WITHERS & RAVENEL

LOW IMPACT DEVELOPMENT CASE STUDY

Carolina Colours Commercial Shopping Center New Bern, North Carolina

Prepared For:

THE NORTH CAROLINA COASTAL FEDERATION
3609 NC 24
Newport, NC 28570
Attn : Todd Miller

SWAIN & ASSOCIATES
1121 Military Cutoff Road, Suite P
Wilmington, NC 28405
Attn : Claude Arnold

Prepared By:
WITHERS & RAVENEL, INC
115 MacKenan Drive
Cary, North Carolina 27511

April 2014
W&R Project No. 2070655.10

Highlights

Low Impact Development (LID) uses decentralized stormwater management measures to maintain the functional capacity of a landscape to infiltrate and convey runoff. These measures protect or replicate the natural hydrology of property, and attempt to manage runoff as close to its source as possible. Scientific studies and water quality monitoring indicate that LID provides better water quality protection than conventional stormwater management measures, and it is frequently more cost-effective because it allows for more efficient use of land and reduces the amount of infrastructure construction necessary to convey and treat stormwater.

Actual market experience with LID measures, especially in large-scale commercial development, is lacking in eastern N.C. This project was financed by the Environmental Enhancement Grants program administered by the N.C. Attorney General to evaluate the advantages of using LID in commercial developments. An experienced and successful commercial developer served as the "client" for this project, and allowed existing development plans for a designed, permitted, and partially constructed shopping center to be used as the basis for evaluating the use of LID measures as an alternative to a conventional stormwater management design.

The property used for this project provides a real life example of a commercial project that was sited based upon projected market demands in a location that had challenging site conditions for stormwater management. Poorly draining soils limit the options for using LID measures at this site, and the fact that the project layout could not be economically changed, made this a very challenging site to design an LID stormwater management system. All this means that if LID proves to be a viable option at this site, it is likely to work just about anywhere.

Findings:

Even with the challenges imposed by the poorly drained soils at this site as well as the fact that the project's basic layout was already mostly pre-determined before conceptual stormwater designs were considered, LID measures still proved to be a cost-effective alternative to a conventional stormwater measures. This favorable comparison results from the fact that the LID design provides for a 16.7 percent increase in buildable area by using landscaped areas more effectively for stormwater treatment. This reduces the amount of land that is used by conventional stormwater measures such as the constructed wetland in the approved design. Largely because of the poor soils on the site, the actual cost of the LID stormwater treatment systems is $200,000 more than the projected cost of the conventional treatment systems (which was estimated to be $2 million), however, gaining valuable additional land for development serves to offset those increased costs.

Better soils and the opportunity to design the shopping center from the outset using a LID design would result in significant cost-savings in building a stormwater management system. The operation and maintenance costs for LID systems compared to conventional systems for commercial developments of this nature tend to be about the same. Therefore, this case study helps to demonstrate that LID stormwater management systems are economically viable for commercial development projects in eastern N.C. Given that such systems have been shown to provide better water quality protection, this case study indicates that LID is a prudent affordable strategy to protect coastal water quality for fishing, shellfishing and swimming in eastern N.C.

Introduction

The N.C. Coastal Federation received a grant from the Environmental Enhancement Grants Program that is administered by the N.C. Attorney General Roy Cooper to promote the use of Low Impact Development (LID) techniques in coastal North Carolina. The Federation partnered with Swain & Associates, a commercial land development firm located in Wilmington, and Withers & Ravenel, a civil engineering firm based in Cary, to compare the costs and use of LID with conventional stormwater treatment measures. Swain & Associates provided site and stormwater engineering plans for a previously approved shopping center in New Bern. Withers & Ravenel used these plans as the basis of comparison between LID and non-LID land use options.

Withers & Ravenel developed a conceptual LID plan for the site that incorporated the design criteria established by Swain & Associates. The conceptual plan conforms with existing ordinances, regulations, policies, and developer agreements applicable to the site. The stormwater analysis uses accepted engineering methods for analysis and permitting of stormwater best management practices (BMP's) and LID techniques.

Development of the LID plan was an iterative process taking into account the needs of various groups relevant to the project. Input was gathered from the Federation, Swain & Associates, and stormwater regulators from the North Carolina Division of Water Quality. While Withers & Ravenel led the redesign of the shopping center's stormwater management plan, innovative concepts were discussed and vetted with the group. The viability of each design concept was analyzed based on its compatibility with the site plan, preference of potential commercial tenants, safety concerns, maintenance requirements, permit compliance, constructability, and innovation. The LID plan was developed over a 12-month period. Three project team meetings were held in Wilmington North Carolina, with additional correspondence between stakeholders over email, phone calls throughout the plan development process.

This case study compares the short and long term costs of using LID as opposed to the traditional end of pipe stormwater system. By studying the impact of LID on initial construction costs and land availability, we hope to better understand the viability of widespread LID implementation for commercial land developers.

Need for LID Measures

The cost of complying with stormwater regulations continues to increase as stormwater regulations evolve in response to continued degradation of coastal water quality. LID practices are a potential solution to both water quality and cost problems. Eliminating the use of large end of pipe treatement devices such as stormwater ponds and spreading stormwater runoff from the built environment to several smaller treatment devices more closely restores the hydrology of a site to its natural state, and reduces impacts of land use change on nearby surface waters, and wetlands.

The use of large end of pipe treatment systems requires that stormwater water be quickly conveyed to a centralized area such as a stormwater pond. This means that water is detained for long periods of time at the end of the closed pipe system, which concentrates pollutants and bypasses the functional capacity of most land to absorb and soak up rainfall. LID techniques aim to slow the water down and take advantage of the infiltration capacity and surface area of the site, reconnecting the rainfall to the subsurface aquifer.

When properly implemented, LID also results in more efficient land use by incorporating stormwater management into landscaped areas of a development site. For example, rain gardens can be incorporated into parking lot islands, which are required by local ordinance. Rather than requiring irrigation, these depressed landscaped areas accept stormwater runoff, allowing a portion of the runoff to percolate into the ground while also minimizing the use of hardened infrastructure such as catch basins and concrete curbs.

LID devices are spread throughout a development site. Their combined capacity to treat and dispose of stormwater allow them to take the place of much larger treatment devices that consume a lot of space in a development. Larger BMP's such as ponds are also potential safety hazards, often requiring fences or other barriers, thereby limiting their use as a site amenity. Due to their smaller size, LID measures are a reduced health hazard so they can be placed closer to residences and businesses, in some instances underneath or atop these structures. Many local and state agencies are continue to identify and eliminate regulatory barriers to using LID practices as a means of meeting state and local environmental standards. Economic savings associated with using LID measures compared to conventional stormwater treatment provide an incentive to developers who adopt and implement LID techniques as the primary means of compliance with stormwater rules.

Project Description Conventional Stormwater Plan

The 30.76 acre project site is located 5.5 miles southeast of New Bern, North Carolina on the west side of US-70. It is south of the intersection with West Thurman Road. The shopping center tract is part of a larger master plan for the 1,800-acre Carolina Colours mixed use development. A portion of the infrastructure for Carolina Colours has already been constructed, including Waterscape Way and the conventional stormwater management device which will serve the shopping center.

The site drains to Brice Creek (Index # 27-101-40-(1)), which is classified at "C, Sw, NSW". Brice Creek is part of the Neuse River Basin. Stormwater permitting is governed by ordinances of the City of New Bern and the N.C. Department of Environment and Natural Resources. Although there is overlap in some regulations, the City's ordinances generally pertain to flood control measures, while state regulations apply to water quality, riparian buffer protection, and nutrient management.

City ordinances require that developments control the peak flow resulting from the 10-year, 24 -hour storm to predevelopment levels. The 10-year storm is also known as the 10 percent annual chance event, meaning it has a 10 percent chance of happening every year. By reducing the developed 10-year storm flows to pre-development conditions, the stormwater impoundment in turn reduces peak flows from storm events with higher probabilities which are the storms that contribute to most stream erosion and water quality impairment. Because the site drains to class C waters, state stormwater rules at the time of permit approval required that stormwater best management practices be used to control and treat the runoff from all impervious surfaces generated by the first 1 inch of rainfall. The site lies within the Neuse River Basin, and because the City of New Bern is part of the Neuse River Basin Nutrient Management Strategy (15A NCAC 02B.0235), the developer is required to reduce nitrogen loading rates to 3.60 lbs/acre/year through the use of onsite measures and/or mitigation fees. At the time of the project kickoff meeting, stormwater permits had been acquired for full buildout of the 25.64 acre tract from the City of New Bern as well as the NC Division of Water Quality.

The site had been clear-cut within the past 10 years (estimated) resulting in an existing land cover of limited tree growth consisting mainly of small pine trees and undergrowth. The site is generally flat with slopes of less than 1 percent. Existing agricultural ditches run from the northwest corner to the southeast corner of the property. The native underlying soils consist of Grantham silt loams, which are HSG D soils. There are no wetlands on the property north of the main access road. South of Waterscape Way there is a small pocket of jurisdictional wetlands near the intersection with Carolina Colors Parkway.

The soils report indicates that static water table was encountered at a depth of approximately 7 feet below existing grades, and that 1 to 2 foot fluctuations in water table are common in the coastal plain of North Carolina. For conservative purposes, the seasonal high water table was assumed to be 3' below existing grades.

Approved Site Plans

The approved grading plan indicates that all site drainage was to be directed to the south, crossing under the Waterscape Way through twin 54-inch pipes and emptying into one constructed wetland BMP. The five-acre wetland was designed to meet the nutrient and sediment reduction requirements of the N.C. Coastal Stormwater rules and additional peak attenuation requirements of the City of New Bern. The existing site plan consists of approved construction plans for development of the shopping center and associated parking, roads, and infrastructure. The shopping center includes the proposed anchor tenant building with attached retail space. The stormwater BMP was designed and constructed for full build out of all anchor tenant buildings, parking lots, and out parcels.

The post development drainage area to the constructed wetland stormwater BMP is 24.90 acres and contains 18.68 acres of allowable impervious cover. A portion of the impervious area has been allocated across seven proposed commercial sites without detailed site layouts. Construction documents are only available for the large anchor tenant site. The plans include buildings for a proposed grocery store with attached retail units, parking lots, roadways, sidewalks, landscaping, and associated infrastructure.

The stormwater BMP has a normal pool area of approximately 74,000 square feet and is located within a five-acre stormwater easement on the east side of Waterscape Way. The wetland ponded water surface area increases to an area of approximately 125,000 square feet when it is full during the 100-year 24-hour storm. The remaining land area used by the wetland consists of grading and earthwork associated with the impoundment, dam, and outlet structure.

LID Design and Permitting Overview

LID permitting is governed by the same rules as conventional stormwater management plans. To show hydrologic matching, LID stormwater plans utilize infiltration, evapotranspiration, and water re-use to mitigate the increase in runoff volume that occurs as pervious land uses are converted to impervious land uses. LID plans usually leverages a treatment train of numerous BMPs and stormwater treatment processes, including infiltration, plant uptake, filtration, sedimentation, and re-use. The state allows for use of the SCS Curve Number method to determine anticipated surface runoff volumes in response to a design rainfall event on Low Impact Development sites.

Calculations were completed using the a beta version of STORM-EZ, a spreadsheet model developed by Withers & Ravenel for documenting hydrologic matching for development projects anywhere in the State of North Carolina. Rainfall depths for the 1-year, 2-year, 5-year, 10-year, 50-year, and 100-year 24 hour storm events were updated based on NOAA Atlas 14 data from New Bern Airport.

The spreadsheet model compares pre-development and post-development runoff volumes for each storm event based on land use inputs provided by the user, and also reports on the fate of rainfall to illustrate whether pre and post development runoff is expected to be converted into infiltration, evapotranspiration, filtered outflow, treated outflow, or untreated surface flow. Predevelopment land use was assumed to be woods in good condition. Post development land uses are based on the approved site plan, which was then modified to incorporate LID practices. The spreadsheet quantifies the anticipated impact of structural and non structural stormwater control measures on stormwater quality and quantity.

Many conventional and LID practices rely on underlying soils to control or reduce runoff volumes. The success of these measures is highly dependent on maintaining adequate storage volume and separation from the seasonal high water table. This is because if the ground water level is higher then there is less soil storage capacity for the stormwater runoff to occupy when infiltrating. Based on soil borings, the water table was estimated to be approximately 7 feet below existing grades with a potential for up to 2 feet of vertical fluctuation. For the purposes of this case study, a seasonal high water table depth of 3 feet was chosen as a conservative value to ensure the viability of the proposed LID measures.

LID Strategy and Implementation Plan

The LID redesign began with an assessment of the existing conditions, with a focus on soil types and natural drainage patterns. In order to accommodate LID practices and reduce the dependency on piped stormwater conveyances, outparcels and parking lot configurations were modified. The location and layout of the anchor tenant was not changed significantly, and all modifications were reviewed by Swain & Associates to ensure compatibility with development goals and general commercial tenant requirements. Due to the high density nature of the site and local building practices, there was no effort to incorporate conservation areas, parking decks, or multi-story buildings.

Site Layout

On many sites it is beneficial to locate impervious surfaces on the poorly drained soils while preserving the better soils in order to minimize the change in runoff volume between natural and developed conditions. Because there is only one soil type on site, there is little or no benefit to revising the general location of impervious surfaces on the site.

The flat grades on the existing site and lack of elevation change between the proposed buildings and the normal pool elevation of the constructed wetland resulted in low slopes on the proposed pipe network. In the approved plan, pipe slopes generally range between 0.07 percent and 0.35 percent. To accommodate the design flows at such a low slope, large pipe sizes are needed. The approved drainage plan routed all runoff to the proposed constructed wetland east of Waterscape Way. The agricultural ditch outfall on the western edge of the property was eliminated. The LID plan aimed to minimize grading and reduce required pipe sizes by using the western stormwater outfall. To comply with State requirements, a stormwater BMP is required prior to discharging runoff from impervious surfaces. The LID option proposes a one-acre stormwater wetland on the west side of the site. The use of this outfall results drainage divide running through the middle of the site, leading to reduced pipe sizes and lengths for the storm sewer network.

In an effort to further reduce the infrastructure costs, the grocery store building was moved approximately 10 feet to the east. This shift allowed for the installation of the vegetated swale behind the loading dock areas. Because of the loading dock trench drain, a small pipe system is still required behind the building. The building shift eliminated one row of parking from the front of the store. These parking spots were regained by reconfiguring the parking lot. This is described in more detail below.

Vegetated Swales

The parking lot was reconfigured to add vegetated storage areas without hampering traffic flow or limiting parking spaces. The resulting parking lot did relocate Outparcel 2, however the net parking count increased. The LID techniques below were all proposed in an effort to treat stormwater within landscaped areas of the parking field.

- Tree box filters were added to the plaza area immediately in front of the building. The filters consist of a 3' deep layer of high flow media. The planters allow for shallow ponded water during rainfall events but limit the amount of surface flow across the paved areas immediately in front of the building. The planters filter water through an engineered soil layer, allowing for vegetative uptake, filtration of pollutants, and removal of bacteria, nutrients, and suspended solids. The porosity of the soil matrix is approximately 40% which allows each tree box to store 1.2 cubic feet of water per square foot of surface area.
- Vegetated swales were incorporated into the parking lot to serve as a conveyance channel and storage area. The swales reduced the dependence on piped infrastructure while also providing

for temporary detention of storm flows. The swales aid in improving water quality and peak flow reduction.

- A wetland swale was added between the parking lot and Waterscape Way. Like the vegetated swales in the parking lot, the wetland swale aids in reducing infrastructure needs while also providing water quality and flood control benefits. The wetland vegetation within the swale also adds to the pollutant reduction capabilities of the swale compared to a typical grassed system.

Pervious Pavement

Parking spaces in the proposed parking lot were converted to pervious concrete with a 12 inch thick gravel base layer underneath. The design allows for infiltration of rainwater through the surface to the gravel bed below, where the water is then slowly discharged into the drainage system via perforated underdrains. Due to the underlying soil types, the system is designed as an underground detention system only, with no volume reduction gained from infiltration. The drainage system in the parking lot serves as the overflow protection measure. Should the pervious pavement gravel layer fill with water, the system will overflow into the catch basins and pipe network. The pervious pavement sub-base layer provides for storage of 130,000 gallons of stormwater. The system could be designed to fully drain by gravity, or could be connected to the irrigation system for water re-use, further reducing the potable water demand for the site.

Wetland

The previously permitted wetland east of waterscape way does not completely go away in the LID option. The basin is still needed to serve as a water quality polishing device and provide additional peak flow controls. The benefit of the storage and treatment capabilities of the upstream devices allows for a reduction in required volume within the wetland. The footprint of the wetland normal pool area has been reduced by over 50 percent, resulting in a new normal pool area of 30,000 square feet.

Land Use Summary

The addition of integrated stormwater controls within the site area results in a more efficient land use on the parcel as a whole. The surface area reduction in the wetland east of waterscape way allows for the creation of a new outparcel on the east side of Waterscape Way. The parcel would occupy land previously covered by the stormwater easement. This outparcel replaces Outparcel 2, which was removed and replaced with parking during the addition of vegetated areas to the parking layout. The repurposing of the land resulted in a net gain of 2.14 acres of revenue generating land.

The second wetland proposed at the rear of the site, south of Lot 6, reduces the buildable area on Lot 6 by 1.51 acres. The new area of Lot 6 is 5.80 acres compared to 7.31 acres on the approved plan. Based on a schematic layout the lot is still well suited for a small anchor tenant.

The net buildable area within the site increased from 25.69 acres to 27.33 acres, an increase of 1.64 acres. Additionally, due to the volume of water retained in the proposed LID measures, the allowable impervious area (per stormwater regulations only) would increase to an estimated maximum allowable impervious area of 21.80 acres, a 16.7 percent increase over the previously permitted site.

Stormwater Design Summary

The proposed LID elements combine to provide a total of 72,755 cubic feet of water quality storage volume for control and treatment of the 1 inch rainfall event as required by state rules. The extended drawdown of these devices, in addition to storage above the water quality pool in each wetland reduce the effective curve number for the post development condition to predevelopment levels. Although no routing was completed for the constructed wetland, the preliminary data suggests that there is sufficient storage to reduce peak flows to below the 10-year levels as required by New Bern.

Due to the additional buildable area, the total project area increased to 30.76 acres. Using this value, the anticipated nitrogen export rate for the site is 9.32 lbs/acre/year after BMP reductions. This is below the allowable 10 lbs/acre/year limit prior to seeking offsite mitigation credits.

Additional Discussion Items

Green Roof

As an optional technique, a green roof could reduce energy usage within the anchor tenant building providing long term operational cost savings. Additionally, there would be no runoff from the design storm event from the green roof, resulting in an additional 23,000 square feet of allowable impervious surfaces, or a reduction in the size of the constructed wetland of approximately 2,000 square feet.

Soil Type

The poor soils on the site limited the ability for LID techniques to effectively infiltrate stormwater runoff back into the aquifer. If well-drained sandy soils had been present, the permeable pavement system would be able to infiltrate all storms up to and including the 2-year rainfall event, reducing surface flows to the wetland by over 90 percent. This potential infiltration, plus additional infiltration and vegetative uptake potentially gained within the vegetated swales, would remove the need for the downstream constructed wetland and further reduce infrastructure costs.

Nutrient Reduction and LID

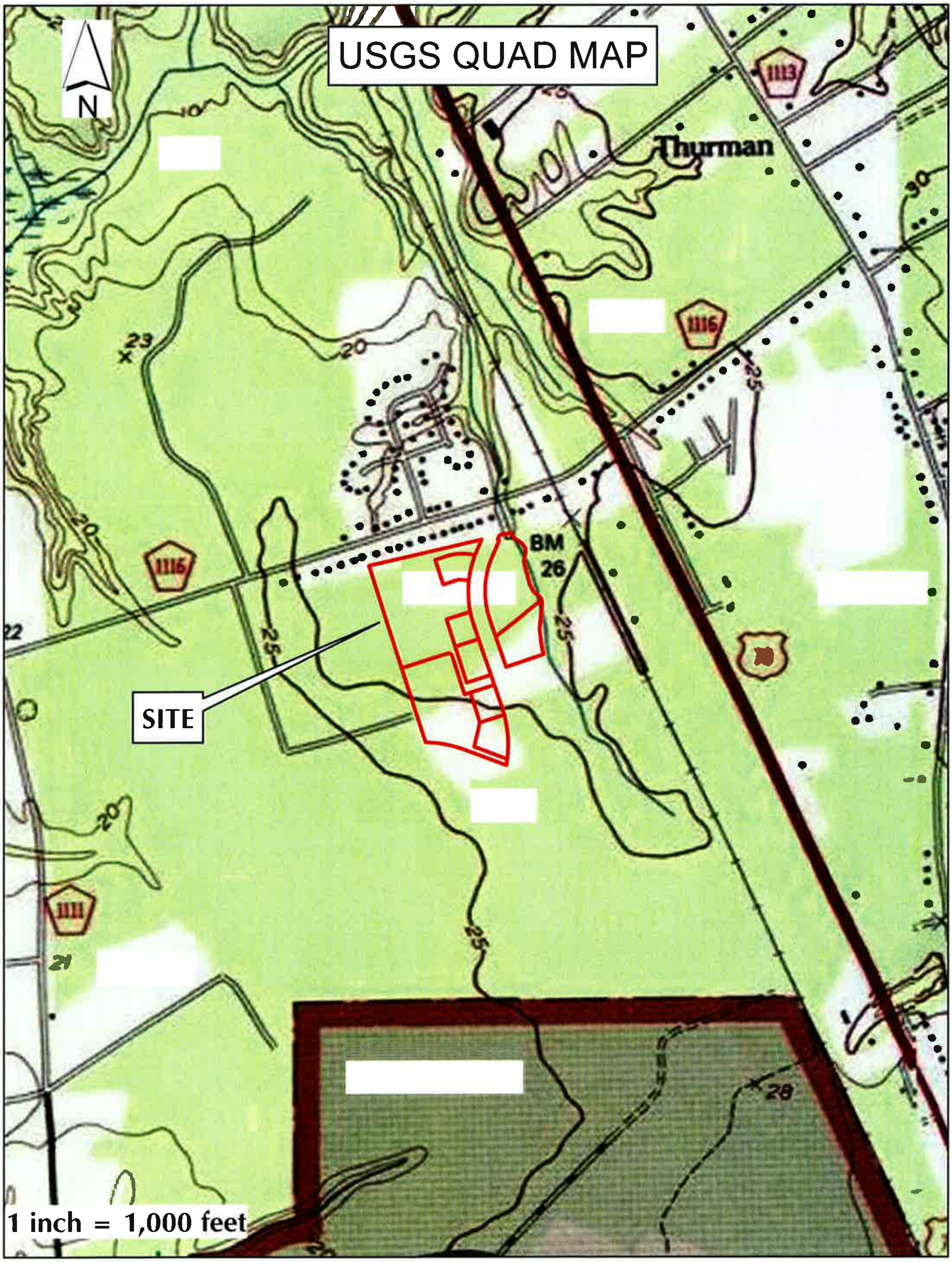
While not applicable to the actual site, a large percentage of the land within coastal North Carolina would have the ability to see more dramatic reductions in infrastructure costs through the use of LID techniques. Furthermore, by infiltrating the entire water quality storm event, this site would not have been subject to nutrient offset payment requirements. This alone is an estimated savings of $145,000.

Construction Cost Analysis

Withers & Ravenel compiled a summary of major construction elements associated with stormwater infrastructure and the proposed LID devices incorporated into the revised plans. The costs were based on estimated unit prices derived from recent construction bids, past project history, and data from the 2011 RS Means Heavy Construction Coast Data handbook.

Excluding the green roof (which is not required to meet stormwater regulations) construction costs are estimated to increase from $2.0M to $2.2M, an increase of 10%. Compare that to the 16.7% increase in buildable area that was gained through implementation. This shows that though slightly more expensive, the value gained by implementing this method exceeds the cost.

BACKGROUND INFORMATION


USGS QUAD MAP
N
Thurman
1113
1116
1116
1111
BM
26
23
20
25
30
28
22
21
10
SITE
1 inch = 1,000 feet

Hydrologic Soil Group—Craven County, North Carolina

Map Scale: 1:3,050 if printed on A size (8.5" x 11") sheet.

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:3,050 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Craven County, North Carolina
Survey Area Data: Version 11, Jun 29, 2009

Date(s) aerial images were photographed: 7/9/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Craven County, North Carolina (NC049)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Gr	Grantham silt loam	D	26.1	100.0%
Ra	Rains fine sandy loam	B/D	0.0	0.0%
Totals for Area of Interest			**26.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Craven County, North Carolina

Gr—Grantham silt loam

Map Unit Setting

Elevation: 20 to 160 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 59 to 70 degrees F
Frost-free period: 200 to 280 days

Map Unit Composition

Grantham, drained, and similar soils: 80 percent
Grantham, undrained, and similar soils: 10 percent

Description of Grantham, Drained

Setting

Landform: Broad interstream divides on depressions, broad interstream divides on flats
Down-slope shape: Concave
Across-slope shape: Concave, linear
Parent material: Loamy and silty marine deposits

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 10.7 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 5 inches: Silt loam
5 to 10 inches: Silt loam
10 to 72 inches: Silty clay loam
72 to 80 inches: Loam

Description of Grantham, Undrained

Setting

Landform: Broad interstream divides on depressions, broad interstream divides on flats
Down-slope shape: Concave
Across-slope shape: Concave, linear
Parent material: Loamy and silty marine deposits

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 10.7 inches)

Interpretive groups

Land capability (nonirrigated): 6w

Typical profile

0 to 5 inches: Silt loam
5 to 10 inches: Silt loam
10 to 72 inches: Silty clay loam
72 to 80 inches: Loam

Data Source Information

Soil Survey Area: Craven County, North Carolina
Survey Area Data: Version 11, Jun 29, 2009

STORM-EZ STORMWATER CALCULATIONS

NC ADMINISTRATIVE USE ONLY		
Date Received	Fee Paid	Permit Number

State of North Carolina
Department of Energy, Mineral, and Land Resources

MCIEAST - MCB CAMP LEJEUNE

STORMWATER PERMIT APPLICATION SUPPLEMENT
Carolina Colours Case Study
New Market HDS, LLC
ONSLOW COUNTY

Date: 07/09/13
Firm:
Designer:

GENERAL PROJECT INFORMATION

Project Name:	**Carolina Colours Case Study**	
Project Address:	**Waterscape Way**	
City:	**New Bern**	
County:	**ONSLOW**	**COASTAL**
ZIP:	**28562**	

Date: **7/9/2013**

Lat:
Long:

Signing Official for Project:	**Claude Arnold**
Organization:	**New Market HDS, LLC**
Title:	**Manager**
Mailing Address:	**1121 Military Cutoff Road, Suite P**
City:	**Wilmington**
Zip:	**28405**
Phone Number:	**(910) 256-2211**

Station Project Number

Other Permit Requirements

No	CAMA Major
No	NPDES Industrial Stormwater
No	404 / 401 Permit
No	Sedimentation & Erosion Control

River Basin:	Neuse	Within 5 miles of an Airport?	No
Receiving Stream Name:	Brice Creek	Within 575' of Saltwater ORW?	No
Receiving Stream Classification:	C, Sw, NSW	Within 1/2 Mile and Draining to SA Waters?	No

Select Rainfall Data:

Select Min. Design Storm: **First Flush / WQV**

Selected Rainfall: **User Defined**

RAINFALL DATA **Storm Event**	**Depth (inches)**
First Flush / WQV	1.00
P90	1.32
P95	2.14
1-yr, 24-hr	3.52
2-yr, 24-hr	4.28
10-yr, 24-hr	6.60
25-yr, 24-hr	8.18
50-yr, 24-hr	9.53
100-yr, 24-hr	11.00

Highlighted Storm is Design Storm

Site Data Results

Pre Development Project Area:	30.76	acres	
Post Development Project Area:	30.76	acres	
Existing Impervious Area:	0.00	acres	0%
Proposed Building/Road Footprint:	21.49	acres	70%
Net Built Upon Area:	20.51	acres	67%

Runoff Volume Results

Design Rainfall Depth: 1.00 in

Design Storm Runoff Volumes

Pre-Development:	0	cf
Post Development (Pre Storage):	61,698	cf
Infiltration / Storage Volume:	61,698	cf
Net Post Development Design Runoff:	0	cf

Messages:

Designer's Information

Name:
Firm:
Address:
City:
Zip:
Phone:
Email:
LID Cert #:

Seal

STORMWATER PERMIT APPLICATION SUPPLEMENT

Carolina Colours Case Study

New Market HDS, LLC

ONSLOW COUNTY

Date: 7/9/2013
Firm:
Designer:

PRE-DEVELOPMENT LAND USE CALCULATIONS

Pre Development Land Use:

HSG	Land-use	CN	Area (sf)	Area (acres)	%
A	Woods	30	1,339,905	30.76	100.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%
		98		0.00	0.00%

			CN	Area (sf.)	Area (ac.)	% Imp	
User Defined					0.00		0.00%
User Defined					0.00		0.00%
			Project Area:	1,339,905	30.76	0.00%	

Land Excluded from CN Calculations:	Area (sf.)	Area (ac.)	
Preserved Surface Waters & Non-Coastal Wetlands :			acres
Preserved Coastal Wetlands :			acres
Total Site Area:	**1,339,905**	**30.76**	**acres**

Pre-Development Runoff Volume for Design Storm = 0.00 acre-inches = **0** **cf**

The Pre Development project area contains 0 sf of built upon area, resulting in a density of 0%.

STORMWATER PERMIT APPLICATION SUPPLEMENT

Carolina Colours Case Study

New Market HDS, LLC

ONSLOW COUNTY

Date: 7/9/2013

Firm:

Designer:

POST-DEVELOPMENT LAND USE CALCULATIONS

Permeable Pavement:

	HSG	Pvmt Type	Pavement Area (sf)	Pavement Area (acres)	Additional BUA (sf)	Additional BUA (acres)	Infiltration Rate (in/hr)	Void Space (%)	Total Gravel Depth (in)	Has Drawdown Orifice?	Orifice Dia. (in)	Orifice Height (in)	Detention Only ?	Check D_{wq}	Check D_{10}
1	A	PC	30,000	0.69	30,000	0.69	4	40%	12	No			NO	OK	OK
2	A	PC	15,000	0.34	15,000	0.34	4	40%	12	No			NO	OK	OK
3	A	PC	12,000	0.28	12,000	0.28	4	40%	12	No			NO	OK	OK

Green Roofs:

DSD (in)	PAW (%)	D_{gr} (in)	Area (sf)	Area (acres)	Retrofit?	Comments
1.00				0.00	No	

Residential Lot Data:

Lot Area (sf.)	Lot Area (ac.)	# of Lots	Max Imp / Lot (sf)	% Imp	Woods / Lot (sf)	% Disconnected Imp %	Avg Lot Size
	0.00						

Remaining Land Use:

HSG	Land-use	CN	Area (sf)	Area (acres)	%
A	Impervious (Connected)	98.0	659,576	15.14	53.80%
A	Open Space (Managed Open Space)	39.0	281,801	6.47	22.99%
A	Woods (Preserved Open Space)	30.0	122,000	2.80	9.95%
A	Impervious (Connected)	98.0	150,528	3.46	12.28%
A	Impervious (Disconnected)	98.0	12,000	0.28	0.98%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
		0.0		0.00	0.00%
	Non Conforming Permeable Pavement	98	0	0.00	0.00%
	Non Conforming Green Roofs	98	0	0.00	0.00%
		Sub-Total:	1,225,905	28.14	100.00%

Note: For Disconnected Impervious Area, enter the HSG of the pervious area that the runoff will DRAIN TO

Land Excluded, or Partially Excluded, from Volume Calculations:

	(sf.)	(ac.)
Permeable Pavement w/ Infiltration & Additional BUA :	114,000	2.62
Green Roofs :	0	0.00
Surface Waters & Non-Coastal Wetlands :	0	0.00
Coastal Wetlands :	0	0.00
Total Site Area:	**1,339,905**	**30.76**

Post Development Runoff Volume for Design Storm = 14.71 acre-inches = **53,393 cf**

The Post Development project area contains 893354 sf of built upon area, resulting in a density of 72.87%

Warnings:

	STORMWATER PERMIT APPLICATION SUPPLEMENT **Carolina Colours Case Study** **New Market HDS, LLC** ONSLOW COUNTY	**Date:** 7/9/2013 **Firm:** **Designer:**

PROPOSED SIPs & STRUCTURAL RUNOFF VOLUME CONTROLS

Offsite Impervious *Area Treated*		sf

DESIGN STORM COMPLIANCE SUMMARY

Design Storm = First Flush / WQV - 1 in. Rainfall	PRE	POST
PRE BMP SURFACE RUNOFF	0 cf	61698 cf
UNTREATED SURFACE RUNOFF	0 cf	0 cf
NET ONSITE IMPERVIOUS AREA TREATED	N/A	100%

0 cf of runoff generated by pervious areas

Enter only runoff volume below that will be infiltrated or drawn down over 2 to 5 days. Additional volume provided in devices should not be entered in this worksheet. Drawdown time requirement applies to all storm events.

STORMWATER CONTROL MEASURES

#	Name / Location	Type of Device	HSG	Contributing Imp. Area *(land use input in italics)* Connected (sf)	Disconnected (sf)	PP / BUA (sf)	GR (sf)	Storage Volume (cf)	D.S BMP #	% of Total Imp. Area	Inflow Volume (cf)	Volume Reduction (cf)	Filtered Outflow (cf)	Treated Outflow (cf)	% of BMP Volume Utilized
				810,104	*12,000*	114,000									
1		Closed Sand Filter	A	8,000				550		0.97%	527		*53*	*475*	*96%*
2		Closed Sand Filter	A	8,750				670		1.06%	577		*58*	*519*	*86%*
3		Grass Swale	A	23,626				4000		2.87%	1557	*1038*		*519*	*65%*
4		Grass Swale	A	7,000				1200		0.85%	461	*308*		*154*	*64%*
5		Grass Swale	A	7,200				1200		0.88%	475	*316*		*158*	*66%*
6		Grass Swale	A	30,000				5000		3.65%	1977	*1318*		*659*	*66%*
7		Constructed Wetland	A	245,000		114,000		60000		29.80%	16148	*2691*		*13456*	*22%*
8		Constructed Wetland	A	195,000				60000		23.72%	12852	*2142*		*10710*	*18%*
9		Closed Sand Filter	A	45,000				3200		5.47%	2966		*297*	*2669*	*93%*
10		Closed Sand Filter	A	45,000				3000		5.47%	2966		*297*	*2669*	*99%*
11		Closed Sand Filter	A	45,000				3000		5.47%	2966		*297*	*2669*	*99%*
12		Permeable Pavement (Detention)	A	150,528				12000		18.31%	9921	*1984*		*7937*	*83%*
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															
PP		Permeable Pavement (Detention)													

Stormwater Control Treatment Summary

	Pre Development	Post Development
DISCONNECTED IMPERVIOUS AREA	0 cf	791 cf
VOLUME REDUCTION FROM BMPS	N/A	9798 cf
POST FILTRATION OUTFLOW FROM BMPS	N/A	1000 cf
TREATED OUTFLOW FROM BMPS	N/A	42595 cf
PERMEABLE PAVEMENT INFILTRATION	N/A	7514 cf
GREEN ROOF EVAPOTRANSPIRATION	N/A	0 cf
BMP SIZING EFFICIENCY	N/A	100%

Warnings:

Note: Large storage devices such as wet/dry detention ponds, constructed wetlands, or infiltration basins may require pond routing calculations. The routing calculations should be provided in addition to this spreadsheet

STORMWATER PERMIT APPLICATION SUPPLEMENT

Carolina Colours Case Study

New Market HDS, LLC

ONSLOW COUNTY

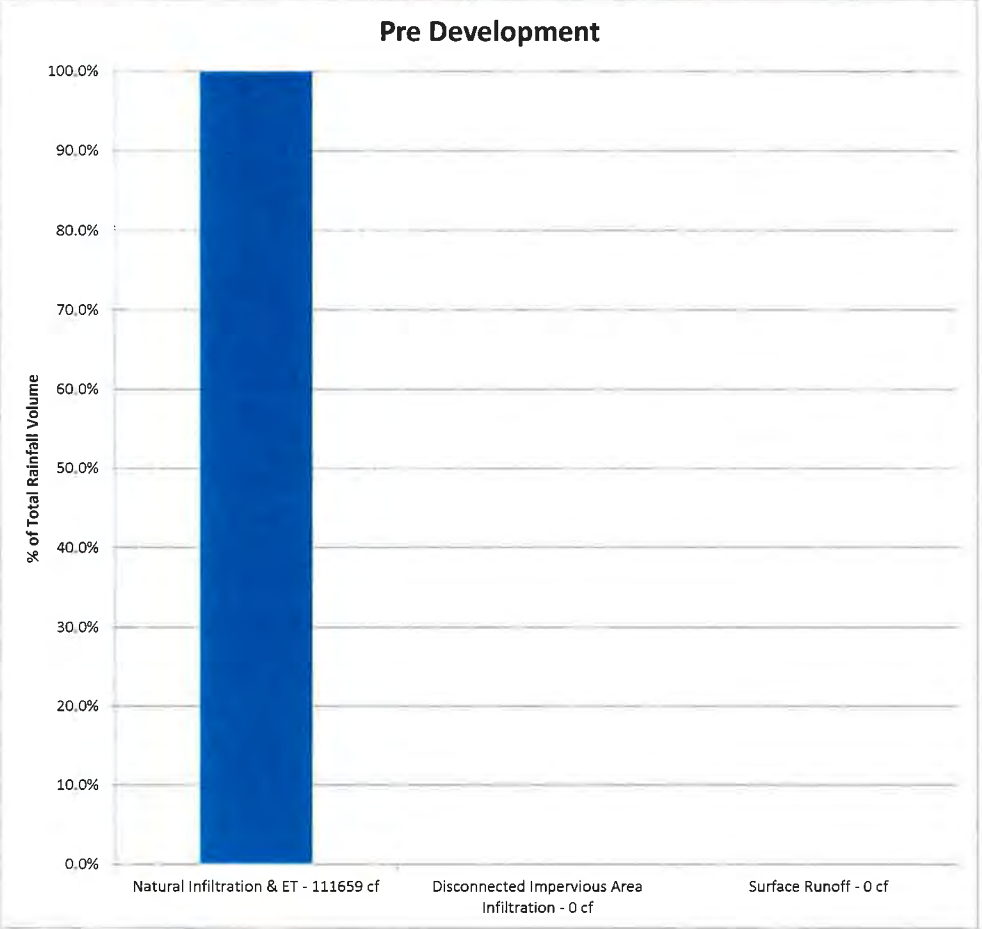
Date: 1/0/1900

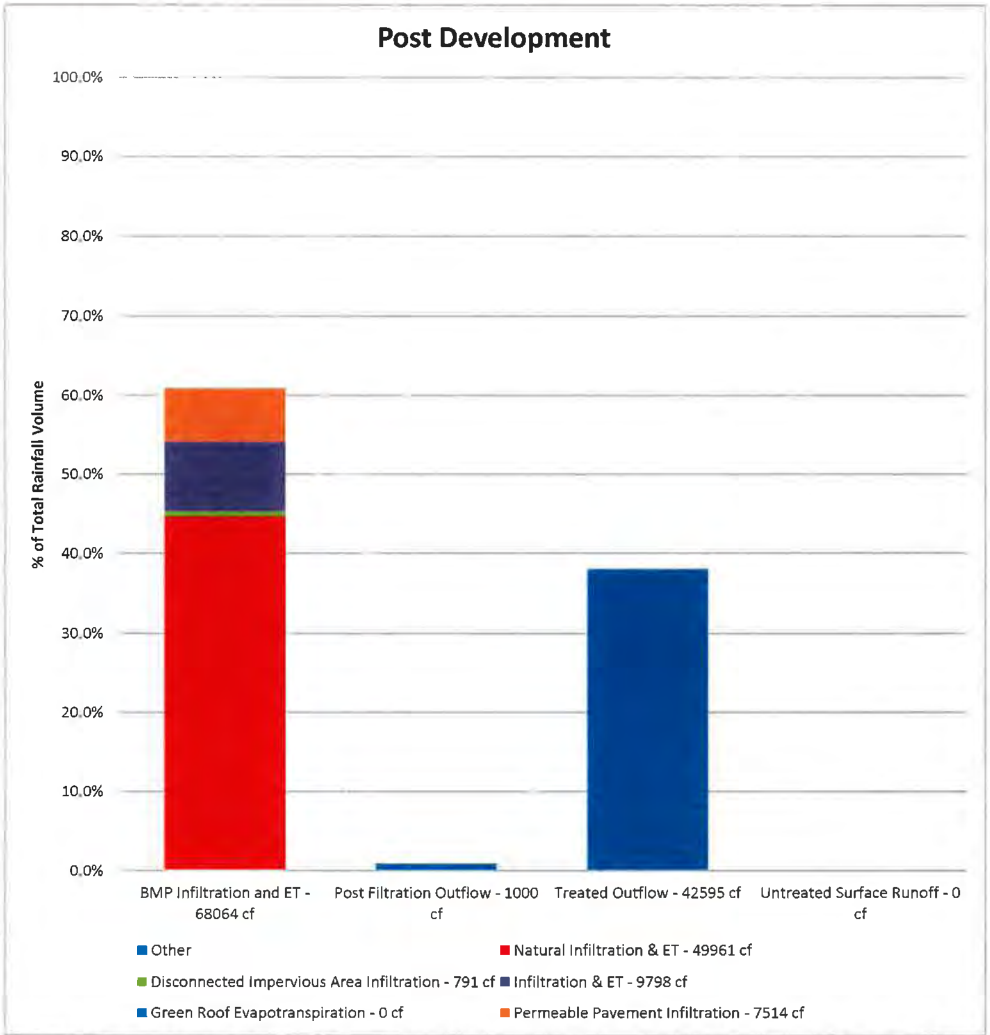
Firm: 41464

Designer:

FATE OF RAINFALL

FATE OF RAINFALL SUMMARY - First Flush / WQV Storm - Rainfall Depth = 1 inches





The"Fate of Rainfall" charts display the hydrologic processes to which rainfall volumes are subjected based on the combinations of land use, soil type, and stormwater controls entered by the user. The charts are designed to display the stormwater plan in a form which illustrates changes to the hydrologic cycle which result from urbanization and various stormwater management strategies.

STORMWATER PERMIT APPLICATION SUPPLEMENT

Carolina Colours Case Study

New Market HDS, LLC

ONSLOW COUNTY

Date: 1/0/1900

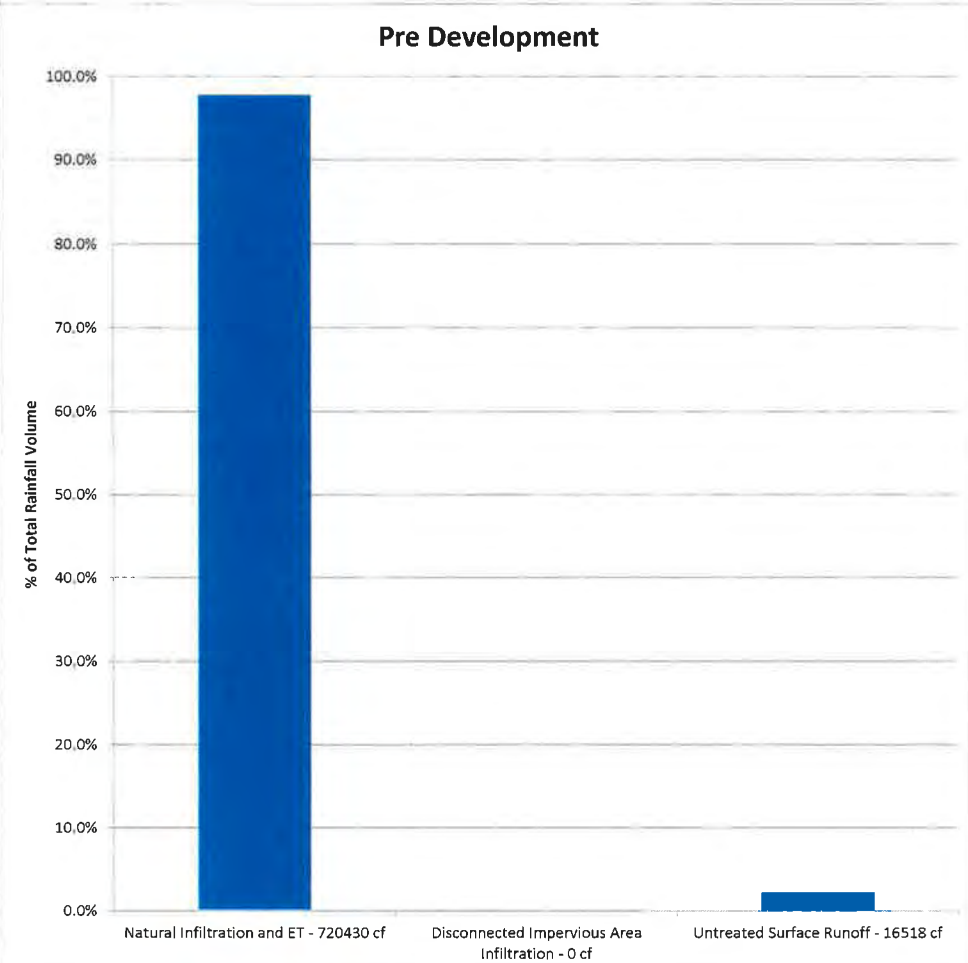
Firm: 41464

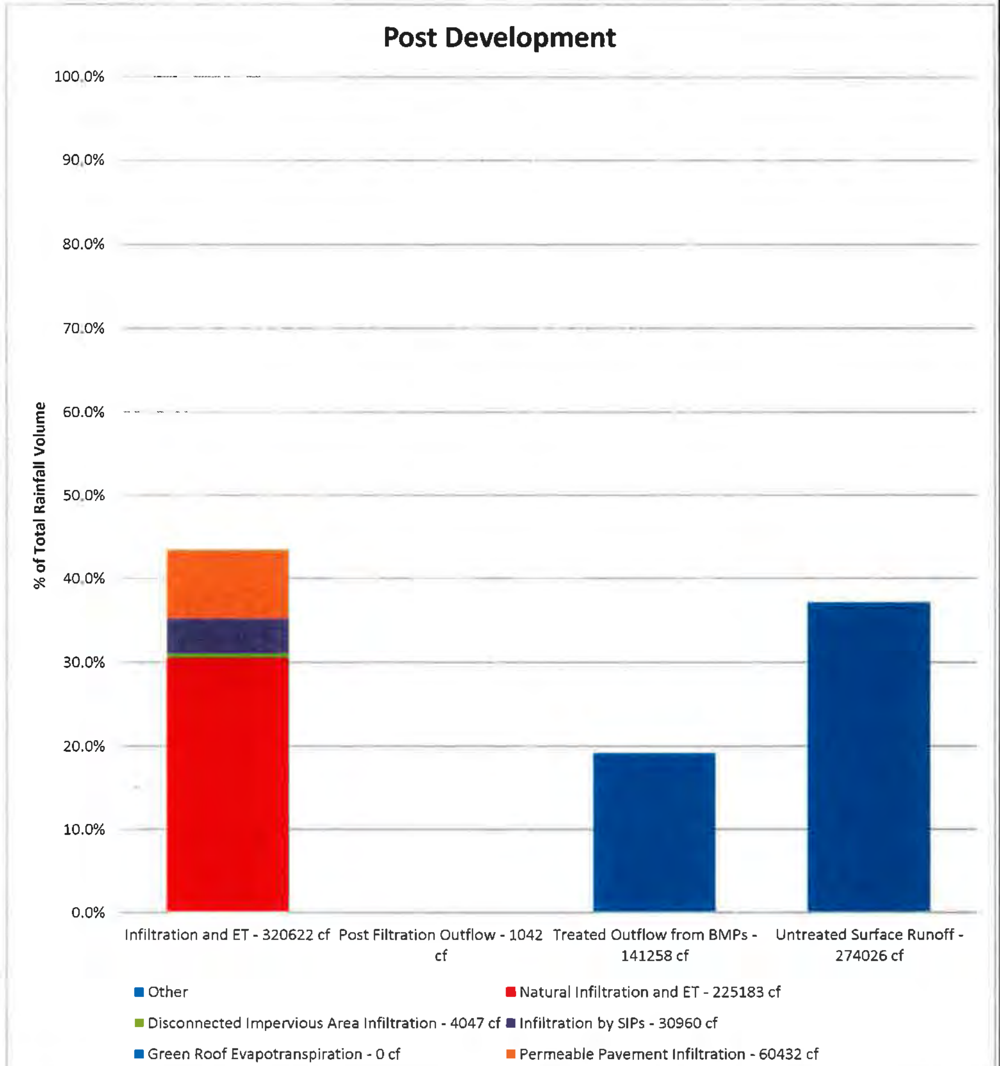
Designer:

FATE OF RAINFALL

Select Storm: **10 Year**

FATE OF RAINFALL SUMMARY - 10 Year Storm - Rainfall Depth = 6.6 inches





The "Fate of Rainfall" charts display the hydrologic processes to which rainfall volumes are subjected based on the combinations of land use, soil type, and stormwater controls entered by the user. The charts are designed to display the stormwater plan in a form which illustrates changes to the hydrologic cycle which result from urbanization and various stormwater management strategies.

	STORMWATER PERMIT APPLICATION SUPPLEMENT	
	Carolina Colours Case Study	Date: 7/9/2013
	New Market HDS, LLC	Firm:
	ONSLOW COUNTY	Designer:

ADDITIONAL CALCULATIONS

TIME OF CONCENTRATION CALCULATIONS:

Pre Development

	Length (ft)	Slope (ft/ft)	Surface Cover	T_t (hrs)
Sheet Flow:				
Sheet Flow:				
Shallow Flow:				
Shallow Flow:				

	Length (ft)	Slope (ft/ft)	n-value	Flow Area (ft^2)	Wetted Perimeter (ft)	T_t (hrs)
Channel Flow:						
Channel Flow:						

Pre-development T_c = 5.00 min *(Minimum 5 minutes)*

Post Development

	Length (ft)	Slope (ft/ft)	Surface Cover	T_t (hrs)
Sheet Flow:				
Sheet Flow:				
Shallow Flow:				
Shallow Flow:				

	Length (ft)	Slope (ft/ft)	n-value	Flow Area (ft^2)	Wetted Perimeter (ft)	T_t (hrs)
Channel Flow:						
Channel Flow:						

Post-development T_c = 5.00 min *(Minimum 5 minutes)*

ADJUSTED CURVE NUMBER CALCULATIONS:

Analysis Area = 30.76 Acres

Pre Development

	F.F.	P90	P95	1-Yr	2-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Rainfall (in) =	1.00	1.32	2.14	3.52	4.28	6.60	8.18	9.53	11.00
$Q^*_{(in)}$ =	0.00	0.00	0.00	0.00	0.00	0.15	0.46	0.84	1.35
CN_{adj} =	**67**	**60**	**48**	**36**	**32**	**30**	**30**	**30**	**30**

Post Development

	F.F.	P90	P95	1-Yr	2-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Rainfall (in) =	1.00	1.32	2.14	3.52	4.28	6.60	8.18	9.53	11.00
$Q^*_{(in)}$ =	0.00	0.05	0.27	0.65	0.96	2.45	3.58	4.57	5.69
CN_{adj} =	**67**	**70**	**69**	**62**	**61**	**61**	**61**	**60**	**60**

PEAK FLOW CALCULATIONS:

Analysis Area = 0.05 sq. mi.

	F.F.	P90	P95	1-Yr	2-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Pre Development									
Q* (in)	0.00	0.00	0.00	0.00	0.00	0.15	0.46	0.84	1.35
q_u (csm/in)	385.00	385.00	385.00	385.00	385.00	385.00	385.00	385.00	666.59
Q (cfs)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.74**	**8.51**	**15.52**	**43.32**
Post Development									
Q* (in)	0.00	0.05	0.27	0.65	0.96	2.45	3.58	4.57	5.69
q_u (csm/in)	385.00	385.00	666.59	809.52	931.69	1165.98	1165.98	1165.98	1165.98
Q (cfs)	**0.00**	**0.89**	**8.54**	**25.14**	**43.16**	**137.53**	**200.52**	**256.31**	**318.74**
	N/A	*N/A*	*N/A*	*N/A*	*N/A*	*4924.2%*	*2257.0%*	*1551.3%*	*635.8%*

***Note: To decrease Post-development peak flows - increase storage volume being drawdown or infiltrated or lengthen post-development time of concentration. See LID HELP for more information.*

ESTIMATED NITROGEN CALCULATIONS

Nitrogen Control Plan

Commercial / Industrial / Residential Sites with Known Impervious Area

Carolina Colours - Approved Site Plan

Project Name: Carolina Colours - Approved Site Plan   Date: 12/2/2012

Project #: 2070655.1   Computed by: HCF

TOTAL TRACT

Total Area:	1,116,878	sqft. =	25.64	ac.
Natural Open Space Area:	0	sqft. =	0.00	ac.
Managed Open Space Area:	302,742	sqft. =	6.95	ac.
Impervious Area	814,136	sqft. =	18.69	ac.

Estimated Post-Development TN Loading

Drainage Area I: To Wetland			
Type of Land Cover	Acres	TN Export Coeff. (lbs/ac/yr)	TN EXPORT (lbs/yr)
Permanently Protected Undisturbed Area	0.00	0.6	0.00
Permanently Protected Managed Area	6.21	1.2	7.45
Impervious Area	18.69	21.2	396.23
Totals	24.90		403.68

Estimated BMP Reduction: 45 %

Estimated Drainage Area I Nitrogen Loading Reduction: 181.66 lbs/yr

Drainage Area II: Untreated			
Type of Land Cover	Acres	TN Export Coeff. (lbs/ac/yr)	TN EXPORT (lbs/yr)
Permanently Protected Undisturbed Area	0.00	0.6	0.00
Permanently Protected Managed Area	0.74	1.2	0.89
Impervious Area	0.00	21.2	0.00
Totals	0.74		0.89

Estimated BMP Reduction: 0 %

Estimated Drainage Area II Nitrogen Loading Reduction: 0.00 lbs/yr

Total Area:	**25.64**	**Acres**
Estimated Project Pre-BMP TN Export:	**404.57**	**lbs/yr**
Estimated Project BMP TN Removal:	**181.66**	**lbs/yr**
Estimated Project TN Load Rate After BMPs:	**8.69**	**lbs/ac/yr**
Estimated Project Composite Nitrogen Loading Rate Reduction:	**44.90**	**%**

Estimated Project Buy Down: $111,082.10

Nitrogen Control Plan

Commercial / Industrial / Residential Sites with Known Impervious Area

Carolina Colours - LID Option

Project Name: Carolina Colours - LID Option　　Date: 12/2/2012

Project #: 2070655.1　　Computed by: HCF

TOTAL TRACT

Total Area:	1,339,906	sqft. =	30.76	ac.
Natural Open Space Area:	0	sqft. =	0.00	ac.
Managed Open Space Area:	376,794	sqft. =	8.65	ac.
Impervious Area	963,112	sqft. =	22.11	ac.

Estimated Post-Development TN Loading

Drainage Area I: To Wetland			
Type of Land Cover	Acres	TN Export Coeff. (lbs/ac/yr)	TN EXPORT (lbs/yr)
Permanently Protected Undisturbed Area	0.00	0.6	0.00
Permanently Protected Managed Area	6.21	1.2	7.45
Impervious Area	21.80	21.2	462.16
Totals	28.01		469.61

Estimated BMP Reduction: 41 %

Estimated Drainage Area I Nitrogen Loading Reduction: 192.54 lbs/yr

Drainage Area II: Untreated			
Type of Land Cover	Acres	TN Export Coeff. (lbs/ac/yr)	TN EXPORT (lbs/yr)
Permanently Protected Undisturbed Area	0.00	0.6	0.00
Permanently Protected Managed Area	2.44	1.2	2.93
Impervious Area	0.31	21.2	6.57
Totals	2.75		9.50

Estimated BMP Reduction: 0 %

Estimated Drainage Area II Nitrogen Loading Reduction: 0.00 lbs/yr

Total Area:	**30.76**	**Acres**
Estimated Project Pre-BMP TN Export:	**479.11**	**lbs/yr**
Estimated Project BMP TN Removal:	**192.54**	**lbs/yr**
Estimated Project TN Load Rate After BMPs:	**9.32**	**lbs/ac/yr**
Estimated Project Composite Nitrogen Loading Rate Reduction:	**40.19**	**%**

Estimated Project Buy Down: $149,547.74

CONSTRUCTION COST ESTIMATES

CAROLINA COLOURS SHOPPING CENTER IMPROVEMENTS

W&R Project No. 02070655.10

ENGINEER'S OPINION OF PROBABLE COST
December 3, 2012

APPROVED CONSTRUCTION DRAWINGS

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNIT	COST PER UNIT	TOTAL COST
1	Asphalt Light Duty Pavement (1.5" SF9.5A, 1" HB, 8" ABC)	**14,482**	SY	$ 33.00	$ 477,906.00
	Asphalt Heavy Duty Pavement (1.5" SF9.5A, 2" HB, 8" ABC)	**14,175**	SY	$ 45.00	$ 637,875.00
2	Landscaping	**3**	AC	$ 80,000.00	$ 240,000.00
4	Pervious Concrete (6" Concrete, 12" Washed Aggregate)	0	SY	$ 81.00	$ -
5	Masonry Drainage Structure	28	EA	$ 4,000.00	$ 112,000.00
6	15" Class III RCP	354	LF	$ 29.00	$ 10,266.00
7	18" Class III RCP	264	LF	$ 35.00	$ 9,240.00
8	24" Class III RCP	790	LF	$ 50.00	$ 39,500.00
9	30" Class III RCP	574	LF	$ 85.00	$ 48,790.00
10	36" Class III RCP	990	LF	$ 100.00	$ 99,000.00
11	42" Class III RCP	553	LF	$ 125.00	$ 69,125.00
12	48" Class III RCP	547	LF	$ 147.00	$ 80,409.00
13	54" Class III RCP	202	LF	$ 160.00	$ 32,320.00
14	8" PVC	370	LF	$ 8.00	$ 2,960.00
15	10" PVC	375	LF	$ 11.00	$ 4,125.00
16	4" Underdrains	0	LF	$ 4.50	$ -
17	Stormwater Tree Well	0	SF	$ 1.50	$ -
18	Stormwater Vegetated Swale	0	SF	$ 10.00	$ -
19	Stormwater Bioswale	0	SF	$ 2.00	$ -
20	Stormwater Wetland	73,395	SF	$ 2.00	$ 146,790.00
22	Green Roof	0	SF	$ 20.00	$ -

$ 2,010,306.00

CAROLINA COLOURS SHOPPING CENTER IMPROVEMENTS

W&R Project No. 02070655.10

ENGINEER'S OPINION OF PROBABLE COST
December 3, 2012

LID IMPLEMENTATION					
ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNIT	COST PER UNIT	TOTAL COST
1	Asphalt Light Duty Pavement (1.5" SF9.5A, 1" HB, 8" ABC)	**7,995**	SY	$ 33.00	$ 263,835.00
2	Asphalt Heavy Duty Pavement (1.5" SF9.5A, 2" HB, 8" ABC)	**14,482**	SY	$ 45.00	$ 651,690.00
2	Landscaping	**1**	AC	$ 80,000.00	$ 40,000.00
4	Pervious Concrete (6" Concrete, 12" Washed Aggregate)	6,380	SY	$ 81.00	$ 516,780.00
5	Masonry Drainage Structure	28	EA	$ 4,000.00	$ 112,000.00
6	15" Class III RCP	0	LF	$ 29.00	$ -
7	18" Class III RCP	0	LF	$ 35.00	$ -
8	24" Class III RCP	359	LF	$ 50.00	$ 17,950.00
9	30" Class III RCP	1,147	LF	$ 85.00	$ 97,495.00
10	36" Class III RCP	1,124	LF	$ 100.00	$ 112,400.00
11	42" Class III RCP	581	LF	$ 125.00	$ 72,625.00
12	48" Class III RCP	230	LF	$ 147.00	$ 33,810.00
13	54" Class III RCP	0	LF	$ 160.00	$ -
14	8" PVC	115	LF	$ 8.00	$ 920.00
15	10" PVC	104	LF	$ 11.00	$ 1,144.00
16	4" Underdrains	7,200	LF	$ 4.50	$ 32,400.00
17	Stormwater Tree Well	7,092	SF	$ 4.50	$ 31,914.00
18	Stormwater Vegetated Swale	13,082	SF	$ 1.50	$ 19,623.00
19	Stormwater Bioswale	9,172	SF	$ 2.00	$ 18,344.00
20	Stormwater Wetlands	89,441	SF	$ 2.00	$ 178,882.00
21	Green Roof	0	SF	$ 20.00	$ -

$ 2,201,812.00

CONCEPTUAL SITE PLANS

PARKING SUMMARY

USE CLASSIFICATION	REQUIRED (5/1000 SF GFA)	PROVIDED
TOTAL SHOPPING CENTER	340	366
HARRIS TEETER EXP. 3 TOTAL SHOPPING CENTER	378	400

HANDICAP SPACES PER ADA:
REQUIRED: 8 TOTAL 2 VAN
PROVIDED: 8 TOTAL 2 VAN

SITE DATA SUMMARY

OWNER/DEVELOPER:	NEW MARKET HDS, LLC 1121 MILITARY CUTOFF ROAD, SUITE P WILMINGTON, NC 28405 CONTACT: CLAUDE C. ARNOLD PHONE: (910) 256-2211
PROJECT ADDRESS:	WATERSCAPE WAY NEW BERN, NC 28562
ACREAGE OF LOTS: (WEST SIDE OF WATERSCAPE WAY)	25.69 ACRES
ACREAGE OF LOT: (EAST SIDE OF WATERSCAPE WAY/LOT 8)	3.16 ACRES
TOTAL ACREAGE OF LOTS:	28.85 ACRES

STORMWATER DEVICE LEGEND

- PERVIOUS CONCRETE
- TREE WELL
- VEGETATED SWALE BIOSWALE
- WETLANDS
- GREEN ROOF

GRAPHIC SCALE
60 0 30 60 120
1 inch = 60 ft.

No.	Revision	Date	By

Designer: W&R
Scale: 1" = 60'
Drawn By: PMO
Date: 08/07/12
Checked By: HCF
Job No.: 02070655.10

CAROLINA COLOURS SHOPPING CENTER

NEW BERN — NORTH CAROLINA

SITE PLAN

WITHERS & RAVENEL
ENGINEERS | PLANNERS | SURVEYORS
111 MacKenan Drive Cary, North Carolina 27511 tel: 919-469-3340 www.withersravenel.com License No. C-0832

Sheet No. 2

No.	Revision	Date	By

Designer W&R	Scale 1" = 30'
Drawn By PMO	Date 08/07/12
Checked By HCF	Job No. 02070655.10

CAROLINA COLOURS SHOPPING CENTER

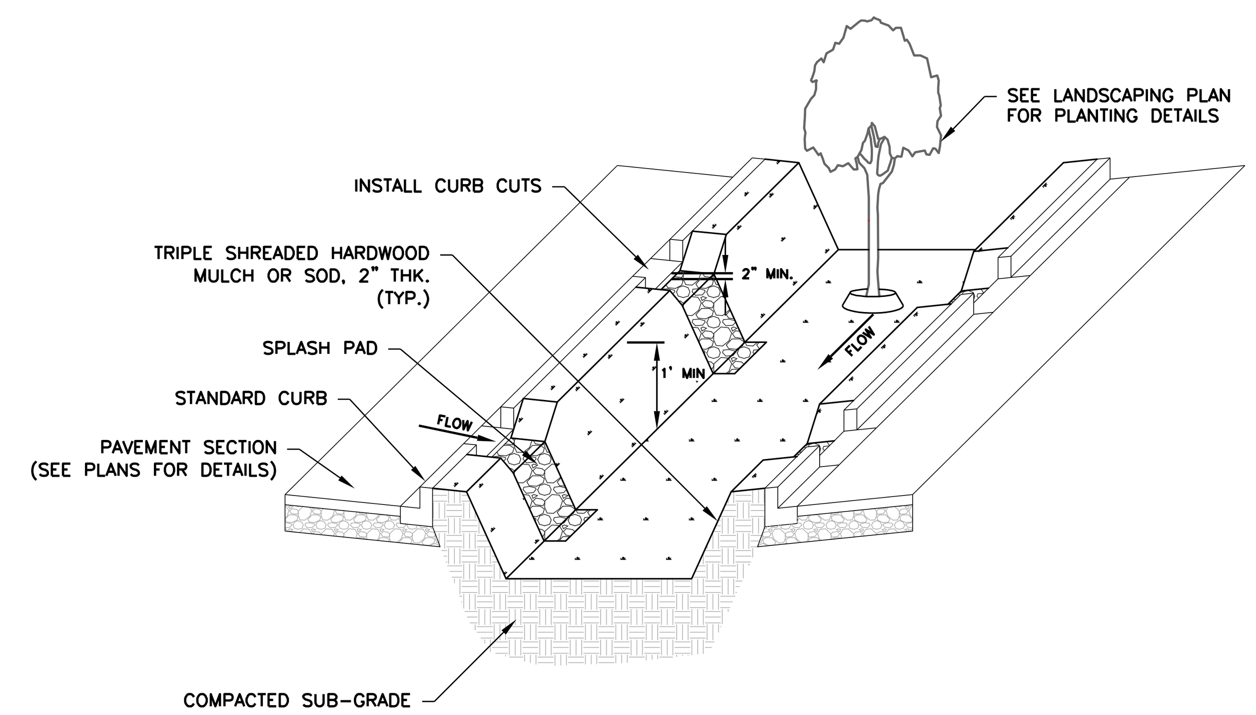
NEW BERN NORTH CAROLINA

ENLARGED SITE PLAN

WITHERS & RAVENEL
ENGINEERS | PLANNERS | SURVEYORS
111 MacKenan Drive Cary, North Carolina 27511 tel: 919-469-3340 www.withersravenel.com License No. C-0832

Sheet No.
3

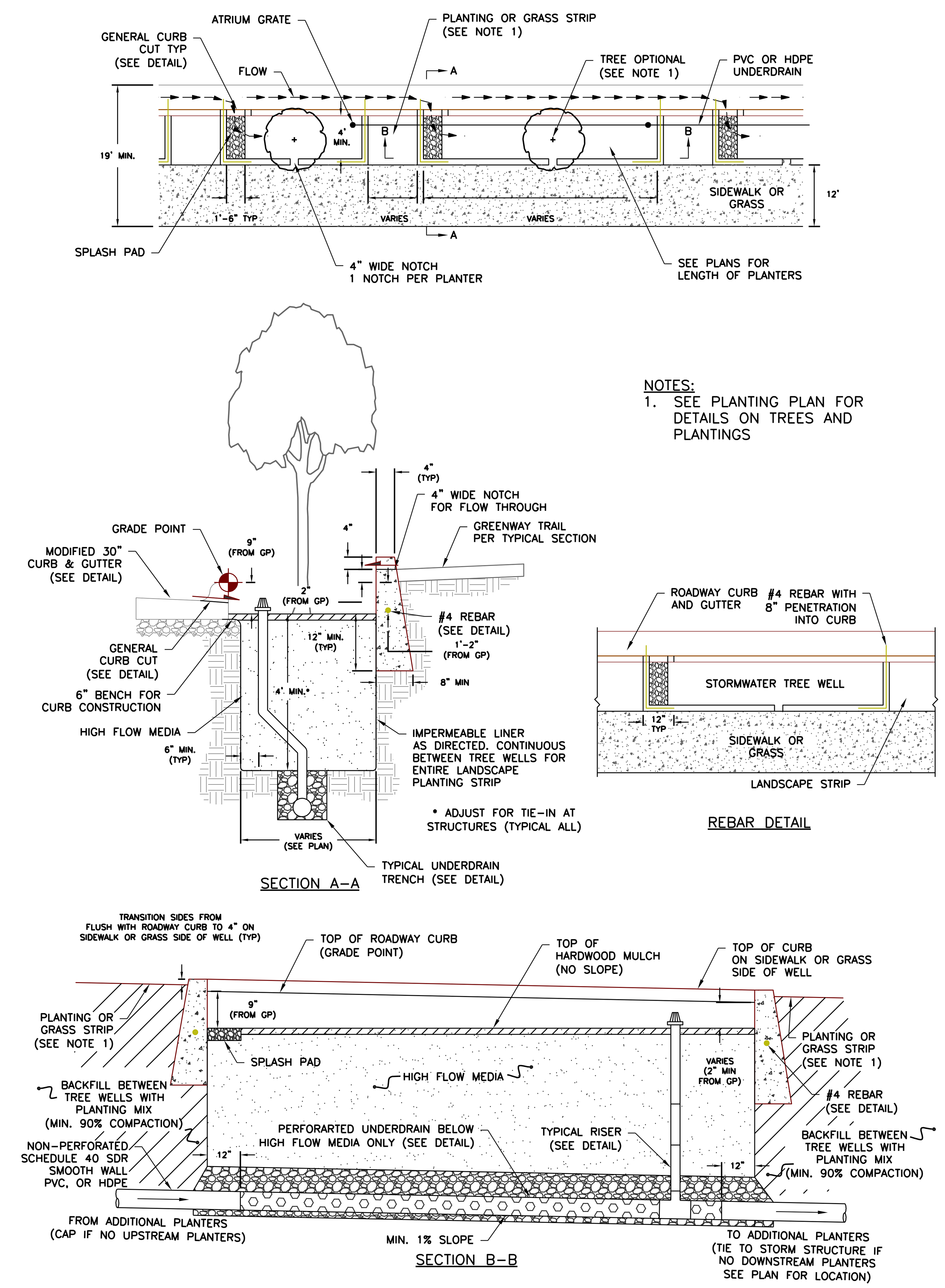
K:\07\07-0650\070655.10-LID Redesign\CAD\BASE – LID Option 3 – FINAL2.dwg– Tuesday, August 20, 2013 10:25:11 AM – PETERSON, PATRICK



NOTES:
1. SWALE DEPTH SHALL BE DEEP ENOUGH TO PASS 10-YR STORM FLOW WITHOUT SURCHARGING GUTTER OR FLOODING PAVEMENT.
2. 10-YR STORM VELOCITY NOT TO EXCEED 2 FT/S.
3. UTILITY LINES MAY NEED TO BE SLEEVED OR RELOCATED.
4. TREES AND SHRUBS SHALL BE PLANTED AT LEAST 2' FROM CENTERLINE OF SWALE.
5. USE THE RAISED AREAS NEAR TREE PLANTINGS AS A BARRIER TO ENCOURAGE SHALLOW PONDING.
6. SOD OR TRIPLE SHREDDED MULCH SHALL BE A MINIMUM OF 2" BELOW THE GUTTER LINE TO ALLOW FOR UNIMPEDED FLOW INTO SWALE.
7. TOP OF LANDSCAPING MIX SHALL BE A MINIMUM OF 4" BELOW THE GUTTER LINE.
8. UNDERDRAIN AND IMPERMEABLE LINER TO BE USED ON CASE BY CASE BASIS, AT DESIGN ENGINEER'S DISCRETION.
9. SOIL TESTING REQUIRED WHEN UNDERDRAIN IS NOT USED.

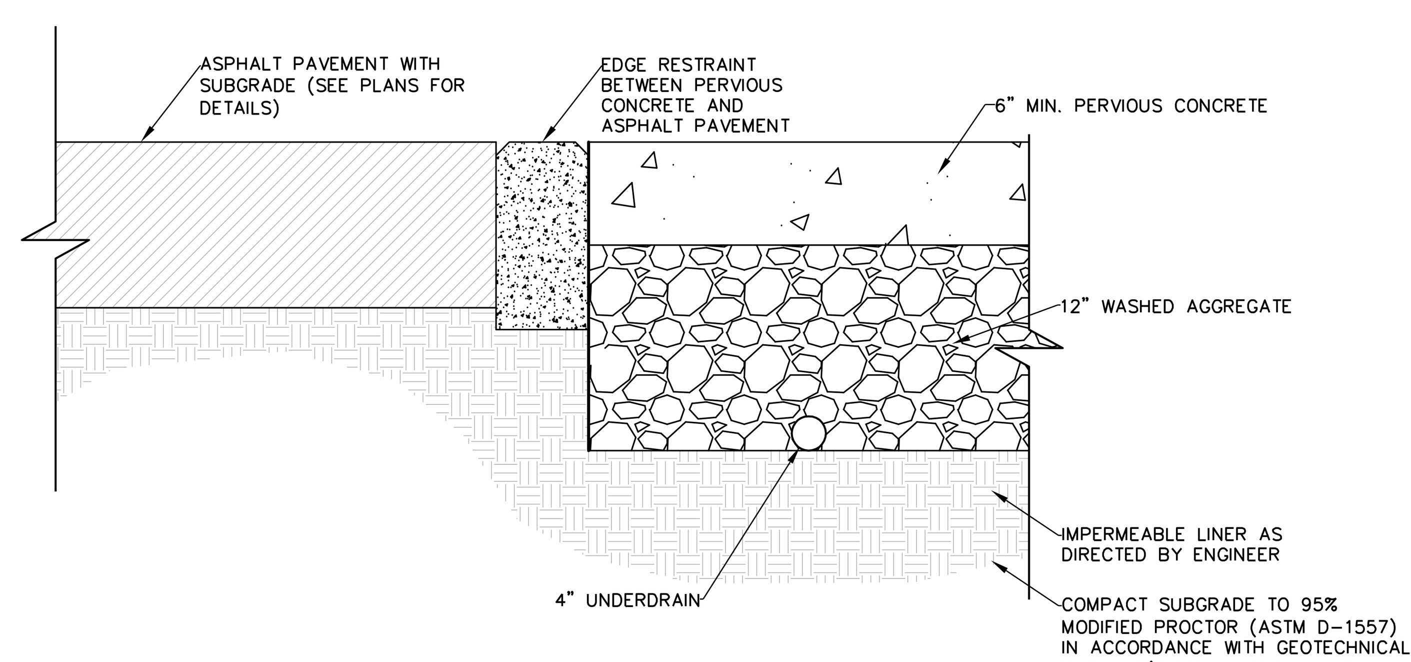
TYPICAL VEGETATED SWALE

NOT TO SCALE



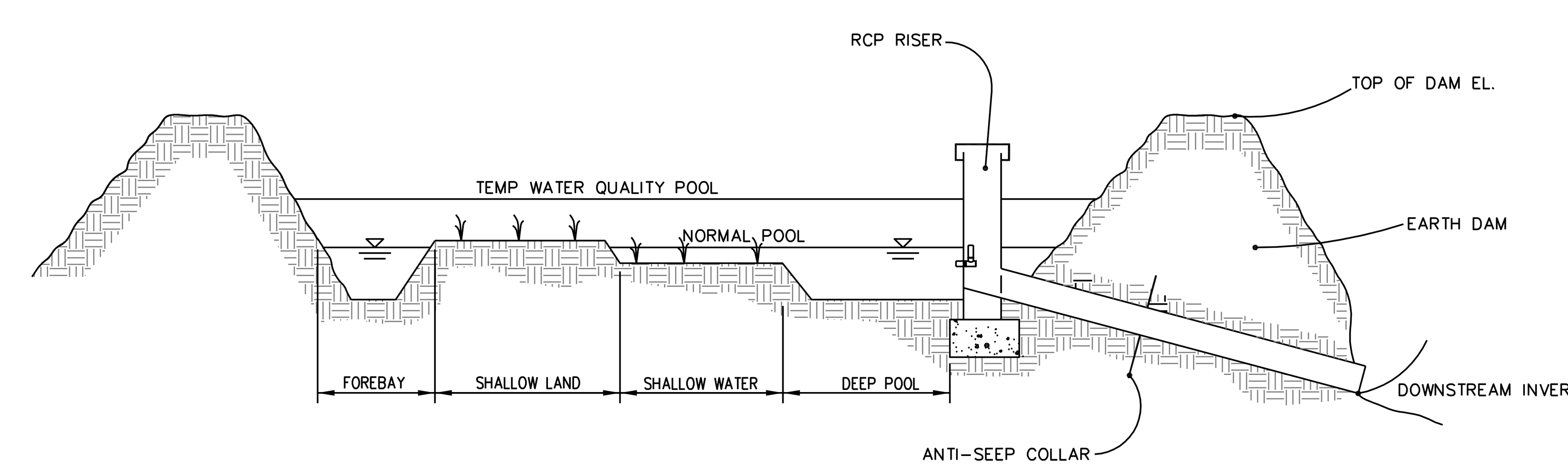
TYPICAL STORMWATER TREE WELL

NOT TO SCALE



TYPICAL PERVIOUS CONCRETE

NOT TO SCALE



TYPICAL STORMWATER WETLAND CROSS SECTION

NOT TO SCALE

No.	Revision	Date	By

Designer W&R	Scale NO SCALE
Drawn By TLM	Date 08/07/12
Checked By HCF	Job No. 02070655.10

CAROLINA COLOURS SHOPPING CENTER

NEW BEN · NORTH CAROLINA

STORMWATER DETAILS

WITHERS & RAVENEL
ENGINEERS | PLANNERS | SURVEYORS
111 MacKenan Drive Cary, North Carolina 27511 tel: 919-469-3340 www.withersravenel.com License No. C-0832

Sheet No. 7A