51	11.69%
1C	3.28	0.09	2.64%
1D	9.33	1.67	17.89%
1E	26.19	5.75	21.96%
1G	7.04	0.24	3.36%
1H	0.43	0.00	0.00%
1I	7.53	0.00	0.00%
1J	1.96	1.17	59.41%
1M	8.40	1.52	18.05%
1T	7.29	3.50	47.93%
1U	42.82	20.00	46.71%
1V	3.29	2.07	63.07%
1W	6.69	3.57	53.47%
1X	12.15	5.51	45.36%
1Y	49.40	2.46	4.99%
1Z	37.51	0.69	1.85%
1CC	33.94	9.19	27.08%
1DD	8.72	4.25	48.74%
1EE	24.09	9.13	37.89%
1FF	28.57	15.54	54.37%
1GG	51.89	10.23	19.72%
1P	8.30	5.99	72.20%
1O	6.18	3.65	59.02%
1Q	23.58	14.75	62.54%
1R	13.41	7.94	59.20%
1F	35.61	12.54	35.23%
1K	21.16	9.87	46.66%
1L	19.45	7.00	36.00%
1N	1.93	0.55	28.58%
1S	15.74	6.21	39.45%
TOTAL	583.37	168.04	28.80%
SOUTH VILLAGE	93.88	36.18	38.53%
CAMPUS CORE A	43.18	26.34	61.00%
CAMPUS CORE B	8.30	5.99	72.20%
CRI	147.22	48.34	32.83%

Table 3 - Tracking BMP Capacity in Watershed 1

			Impervious Area			
BMP	Basin	Drainage Area acres	Pre-Development acres	Build-Out acres	Compensatory Treatment acres	Treatment Capacity Used acres
9	1K	21.16	8.89	9.87	8.89	0.98
	1S	15.74	5.86	6.21	5.86	0.35
10	1DD	8.72	0.25	4.25	0.25	4.00
11	1FF	28.57	7.54	15.54	7.54	8.00
12	1GG	51.89	2.37	10.23	2.37	7.86
			Total	46.10	24.91	21.19

Appendix 3

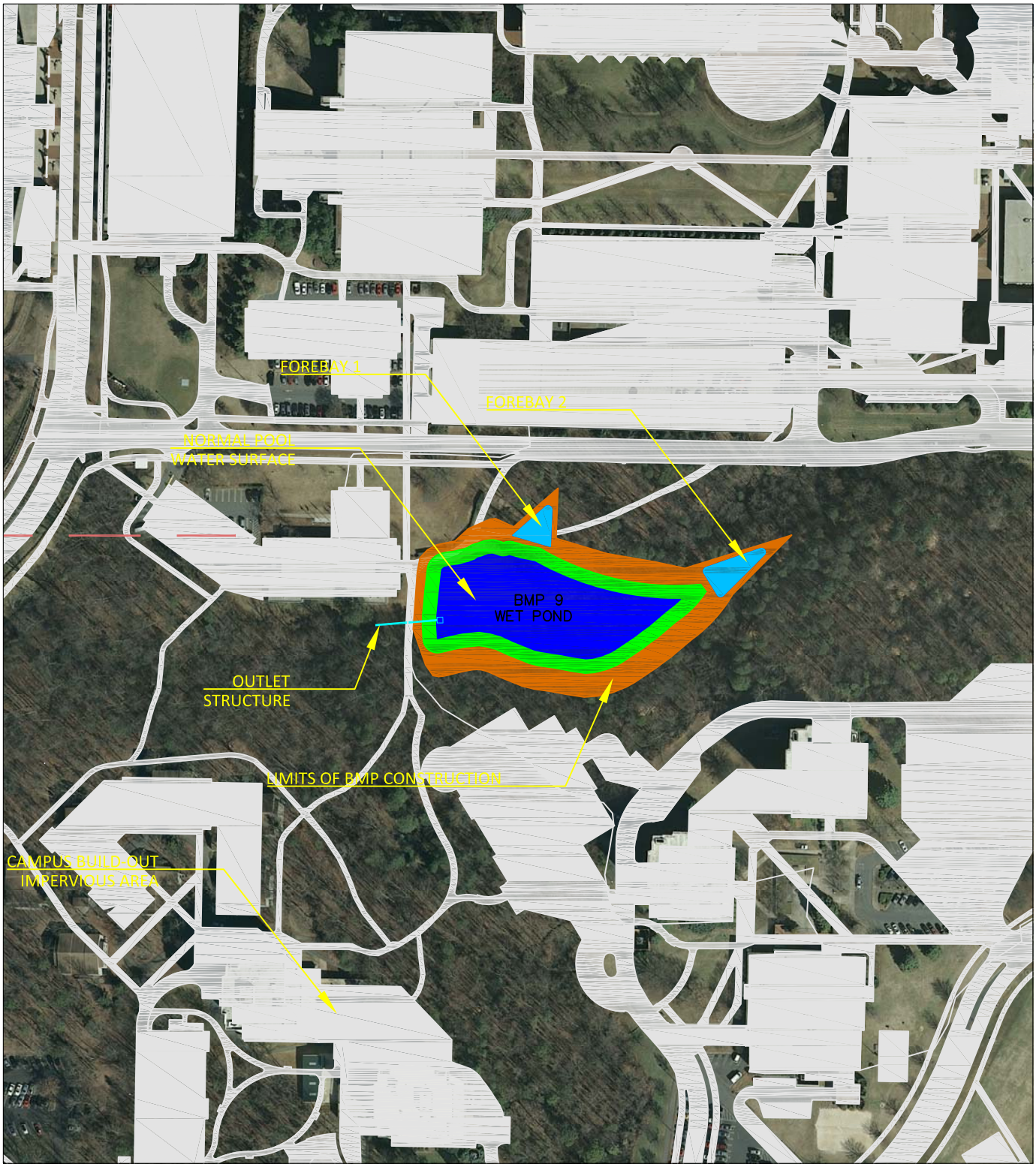
SCHEMATIC DESIGN

- **MAPS**
  - **BMP 9 – Schematic Plan**
  - **BMP 10 – Schematic Plan**
  - **BMP 11 – Schematic Plan**
  - **BMP 12 – Schematic Plan**

- **TABLES**
  - **Table 4 - BMP Summary**
  - **Table 5 - Outlet Structure Summary**

- **WET DETENTION POND SIZING WORKSHEETS**
  - **BMP 9 (1K & 1S)**
  - **BMP 10 (1DD)**
  - **BMP 11 (1FF)**
  - **BMP 12 (1GG)**

- **STORM WATER FEE CREDITS**
  - **BMP 9 (1K & 1S)**
  - **BMP 10 (1DD)**
  - **BMP 11 (1FF)**
  - **BMP 12 (1GG)**



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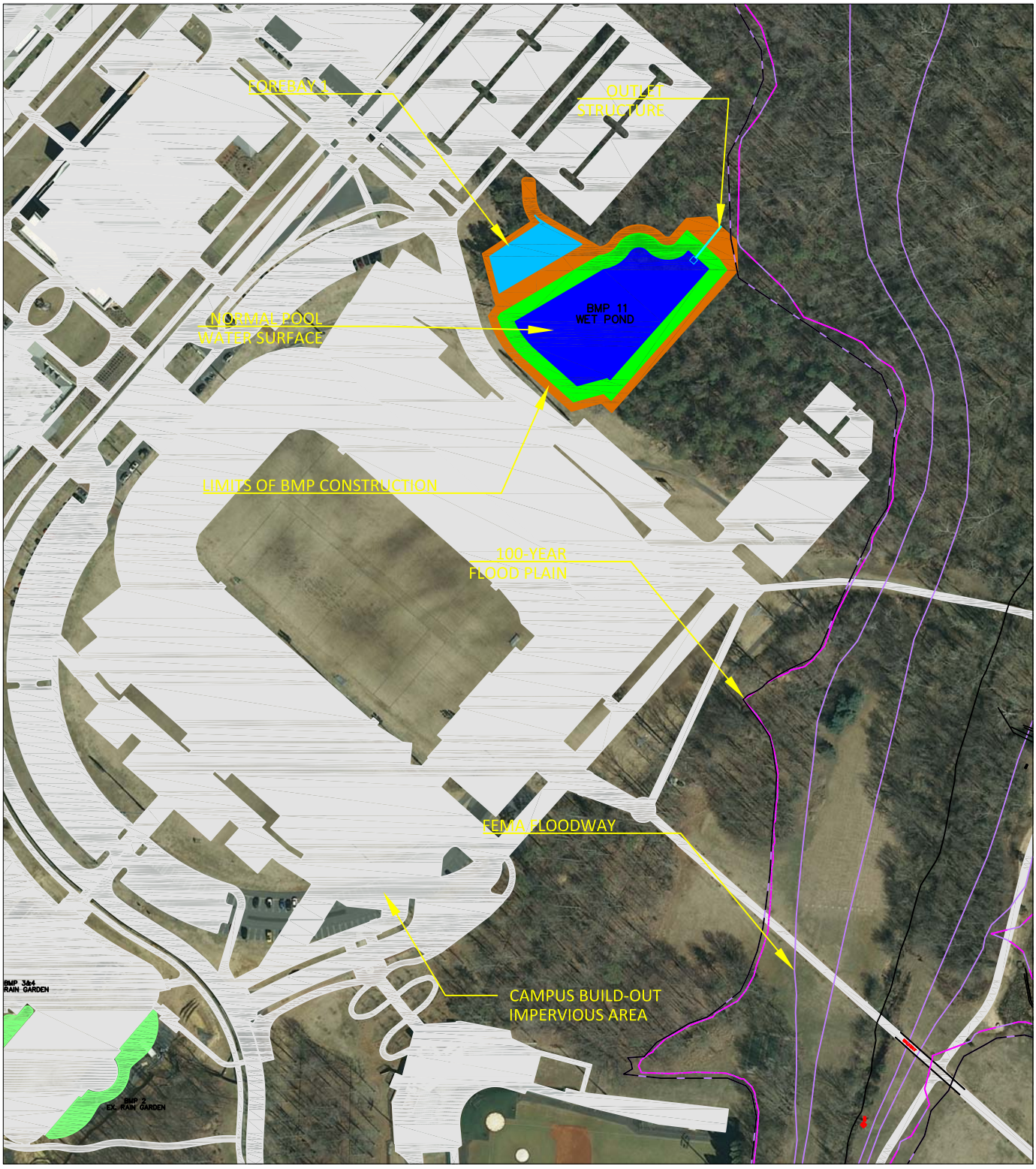
BMP 9
SCHEMATIC PLAN

1" = 200'

N

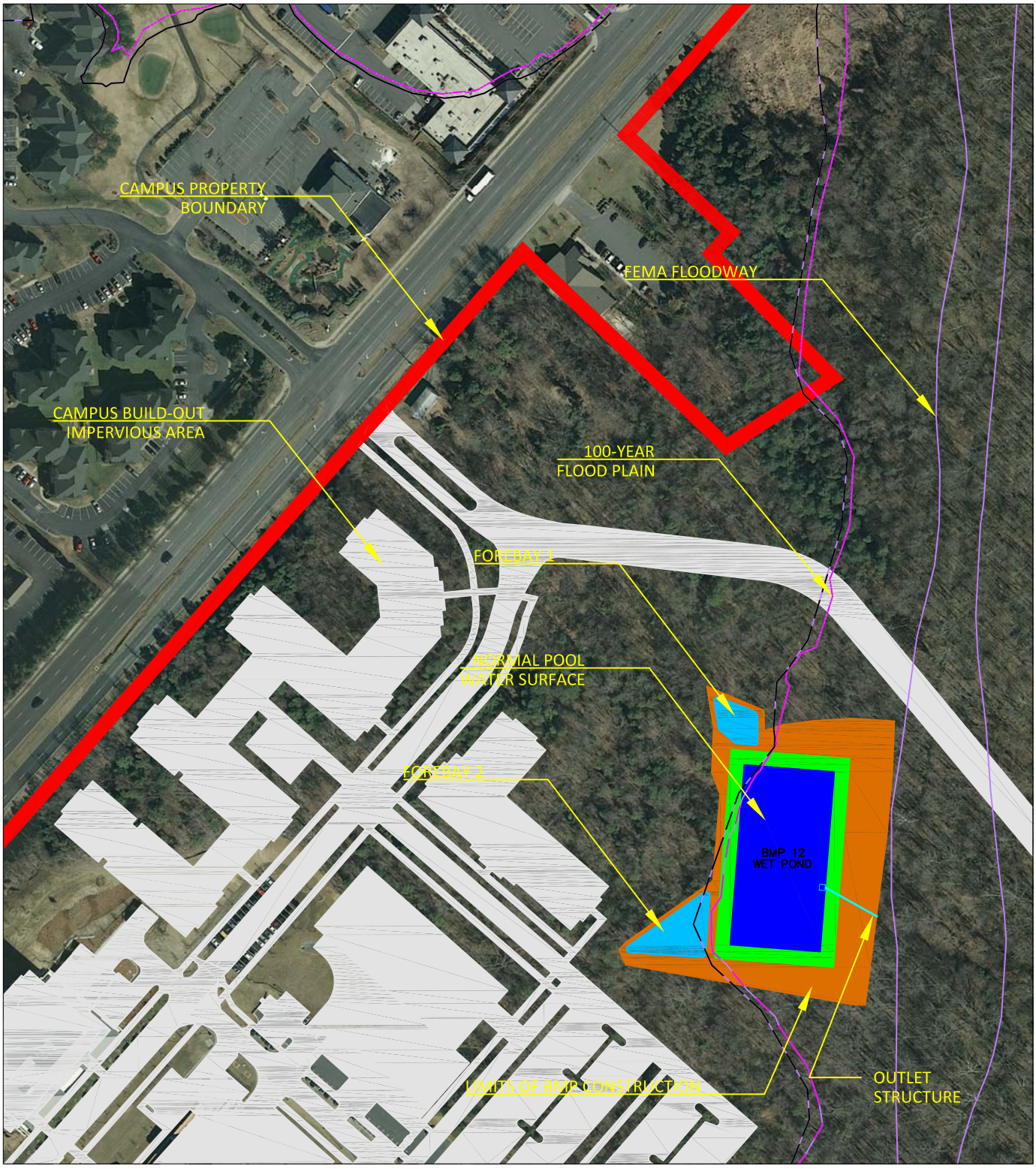
BMP 10
SCHEMATIC PLAN

1" = 200'



BMP 11
SCHEMATIC PLAN

1" = 200'



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BMP 12
SCHEMATIC PLAN

1" = 200'

STEWART

Table 4 - BMP SUMMARY

STRUCTURE	DESCRIPTION	EXISTING	PROPOSED	CATCHMENT	TRIBUTARY AREA (AC)	IMPERVIOUS AREA (AC) EXISTING	IMPERVIOUS AREA (AC) FUTURE	WATER QUALITY PROVIDED	CHANNEL PROTECTION PROVIDED	DETENTION PROVIDED 2 YEAR	DETENTION PROVIDED 10 YEAR
BMP1	SAND FILTER	✓		1CC	1.10	1.10	0.00	✓			
BMP2	RAIN GARDEN	✓		1CC	1.07	0.83	0.00	✓		✓	✓
BMP3	RAIN GARDEN	✓		1CC	0.25	0.18	0.00	✓		✓	✓
BMP4	RAIN GARDEN	✓		1CC	0.31	0.26	0.00	✓		✓	✓
BMP5	U/G DET	✓		1CC	1.10	1.10	0.00			✓	✓
BMP6	WET POND	✓		1S		THE TRIBUTARY AREA ASSOCIATED WITH BMP 6 IS ADDRESSED WITH BMP 9.					
BMP7	WET POND	✓		1K		THE TRIBUTARY AREA ASSOCIATED WITH BMP 7 IS ADDRESSED WITH BMP 9.					
BMP8	WET POND	✓		1F	3.68 (1)	2.53	0.00	✓	✓	✓	✓
BMP9	WET POND		✓	1K & 1S	36.90	15.04	16.08	✓	✓	✓	✓
BMP10	WET POND		✓	1DD	24.72	8.28	11.11	✓	✓	✓	✓
BMP11	WET POND		✓	1FF	26.65	16.58	20.30	✓	✓	✓	✓
BMP12	WET POND		✓	1GG	25.85	7.70	12.20	✓	✓	✓	✓

NOTES:
1. This area represents a portion of subcatchment 1F.

Table 5 - OUTLET STRUCTURE SUMMARY

STRUCTURE	RISER TYPE	RISER SIZE	RISER HEIGHT	ORIFICE SIZE	ORIFICE ELEVATION	OUTLET PIPE
BMP9	PRE-CAST CONCRETE VAULT	4' X 8'	+1.60'	3.2"	0.00'	60" RCP
BMP10	PRE-CAST CONCRETE VAULT	4' X 4'	+1.00'	3.3"	0.00'	36" RCP
BMP11	PRE-CAST CONCRETE VAULT	4' X 4'	+2.00'	3"	0.00'	48" RCP
BMP12	PRE-CAST CONCRETE VAULT	4' X 4'	+1.20'	3:00	0.00'	36" RCP

Wet Detention Pond Sizing BMP 9
(for 85% TSS removal)

Project: UNCC MS-4 1K & 1S
Number: X11024.00
Date: 10-Apr-12

Forebay Sizing

Total Drainage Area =	36.90	ac
Total Impervious Area =	16.08	ac
Percent Impervious =	44%	
Design Rainfall Depth =	0.2	in
Max. Perm. Pool Depth =	6	ft
Volume Required =	**11674**	**cu-ft**
=	**0.27**	**ac-ft**

Water Quality Volume (WQv)

Simple Method

Rv = 0.05 + 0.009(I)

I = % impervious =	44%	
Rainfall Depth =	1	in
Rv =	0.44	in
Volume =	**1.36**	**ac-ft**
=	**59231**	**cu-ft**
5% of Volume =	**0.068**	**ac-ft**

Comput Modified CN

P =	1.00	
WQv =	0.44	in
Modified CN (CNm) =	**92.84**	

Channel Protection Volume (CPv)

CN =	84.00	
S =	1.90	in
P =	2.58	in
Qd =	1.18	in
CPv =	**3.62**	**ac-ft**
CPv =	**157839**	**cu-ft**
5% of Volume =	**0.18**	**ac-ft**

Desired Surface Area

Total Drainage Area =	36.90	ac
Total Impervious Area =	16.08	ac
Percent Impervious =	44%	
Design Rainfall Depth =	1	in
Max. Perm. Pool Depth =	4	ft
SA/DA Ratio =	1.5	
Surface Area Required =	**24110**	**sf**
=	**0.55**	**ac**

PONDPACK RESULTS

Storm	PRE		POST	
	FLOW	VOLUME	FLOW	VOLUME
1"-6 Hour			0.32	1.296
1Yr-24 Hour	40.16	3.56	8.86	3.491
2Yr-6 Hour	42		10.47	
10Yr-6 Hour	92.16		94.92	

Flow in CFS
Volume in ac-ft

Wet Detention Pond Sizing BMP 10
(for 85% TSS removal)

Project: UNCC MS-4 1DD
Number: X11024.00
Date: 10-Apr-12

Forebay Sizing

Total Drainage Area =	24.72	ac
Total Impervious Area =	11.11	ac
Percent Impervious =	45%	
Design Rainfall Depth =	0.2	in
Max. Perm. Pool Depth =	6	ft
Volume Required =	**8066**	**cu-ft**
=	**0.19**	**ac-ft**

Water Quality Volume (WQv)

Simple Method

Rv = 0.05 + 0.009(I)

I = % impervious =	45%	
Rainfall Depth =	1	in
Rv =	0.45	in
Volume =	**0.94**	**ac-ft**
=	**40783**	**cu-ft**
5% of Volume =	**0.0468**	**ac-ft**

Comput Modified CN

P =	1.00	
WQv =	0.45	in
Modified CN (CNm) =	**93.08**	

Channel Protection Volume (CPv)

CN =	82.00	
S =	2.20	in
P =	2.58	in
Qd =	1.06	in
CPv =	**2.18**	**ac-ft**
CPv =	**94859**	**cu-ft**
5% of Volume =	**0.11**	**ac-ft**

Desired Surface Area

Total Drainage Area =	24.72	ac
Total Impervious Area =	11.11	ac
Percent Impervious =	45%	
Design Rainfall Depth =	1	in
Max. Perm. Pool Depth =	4	ft
SA/DA Ratio =	1.5	
Surface Area Required =	**16152**	**sf**
=	**0.37**	**ac**

PONDPACK RESULTS

Storm	PRE		POST	
	FLOW	VOLUME	FLOW	VOLUME
1"-6 Hour			0.25	0.884
1Yr-24 Hour	29.77	2.168	3.7	2.075
2Yr-6 Hour	31.3		4.68	
10Yr-6 Hour	70.53		29.66	

Flow in CFS
Volume in ac-ft

Wet Detention Pond Sizing BMP 11
(for 85% TSS removal)

Project: UNCC MS-4 1FF
Number: X11024.00
Date: 10-Apr-12

Forebay Sizing

Total Drainage Area =	26.65	ac
Total Impervious Area =	20.30	ac
Percent Impervious =	76%	
Design Rainfall Depth =	0.2	in
Max. Perm. Pool Depth =	6	ft
Volume Required =	**14738**	**cu-ft**
=	**0.34**	**ac-ft**

Water Quality Volume (WQv)

Simple Method

Rv = 0.05 + 0.009(I)

I = % impervious =	76%	
Rainfall Depth =	1	in
Rv =	0.74	in
Volume =	**1.63**	**ac-ft**
=	**71157**	**cu-ft**
5% of Volume =	**0.0817**	**ac-ft**

Comput Modified CN

P =	1.00	
WQv =	0.74	in
Modified CN (CNm) =	**97.37**	

Channel Protection Volume (CPv)

CN =	92.00	
S =	0.87	in
P =	2.58	in
Qd =	1.77	in
CPv =	**3.93**	**ac-ft**
CPv =	**170973**	**cu-ft**
5% of Volume =	**0.20**	**ac-ft**

Desired Surface Area

Total Drainage Area =	26.65	ac
Total Impervious Area =	20.30	ac
Percent Impervious =	76%	
Design Rainfall Depth =	1	in
Max. Perm. Pool Depth =	4	ft
SA/DA Ratio =	1.5	
Surface Area Required =	**17413**	**sf**
=	**0.40**	**ac**

PONDPACK RESULTS

Storm	PRE		POST	
	FLOW	VOLUME	FLOW	VOLUME
1"-6 Hour			0.72	1.534
1Yr-24 Hour	43.75	3.374	13.46	3.731
2Yr-6 Hour	47.85		14.99	
10Yr-6 Hour	91.08		58.49	

Flow in CFS
Volume in ac-ft

Wet Detention Pond Sizing BMP 12
(for 85% TSS removal)

Project: UNCC MS-4 1GG
Number: X11024.00
Date: 10-Apr-12

Forebay Sizing

Total Drainage Area =	25.85	ac
Total Impervious Area =	12.20	ac
Percent Impervious =	47%	
Design Rainfall Depth =	0.2	in
Max. Perm. Pool Depth =	6	ft
Volume Required =	**8857**	**cu-ft**
=	**0.20**	**ac-ft**

Water Quality Volume (WQv)

Simple Method

Rv = 0.05 + 0.009(I)

I = % impervious =	47%	
Rainfall Depth =	1	in
Rv =	0.47	in
Volume =	**1.02**	**ac-ft**
=	**44549**	**cu-ft**
5% of Volume =	**0.0511**	**ac-ft**

Comput Modified CN

P =	1.00	
WQv =	0.47	in
Modified CN (CNm) =	**93.47**	

Channel Protection Volume (CPv)

CN =	85.00	
S =	1.76	in
P =	2.58	in
Qd =	1.24	in
CPv =	**2.68**	**ac-ft**
CPv =	**116591**	**cu-ft**
5% of Volume =	**0.13**	**ac-ft**

Desired Surface Area

Total Drainage Area =	25.85	ac
Total Impervious Area =	12.20	ac
Percent Impervious =	47%	
Design Rainfall Depth =	1	in
Max. Perm. Pool Depth =	4	ft
SA/DA Ratio =	1.5	
Surface Area Required =	**16890**	**sf**
=	**0.39**	**ac**

PONDPACK RESULTS

Storm	PRE		POST	
	FLOW	VOLUME	FLOW	VOLUME
1"-6 Hour			0.24	0.96
1Yr-24 Hour	38.82	2.15	6.45	2.55
2Yr-6 Hour	47.22		7.81	
10Yr-6 Hour	103.60		45.04	

Flow in CFS
Volume in ac-ft

UNC Charlotte Storm Water Managment
Master Plan
Storm Water Fee Credit Worksheets

BMP 9

	Impervious Area Acres	10y/6hr Peak Flow cfs	2y/6hr Volume acre-ft
Pre-Developed	0	53.04	1.286
With Controls	I2	53.96	2.845
Developed	16.08	92.97	2.916

I2 - Peak	I2 - Volume
0.370	15.380
97.70%	4.36%

Credit	42%

Monthly Fee	$ 2,340.44
Discounted Fee	$ 1,364.67
Monthly Savings	$ 975.78

UNC Charlotte Storm Water Managment
Master Plan
Storm Water Fee Credit Worksheets

BMP 10

	Impervious Area Acres	10y/6hr Peak Flow cfs	2y/6hr Volume acre-ft
Pre-Developed	0	46.2	0.933
With Controls	I2	36.37	2.013
Developed	11.11	79.13	2.072

I2 - Peak	I2 - Volume
0.000	10.535
100.00%	5.18%

Credit	43%

Monthly Fee	$ 1,617.06
Discounted Fee	$ 919.98
Monthly Savings	$ 697.08

UNC Charlotte Storm Water Managment
Master Plan
Storm Water Fee Credit Worksheets

BMP 11

	Impervious Area Acres	10y/6hr Peak Flow cfs	2y/6hr Volume acre-ft
Pre-Developed	0	43.58	0.929
With Controls	I2	58.49	3.21
Developed	20.3	99.93	3.31

I2 - Peak	I2 - Volume
5.371	19.447
73.54%	4.20%

Credit	32%

Monthly Fee	$ 2,954.67
Discounted Fee	$ 2,011.06
Monthly Savings	$ 943.60

UNC Charlotte Storm Water Managment
Master Plan
Storm Water Fee Credit Worksheets

BMP 12

	Impervious Area Acres	10y/6hr Peak Flow cfs	2y/6hr Volume acre-ft
Pre-Developed	0	70.23	0.976
With Controls	I2	45.04	2.095
Developed	12.2	121.25	2.167

I2 - Peak	I2 - Volume
0.000	11.462
100.00%	6.05%

Credit	44%

Monthly Fee	$ 1,775.71
Discounted Fee	$ 1,001.02
Monthly Savings	$ 774.69