

**STORMWATER  
CALCULATIONS**

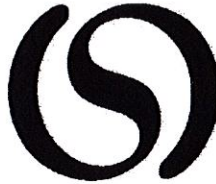
for

**TIME**

**PREPARED FOR**

**ENRIGHT, LLC**  
500 Sericea Ct.  
Wilmington, NC 28412

**Prepared by:**



**CSD ENGINEERING**

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License # C-2710



Howard Resnik, P.E.

1/18/17

Final SW Calcs  
2/16/17  
SWP 2017005  
rac

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**JAN 19 2017**

**ENGINEERING**

## **PROJECT DATA:**

### Existing Site Data (within Pond drainage delineation)

Existing wetlands	0.0 sf (0.0 acres)
Existing uplands	13,992 sf (0.32 acres)
<b>Total proposed project area</b>	<b>13,992 sf (0.32 acres)</b>

### Proposed Site Data:

Proposed buildings	8,606 sf (0.20 acres)
Proposed impervious drive aisle	2,976 sf (0.07 acres)
*Proposed pervious drive aisle	350 sf (0.01 acres)
<b>Total proposed impervious area</b>	<b>11,932 sf (0.27 acres)</b>

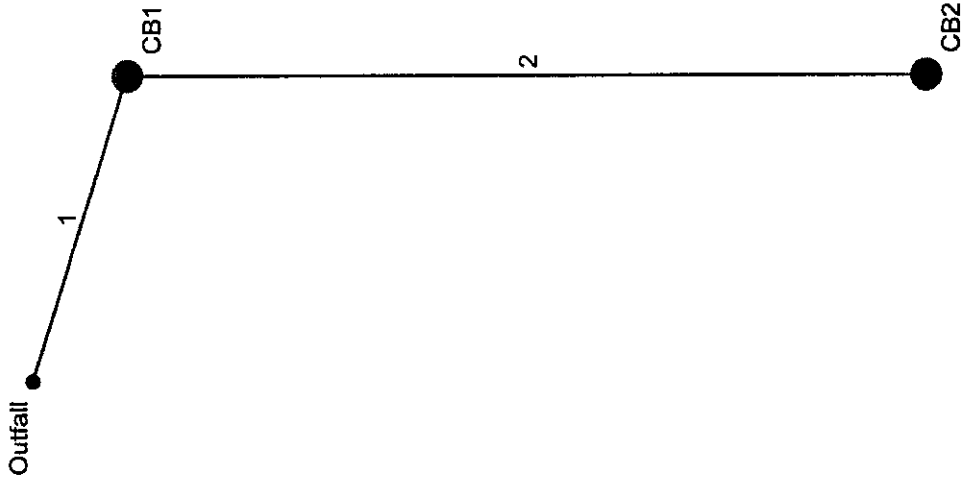
\*1,400 sf of pervious material to be installed receiving 75% credit = 350 sf

### Soil Types Within Project Limits:

<u>Abbreviation</u>	<u>Type and Description</u>	<u>Hydrologic Group</u>	<u>Area</u>
Ur	Urban	A	0.32 ac

(See attached soils map)

# Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: COLLECTION\_SYSTEM.stm

Number of lines: 2

Date: 1/10/2017

# Storm Sewer Tabulation

Station Line	To Line	Len (ft)	Dmg Area (ac)		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
			Incr	Total		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	43.000	0.10	0.31	0.95	0.10	0.29	5.0	5.7	9.4	2.85	2.43	3.63	12	0.47	42.50	42.70	44.00	44.28	45.20	45.90	EX TO CB1
2	1	110.000	0.21	0.21	0.95	0.20	0.20	5.0	5.0	9.7	1.93	2.15	2.46	12	0.36	42.70	43.10	44.39	44.71	45.90	45.70	CB1 TO CB2

Project File: COLLECTION\_SYSTEM.stm

Number of lines: 2

Run Date: 1/10/2017

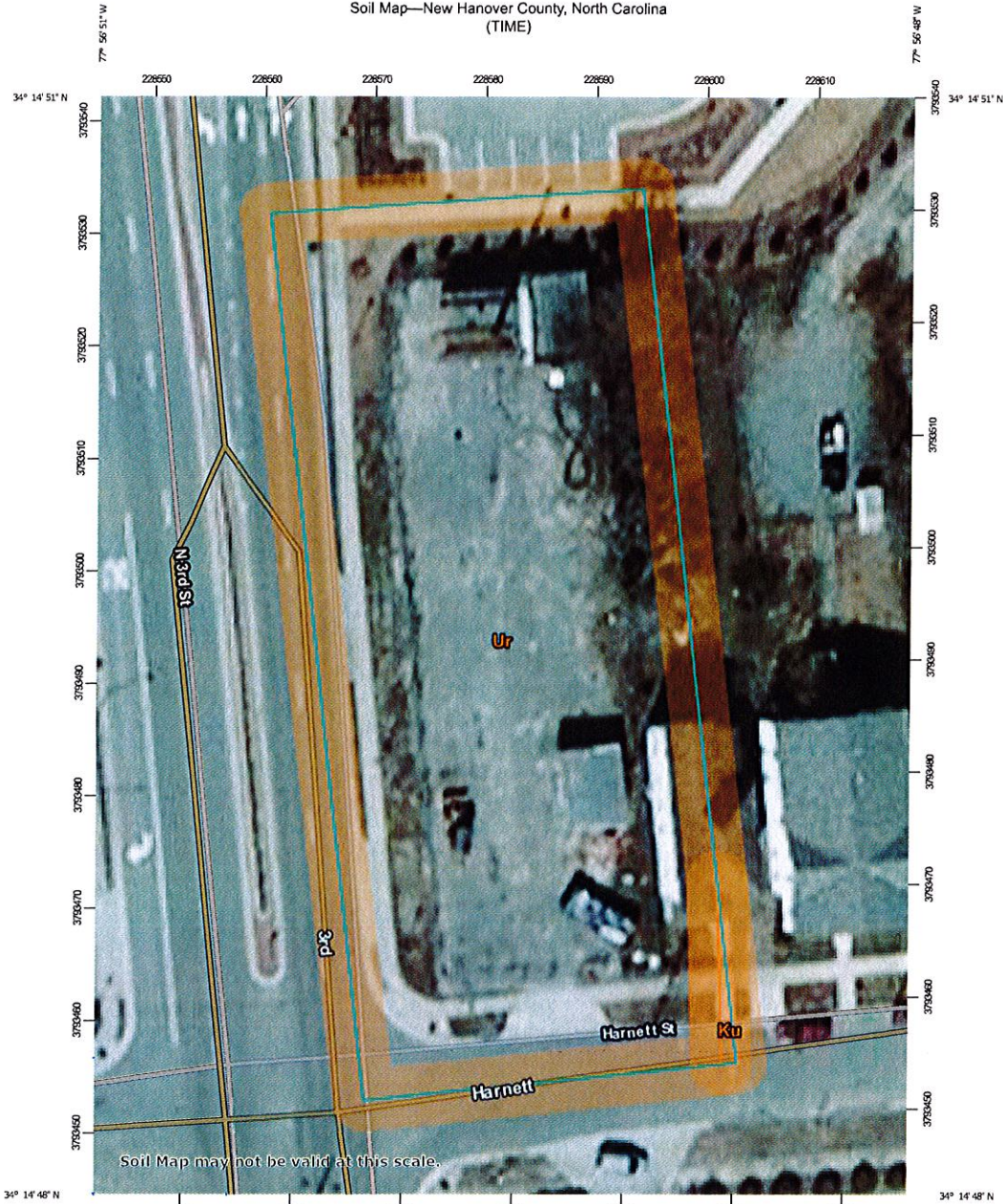
NOTES: Intensity = 98.50 / (Inlet time + 12.60) ^ 0.81; Return period = Yrs. 10 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

# Storm Sewer Tabulation

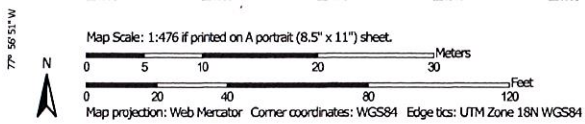
Station	Line	Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (ft) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
			incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	43.000	0.10	0.31	0.95	0.10	0.29	5.0	5.6	11.6	3.50	2.43	4.46	12	0.47	42.50	42.70	44.00	44.42	45.20	45.90	EX TO CB1
2	1	110.000	0.21	0.21	0.95	0.20	0.20	5.0	5.0	11.9	2.37	2.15	3.02	12	0.36	42.70	43.10	44.58	45.07	45.90	45.70	CB1 TO CB2
Project File: COLLECTION_SYSTEM.stm														Number of lines: 2		Run Date: 1/10/2017						

NOTES: intensity = 81.33 / (inlet time + 10.40) ^ 0.70; Return period = Yrs. 50; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Soil Map—New Hanover County, North Carolina  
(TIME)



Soil Map may not be valid at this scale.





# ECS SOUTHEAST, LLP

Geotechnical • Construction Materials • Environmental • Facilities

*"Setting the Standard for Service"*

NC Registered Engineering Firm F-1078  
NC Registered Geologists Firm C-406  
SC Registered Engineering Firm 3239

January 16, 2017

Mr. Bill Gilligan  
500 Sericea Ct.  
Wilmington, North Carolina 28412

Reference: Report of Seasonal High Water Table Estimation and Infiltration Testing  
Time Site  
Wilmington, New Hanover County, North Carolina  
ECS Project No. 49.3767

Dear Mr. Gilligan:

ECS Southeast, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing within the stormwater best management practice (BMP) area(s) at the corner of 3<sup>rd</sup> Street and Harnett Street in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

### Field Testing

On January 16, 2016, ECS conducted an exploration of the subsurface soil and groundwater conditions at one requested location shown on the attached Boring Location Plan (Figure 1). ECS located the boring using a site plan provided by Coastal Site Design, PLLC. The purpose of this exploration was to obtain subsurface information of the in situ soils for the stormwater BMP area(s). ECS explored the subsurface soil and groundwater conditions by advancing one hand auger boring into the existing ground surface at the requested boring location. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS also recorded the SHWT and groundwater elevation observed at the time of the hand auger boring. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring location.

The SHWT and groundwater elevation was estimated at the boring location below the existing grade elevation. A summary of the findings are as follows:

Location	SHWT	Groundwater
B-1	105 inches	>120 inches

ECS has conducted one infiltration test utilizing a compact constant head permeameter near the hand auger boring in order to estimate the infiltration rate for the subsurface soils. Infiltration tests are typically conducted at two feet above the SHWT or in the most restrictive soil horizon. Tests in clayey conditions are conducted and calculated up to 30 minute intervals. If an exact hydraulic conductivity is necessary for these locations, then ECS recommends collecting samples by advancing Shelby tubes and performing laboratory permeability testing.

### Field Test Results

Below is a summary of the infiltration test results:

Location	Description	Depth	Inches/ hour
B-1	Orange fine to med. SAND	65 inches	20.32

Infiltration rates and SHWT may vary within the proposed site due to changes in elevation and subsurface conditions.

### Closure

ECS's analysis of the site has been based on our understanding of the site, the project information provided to us, and the data obtained during our exploration. If the project information provided to us is changed, please contact us so that our recommendations can be reviewed and appropriate revisions provided, if necessary. The discovery of any site or subsurface conditions during construction which deviate from the data outlined in this exploration should be reported to us for our review, analysis and revision of our recommendations, if necessary. The assessment of site environmental conditions for the presence of pollutants in the soil and groundwater of the site is beyond the scope of this geotechnical exploration.

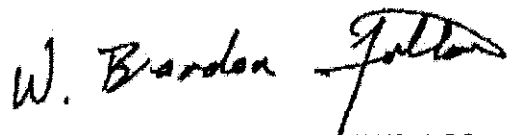
ECS appreciates the opportunity to provide our services to you on this project. If you have any questions concerning this report or this project, please contact us at (910) 686-9114.

Respectfully,

**ECS SOUTHEAST, LLP**



K. Brooks Wall  
Project Manager  
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W. Brandon Fulton, PSC, PWS, LSS  
Environmental Department Manager  
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704-525-5152

Attachments: Figure 1 - Boring Location Plan  
Infiltration Testing Form  
ASFE Document





**APPROXIMATE BORING LOCATION**



SCALE SHOWN ABOVE

Time Site  
Wilmington, New Hanover County,  
North Carolina

ECS Project # 49.3767  
January 16, 2017  
KBW



Figure 1– Boring Location Plan

Provided by: Google Earth

Infiltration Testing Form  
Time Site  
Wilmington, New Hanover County, North Carolina  
ECS Project No. 49.3767  
January 16, 2017

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-1	0-12"	SM	Brown/orange fine SAND w/ silt
	12"-70"	SP	Orange fine to med. SAND
	70"-120"	SP	Tan/brown fine to med. SAND

Seasonal High Water Table was estimated to be at 105 inches below the existing grade elevation.

Groundwater was not encountered up to 120 inches below the existing grade elevation.

Test was conducted at 65 inches below existing grade elevation

Infiltration Rate: 20.32 inches per hour



9" 12' ON  
 164 MILES  
 1" 39' ON  
 28 MILES

UTM GRID AND 2011 MAGNETIC NORTH  
 DECLINATION AT CENTER OF SHEET

# CASTLE HAYNE, NC

2013

# WILMINGTON, NC

2013

CONTOUR INTERVAL 5 FEET  
 NORTH AMERICAN VERTICAL DATUM OF 1988

**PERVIOUS PAVEMENT CALCULATIONS for  
TIME**

**PONDING TIME**

T = PONDING TIME DAYS  
P = 1.5 DEPTH OF THE DESIGN STORM (INCHES)  
R = 1 Aa/Ap (RATIO OF THE ADDITIONAL BUA TO THE PERMEABLE PAVEMENT, BETWEEN 0 AND 1)  
SF = 0.2 SAFETY FACTOR (0.2)  
I = 20.3 MEASURED IN-SITU SOIL INFILTRATION RATE (IN/HR)

$$T = P(1+R) / (24 \times SF \times I)$$

$$T = 0.03 \text{ DAYS}$$

**AGGREGATE DEPTH OF WATER QUALITY STORM (Dwq)**

Dwq = DEPTH OF AGGREGATE NEEDED TO TREAT THE WATER QUALITY STORM (INCHES)  
P = 1.5 RAINFALL DEPTH FOR THE WATER QUALITY STORM (INCHES)  
R = 1 Aa/Ap (RATIO OF THE ADDITIONAL BUA TO THE PERMEABLE PAVEMENT, BETWEEN 0 AND 1)  
n = 0.4 PERCENT VOIDS, UNITLESS DECIMAL

$$Dwq = P(1+R)/n$$

$$Dwq = 7.5 \text{ INCHES}$$

**AGGREGATE DEPTH TO INFILTRATE 10 YR 24 HR STORM**

D10 = DEPTH OF AGGREGATE NEEDED TO INFILTRATE 10 YR STORM (INCHES)  
P10 = 7.22 RAINFALL DEPTH FOR THE 10 YR STORM (INCHES)  
R = 1 Aa/Ap (RATIO OF THE ADDITIONAL BUA TO THE PERMEABLE PAVEMENT, BETWEEN 0 AND 1)  
d = 24 STORM DURATION (24 HRS)  
I = 20.3 MEASURED IN-SITU SOIL INFILTRATION RATE (IN/HR)  
SF = 0.2 SAFETY FACTOR (0.2)  
n = 0.4 PERCENT VOIDS, UNITLESS DECIMAL

$$D10 = P10(1+R) - (d)(I)(SF) / N$$

$$D10 = -208 \text{ INCHES}$$

IF D10 IS NEGATIVE THEN AGGREGATE DEPTH NEEDED WILL BE EQUAL TO Dwq

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**FEB 07 2017**

**ENGINEERING**