

**NARRATIVE STATEMENT
AND
DESIGN CALCULATIONS**

Health and Human Services

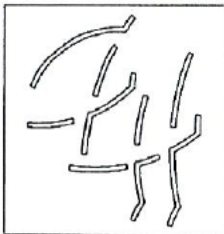
1650 Greenfield Street
Wilmington, NC

September, 2018

RECEIVED

SEP 5 2018

ENGINEERING



CLH design, p.a.

400 Regency Forest Drive, Suite 120
Cary, North Carolina 2751127518
Phone: (919) 319-6716 Fax: (919) 319-7516

Final SW Calcs
SWP 2018042

9/27/18

RAC

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Narrative Statement

Project Description

New Hanover County's Health and Human Services building is an existing office building located east of 16th St., west of 17th St., and South of Greenfield Street and is a 5.04 acre site.

This proposed re-development project consists two phases. In phase one, the new building, southern parking lot areas, and a new bus drop-off on 16th Street will be constructed while the existing building remains occupied. In phase two, the existing building will be demolished and the parking lot will be constructed while the new building is in operation. The construction limits of the project contain approximately 5.3 acres.

There is an existing 42" CMP storm pipe system that bypasses through the site from the northeast corner to the west of the site and discharges to the west of 16th Street near Willard Street. The site stormwater discharges into the 42" CMP system.

FEMA FIRM #3720313600J dated April 3, 2006 indicates there is a portion of the tract located in the zone "X" and shaded "X" (BFE 22.7) and zone "AE" floodway (BFE 22.7).

FEMA FIRM #3720312700K dated August 29, 2014 indicates there is a portion of the tract located in the zone "X" (BFE 24) and zone "AE" floodway (BFE 24).

Soils on the site consist predominately of Baymeade fine sand which is identified as type A hydrologic soil, some Seagate fine sands on the southeast side of the site which is identified as a type B hydrologic soil, and Johnston soils though the floodway area of the site which is identified as type A/D soils. Seasonal high water table and infiltration rate borings can be found on sheet C3.1-3.2.

The clearing limits are shown on Sheets C04.00 through C04.04. Construction consists of a new 94,560-sf four story office building, staff and visitor parking lots, bus drop off area on 16th Street, pervious concrete, and three underground infiltration devices, and associated utility infrastructure to serve the building.

Stormwater Management Methodology

Stormwater Quality

This project has been designed to treat the first 1.5" water quality volume. For the purposes of analysis, a portion of the total parcel area is delineated as the study area for this re-development. The study area encompasses all of the proposed construction for this project and includes 5.3 acres. The project consists of demolition of the existing building, constructing a new four story building, staff and visitor parking spaces, bus drop off area on 16th street, pervious concrete and three underground infiltration devices.

The existing impervious area on the site in the pre-development conditions is 174,417 sf (4 acres). The proposed post-development impervious area is 156,685 sf (3.60acres). The net change in impervious area due to this project will be a decrease of 0.41 acres (17,732 sf). Additionally, the site gets 32,427 sf (0.74 acres) credit from a previous parking expansion project (Exhibit plan sheet is attached in calculations booklet). Therefore the remaining new impervious area required to treat the first 1.5 inches of 124,258 sf (2.85 acres).

The site will meet stormwater treatment requirements by utilizing three underground detention devices and three permeable pavement areas treating approximately 1:1 ratio a total of 127,274 sf (2.92 acres) of impervious area, which is an extra 3,016 sf.

Please see the Stormwater Management Plan sheets (C-3.3 through C-3.5) for graphic representations of the pre-development and post-development impervious areas including drainage areas to each SCM, and drainage areas to each proposed inlet structure. The impervious square footages are detailed as required in the completed Stormwater Permit Application Form.

Stormwater Quantity

Since this is a re-development project with no net increase in impervious area, stormwater detention is not required.

Maps



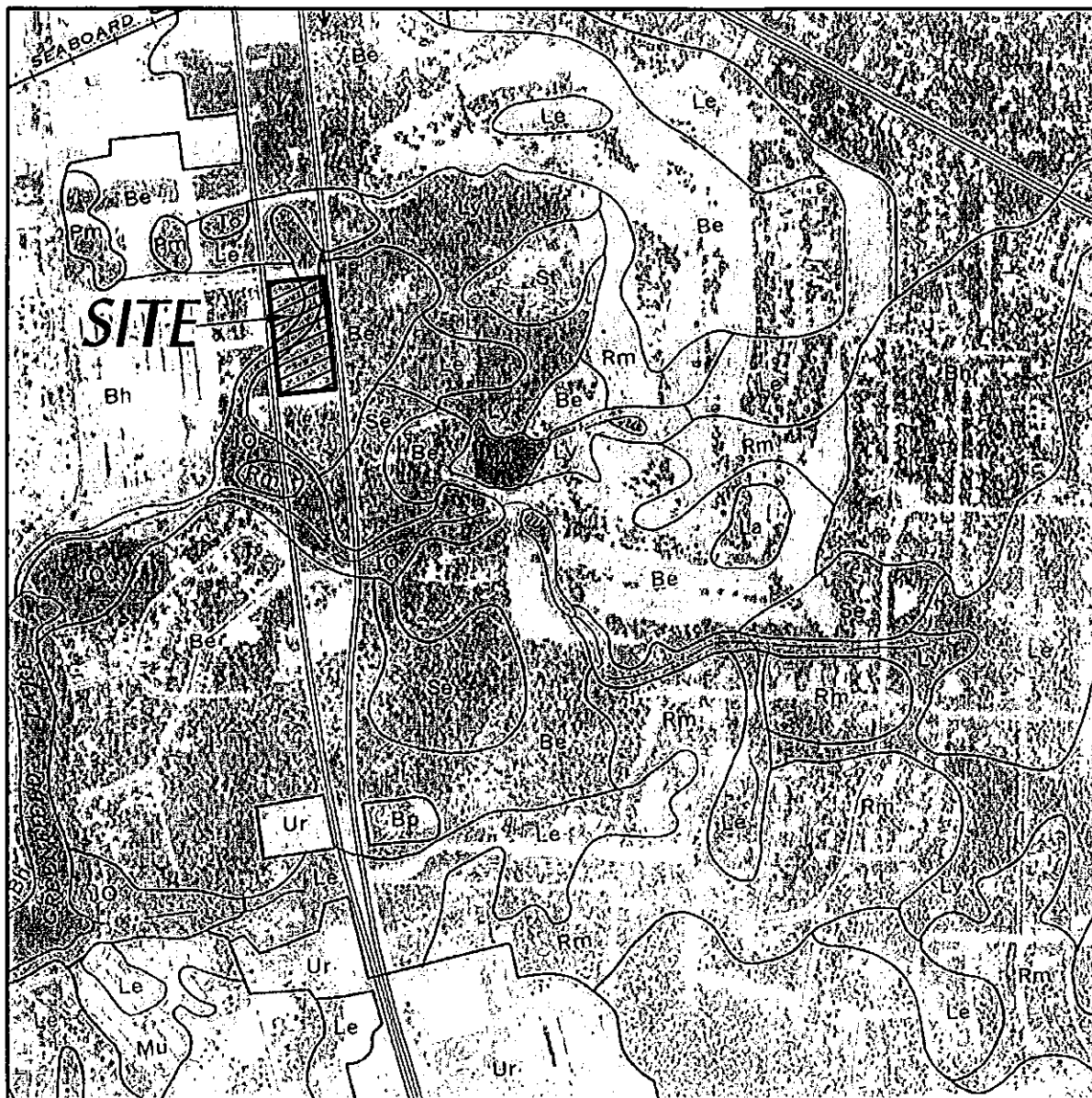
SCALE: 1" = 1000'

HEALTH AND HUMAN SERVICES
 WILMINGTON, NC
 DATE: MARCH, 2018
 PROJECT NO: 16-176

2013 WILMINGTON QUAD MAP



CLH DESIGN, P.A.
 Regency Park
 400 Regency Forest Drive
 Suite 120
 Cary, North Carolina 27518
 Phone: (919) 319-6716
 Fax: (919) 319-7516



SCALE: 1" = 1000'

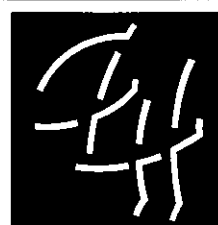
HEALTH AND HUMAN SERVICES

WILMINGTON, NC

DATE: MARCH, 2018

PROJECT NO: 16-176

NEW HANOVER COUNTY SOILS MAP



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Deed

NO REVENUE STAMPS

BOOK PAGE
2683 0048

Prepared by: DAVID E. HUFFINE, P.A.
202 North Third Street, 1st Floor, P.O. Box 2154
Wilmington, NC 28402 • (910) 251-1954

Tax Parcel No. ¹⁴ R 05419-002-000

STATE OF NORTH CAROLINA)
)
COUNTY OF NEW HANOVER)

QUITCLAIM DEED

000159

THIS QUITCLAIM DEED, made and entered into this the 13th day of November, 1997, by and between SOUTHPOINTE BUILDERS, INC., a North Carolina corporation, party of the first part, and NEW HANOVER COUNTY, a body politic organized under the laws of the State of North Carolina, party of the second part;

WITNESSETH:

THAT, the said party of the first part, for and in consideration of the sum of TEN DOLLARS (\$10.00) and other valuable considerations, to it in hand paid by the said party of the second part, the receipt whereof is hereby acknowledged, has remised and released, and by these presents do remise and release and forever quitclaim unto the party of the second part, and its successors and assigns, all right, title, claim, and interest of the said party of the first part in and to that certain tract, piece, parcel or lot of land, situate, lying and being in the County of New Hanover, State of North Carolina, and more particularly described as follows:

Any interest of the party of the first part in and to Block G of the Division of the French Property same as shown on map thereof recorded in Map Book 4, at Page 85 in the Office of the Register of Deeds of New Hanover County expressly excluding from the operation of this conveyance any portion of Primrose Street as shown on the aforementioned map which has now been removed from dedication by instrument recorded in Deed Book 1991, at Page 247 in the Office of the Register of Deeds of New Hanover County

TO HAVE AND TO HOLD the aforesaid tract or parcel of land and all privileges thereunto belonging to it, the said party of the second part, its successors and assigns, free and discharged from all right, title, claim or interest of the said party of the first part or anyone claiming by, through, or under it

IN TESTIMONY WHEREOF, the party of the first part has caused this instrument to be executed in its corporate name by its President, attested by its

615628

Returned To
David E. Huffine

Asst Secretary and sealed with its corporate seal, all the day and year first above written.

1999 DEC 21 PM 2:27

SOUTHPOINTE BUILDERS, INC.

RECORD HANOVER COUNTY
REGISTER OF DEEDS
SEARCHED
SERIALIZED

By: Allen Gray
President

ATTEST:

[Signature]
Asst Secretary
SOUTHPOINTE BUILDERS, INC.
CORPORATE SEAL

STATE OF NORTH CAROLINA)
COUNTY OF NEW HANOVER)

I, Jennifer B. Bolton, a Notary Public for the State of North Carolina, County of New Hanover do hereby certify that Edwin E. Collins personally appeared before me this day, and being by me first duly sworn, acknowledged that he is Asst Secretary of Southpointe Builders, Inc., a North Carolina corporation, and that by authority duly given and as the act of corporation, the foregoing instrument was signed by its President, sealed with its corporate seal and attested by himself as its Asst Secretary.

WITNESS my hand and official seal, this the 13th day of November, 1997.

[Seal]
JENNIFER B. BOLTON
NOTARY PUBLIC
NEW HANOVER COUNTY, N.C.

Jennifer B. Bolton
Notary Public

My Commission Expires: 12-9-97

STATE OF NORTH CAROLINA
New Hanover County

The Foregoing/ Annexed Certificate(s) of
Jennifer B. Bolton

Notary (Notaries) Public is/ are certified to be correct.

This the 21 day of Dec 1999

Mary Sue Oats, Register of Deeds
Mavis Ann Storer
Deputy/Assistant

Underground Infiltration Chamber Sizing

INFILTRATION BASIN SIZING		DATE 9-4-18	
PROJECT NAME New Hanover County Health and Human Services	PROJECT NO 16-176		
LOCATION Wilmington, NC	BY KAL		

Estimate of Infiltration Area and Volume Basin A

Drainage Area, (DA) = 0.74 ac
 Impervious Area c= 0.95 0.59 ac
 Pervious Area c= 0.20 0.15 ac
 Cc = 0.80
 Soil K (in/hr)= 0.92 in/hr
 % Impervious = 79.7 %

Temporary Water Quality Pool
 Design Storm Rainfall 1.50 in (Typically 1-in)
 Runoff Coeff. (Rv = 0.05 + 0.009 (% Imperv.)) = 0.77 ac/ac
 Required Volume (design rainfall)(Rv)(DA) = 3,093 cf

Depth Storage: 1.44 ft
 Bottom Surface Area: 2,272 sf
 Top Surface Area: 2,272 sf
 Volume Provided: 3,272 cf (Volume reduced for 95% void due to underground system)
 3,108 cf

Infiltration Design (Dewatering)
 Surface Area Req.=(12)(FS)(Vol)/(K)(t) 1,121 sf min.
 FS=2
 t=72 hrs
 2,272 sf provided

Dewatering
 Time=(12)(FS)(Vol)/(K)(SA) 38 hrs

Soils:
 60% Johnston Type D Open Space CN= 80
 40% Baymead Type A Open Space CN= 39
 Weighted Open Space: 63.6
 Drainage Area CN: 91.0

Routing:
 I10: 7.23 in/hr I50: 8.87 in/hr

Weir length in splitter manhole: 5 ft
 Weir elevation: 22.44 ft

Q10 peak (from Rational Method): = 4.269 cfs (assume chambers are full)
 h (above weir elevation): = 0.406 ft
Q10 water surface elevation = 22.85 ft

Q50 peak (from Rational Method): = 5.238 cfs (assume chambers are full)
 h (above weir elevation): = 0.465 ft
Q50 water surface elevation = 22.91 ft

INFILTRATION BASIN SIZING

DATE

9-4-18

PROJECT NAME

New Hanover County Health and Human Services

PROJECT NO

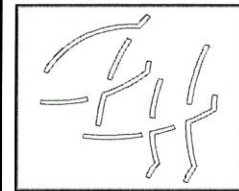
16-176

LOCATION

Wilmington, NC

BY

KAL

**Estimate of Infiltration Area and Volume****Basin B**

Drainage Area, (DA) = 1.52 ac
 Impervious Area c= 0.95 1.29 ac
 Pervious Area c= 0.20 0.23 ac
 Cc = 0.84
 Soil K (in/hr)= 3.00 in/hr
 % Impervious = 84.9 %

Temporary Water Quality Pool

Design Storm Rainfall 1.50 in (Typically 1-in)
 Runoff Coeff. (Rv = 0.05 + 0.009 (% Imperv.)) = 0.81 ac/ac
 Required Volume (design rainfall)(Rv)(DA) = 6,735 cf

Depth Storage: 2.60 ft
 Bottom Surface Area: 2,758 sf
 Top Surface Area: 2,758 sf (Volume reduced for
 Volume Provided: 7,171 cf 95% void due to
 6,812 cf underground system)

Infiltration Design (Dewatering)

Surface Area Req.= $(12)(FS)(Vol)/(K)(t)$ 748 sf min.
 FS=2
 t=72 hrs

Dewatering

Time= $(12)(FS)(Vol)/(K)(SA)$ 21 hrs

Soils:

40% Johnston Type D Open Space CN= 80
 60% Baymead Type A Open Space CN= 39
 Weighted Open Space: 55.4
 Drainage Area CN: 91.6

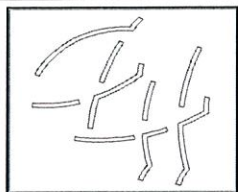
Routing:

110: 7.23 in/hr 150: 8.87 in/hr

Weir length in splitter manhole: 8 ft
 Weir elevation: 21.6 ft

Q10 peak (from Rational Method): = 9.193 cfs (assume chambers are full)
 h (above weir elevation): = 0.495 ft
Q10 water surface elevation = 22.09 ft

Q50 peak (from Rational Method): = 11.28 cfs (assume chambers are full)
 h (above weir elevation): = 0.567 ft
Q50 water surface elevation = 22.17 ft

INFILTRATION BASIN SIZING		DATE 9-4-18	
PROJECT NAME New Hanover County Health and Human Services		PROJECT NO 16-176	
LOCATION Wilmington, NC		BY KAL	

Estimate of Infiltration Area and Volume Basin C

Drainage Area, (DA) = 1.20 ac
 Impervious Area c= 0.95 0.93 ac
 Pervious Area c= 0.20 0.27 ac
 Cc = 0.78
 Soil K (in/hr)= 9.00 in/hr
 % Impervious = 77.5 %

Temporary Water Quality Pool

Design Storm Rainfall 1.50 in (Typically 1-in)
 Runoff Coeff. (Rv = 0.05 + 0.009 (% Imperv.)) = 0.75 ac/ac
 Required Volume (design rainfall)(Rv)(DA) = 4,884 cf

Depth Storage: 1.44 ft
 Bottom Surface Area: 3,593 sf
 Top Surface Area: 3,593 sf (Volume reduced for 95% void due to underground system)
 Volume Provided: 5,174 cf
 4,915 cf

Infiltration Design (Dewatering)

Surface Area Req.=(12)(FS)(Vol)/(K)(t) 181 sf min.
 FS=2
 t=72 hrs

Dewatering

Time=(12)(FS)(Vol)/(K)(SA) 3.84 hrs

Soils:

00% Johnston Type D Open Space CN= 80
 100% Baymead Type A Open Space CN= 39
 Weighted Open Space: 39
 Drainage Area CN: 84.7

Routing:

110: 7.23 in/hr 150: 8.87 in/hr

Weir length in splitter manhole: 5 ft
 Weir elevation: 20.24 ft

Q10 peak (from Rational Method): = 6.778 cfs (assume chambers are full)
 h (above weir elevation): = 0.553 ft
Q10 water surface elevation = 20.79 ft

Q50 peak (from Rational Method): = 8.316 cfs (assume chambers are full)
 h (above weir elevation): = 0.633 ft
Q50 water surface elevation = 20.87 ft

Stage Storage Table

Pond Report

Pond No. 1 - SCM A

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 21.00 ft. Voids = 95.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	21.00	2,272	0	0
0.25	21.25	2,272	540	540
0.50	21.50	2,272	540	1,079
0.75	21.75	2,272	540	1,619
1.00	22.00	2,272	540	2,158
1.25	22.25	2,272	540	2,698
1.44	22.44	2,272	410	3,108

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	0.00	0.00	0.00
Span (in)	= 18.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 20.00	0.00	0.00	0.00
Length (ft)	= 64.00	0.00	0.00	0.00
Slope (%)	= 0.94	0.00	0.00	n/a
N-Value	= .010	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	5.00	0.00	0.00
Crest El. (ft)	= 24.00	22.44	0.00	0.00
Weir Coeff.	= 3.30	3.30	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No
Exfil.(in/hr)	= 0.920 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	21.00	0.00	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.25	540	21.25	4.28 ic	---	---	---	0.00	0.00	---	---	0.048	---	0.048
0.50	1,079	21.50	4.28 ic	---	---	---	0.00	0.00	---	---	0.048	---	0.048
0.75	1,619	21.75	4.28 ic	---	---	---	0.00	0.00	---	---	0.048	---	0.048
1.00	2,158	22.00	4.28 ic	---	---	---	0.00	0.00	---	---	0.048	---	0.048
1.25	2,698	22.25	4.28 ic	---	---	---	0.00	0.00	---	---	0.048	---	0.048
1.44	3,108	22.44	4.28 ic	---	---	---	0.00	0.00	---	---	0.048	---	0.048

Pond Report

Pond No. 2 - SCM B

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 19.00 ft. Voids = 95.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	19.00	2,758	0	0
0.25	19.25	2,758	655	655
0.50	19.50	2,758	655	1,310
0.75	19.75	2,758	655	1,965
1.00	20.00	2,758	655	2,620
1.25	20.25	2,758	655	3,275
1.50	20.50	2,758	655	3,930
1.75	20.75	2,758	655	4,585
2.00	21.00	2,758	655	5,240
2.25	21.25	2,758	655	5,895
2.50	21.50	2,758	655	6,550
2.60	21.60	2,758	262	6,812

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 18.10	0.00	0.00	0.00
Length (ft)	= 70.00	0.00	0.00	0.00
Slope (%)	= 2.29	0.00	0.00	n/a
N-Value	= .010	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	5.00	0.00	0.00
Crest El. (ft)	= 24.00	21.60	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No
Exfil.(in/hr)	= 3.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Civ A cfs	Civ B cfs	Civ C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	19.00	0.00	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.25	655	19.25	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
0.50	1,310	19.50	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
0.75	1,965	19.75	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
1.00	2,620	20.00	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
1.25	3,275	20.25	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
1.50	3,930	20.50	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
1.75	4,585	20.75	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
2.00	5,240	21.00	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
2.25	5,895	21.25	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
2.50	6,550	21.50	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192
2.60	6,812	21.60	4.47 ic	---	---	---	0.00	0.00	---	---	0.192	---	0.192

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Tuesday, 09 / 4 / 2018

Pond No. 3 - SCM C

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 18.80 ft. Voids = 95.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	18.80	3,593	0	0
0.25	19.05	3,593	853	853
0.50	19.30	3,593	853	1,707
0.75	19.55	3,593	853	2,560
1.00	19.80	3,593	853	3,413
1.25	20.05	3,593	853	4,266
1.44	20.24	3,593	648	4,915

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 18.00	0.00	0.00	0.00
Length (ft)	= 20.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .010	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

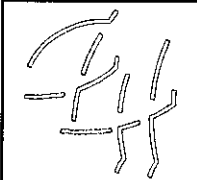
	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	5.00	0.00	0.00
Crest El. (ft)	= 23.50	20.25	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No
Exfil.(in/hr)	= 9.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	18.80	0.00	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.25	853	19.05	3.65 ic	---	---	---	0.00	0.00	---	---	0.749	---	0.749
0.50	1,707	19.30	3.65 ic	---	---	---	0.00	0.00	---	---	0.749	---	0.749
0.75	2,560	19.55	3.65 ic	---	---	---	0.00	0.00	---	---	0.749	---	0.749
1.00	3,413	19.80	3.65 ic	---	---	---	0.00	0.00	---	---	0.749	---	0.749
1.25	4,266	20.05	3.65 ic	---	---	---	0.00	0.00	---	---	0.749	---	0.749
1.44	4,915	20.24	3.65 ic	---	---	---	0.00	0.00	---	---	0.749	---	0.749

Permeable Pavement Design

Permeable Pavement	DATE 7/31/18	
PROJECT NAME New Hanover Health & Human Services	PROJECT NO 16-176	
LOCATION Wilmington, NC	BY KAL	

Permeable Pavement Area No.: A32

Drainage Area, (DA) =	3,014 sf	0.069 ac
Impervious Area c= 0.95	3,014 sf	0.069 ac
Pervious Area c= 0.20	0 sf	0.000 ac
Hydrologic Soil Group =	B	Mandarin Fine Sand
Cc =	0.95	
CN =	98	
% Impervious =	100.0 %	

Water Quality Volume Estimation

Simple Method

Design Storm Rainfall Depth	1.50 in	(1.5" Coastal, 1" Other)
Runoff Coeff. (Rv = 0.05 + 0.009 (% Imperv.)) =	0.95 ac/ac	
Runoff Volume, V (design rainfall)(Rv)(DA) =	358 cf	

Discrete NRCS Curve Number Method

Design Storm Rainfall Depth (P) =	1.50 in	(1.5" Coastal, 1" Other)
Soil Retention (S = (1000/CN) - 10) =	0.204 in	
Runoff Depth (Q* = ((P - 0.2S) ² / (P + 0.8S)) =	1.28 in	
Runoff Volume V (Q* x DA) =	322 cf	

Permeable Pavement

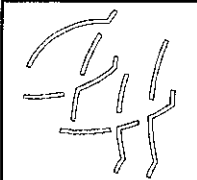
Area of Permeable Pavement (Ap) =	1,507 sf	0.035 ac
Area of Additional Built-Upon Area (Aa) =	1,507 sf	0.035 ac
Area of Pervious Surfaces =	0 sf	0.000 ac
Total Drainage Area =	3,014 sf	0.069 ac

Bottom Elevation of Subbase Aggregate =	21.83 ft
Porosity of Aggregate, P =	40%
Runoff Volume to be Contained in Aggregate, V =	322 cf
Ponding Depth of Runoff Volume in Aggregate =	7.50 in
D = (p(1+R)/n)	
Elev. of Runoff Volume Ponding in Aggregate =	22.46 ft

Selected Depth of Aggregate =	8.0 in
Storage Volume of Aggregate =	402 cf

Infiltration Rate of Subgrade Soils =	0.470 in/hr
Depth of Design Storm =	1.50 in
Aa/Ap =	1.00
Safety Factor (SF) =	0.2

Drawdown Time = P(1+R)/24*SF*i	1.3 days
	32 hrs

Permeable Pavement	DATE 7/31/18	
PROJECT NAME New Hanover Health & Human Services	PROJECT NO 16-176	
LOCATION Wilmington, NC	BY KAL	

Permeable Pavement Area No.: A33

Drainage Area, (DA) =	3,311 sf	0.076 ac
Impervious Area c= 0.95	3,311 sf	0.076 ac
Pervious Area c= 0.20	0 sf	0.000 ac
Hydrologic Soil Group =	B	Mandarin Fine Sand
Cc =	0.95	
CN =	98	
% Impervious =	100.0 %	

Water Quality Volume Estimation

Simple Method

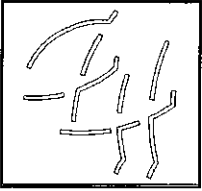
Design Storm Rainfall Depth	1.50 in	(1.5" Coastal, 1" Other)
Runoff Coeff. (Rv = 0.05 + 0.009 (% Imperv.)) =	0.95 ac/ac	
Runoff Volume, V (design rainfall)(Rv)(DA) =	393 cf	

Discrete NRCS Curve Number Method

Design Storm Rainfall Depth (P) =	1.50 in	(1.5" Coastal, 1" Other)
Soil Retention (S = (1000/CN) - 10) =	0.204 in	
Runoff Depth (Q* = ((P - 0.2S) ² / (P + 0.8S)) =	1.28 in	
Runoff Volume V (Q* x DA) =	353 cf	

Permeable Pavement

Area of Permeable Pavement (Ap) =	1,683 sf	0.039 ac
Area of Additional Built-Upon Area (Aa) =	1,628 sf	0.037 ac
Area of Pervious Surfaces =	0 sf	0.000 ac
Total Drainage Area =	3,311 sf	0.076 ac
Bottom Elevation of Subbase Aggregate =	21.83 ft	
Porosity of Aggregate, P =	40%	
Runoff Volume to be Contained in Aggregate, V =	353 cf	
Ponding Depth of Runoff Volume in Aggregate =	7.38 in	
D = (p(1+R)/n)		
Elev. of Runoff Volume Ponding in Aggregate =	22.44 ft	
Selected Depth of Aggregate =	8.0 in	
Storage Volume of Aggregate =	449 cf	
Infiltration Rate of Subgrade Soils =	0.470 in/hr	
Depth of Design Storm =	1.50 in	
Aa/Ap =	0.97	
Safety Factor (SF) =	0.2	
Drawdown Time = P(1+R)/24*SF*i	1.3 days	
	31 hrs	

Permeable Pavement	DATE 7/31/18	
PROJECT NAME New Hanover Health & Human Services	PROJECT NO 16-176	
LOCATION Wilmington, NC	BY KAL	

Permeable Pavement Area No.: A34

Drainage Area, (DA) =	3,612 sf	0.083 ac
Impervious Area c= 0.95	3,612 sf	0.083 ac
Pervious Area c= 0.20	0 sf	0.000 ac
Hydrologic Soil Group =	B	Mandarin Fine Sand
Cc =	0.95	
CN =	98	
% Impervious =	100.0 %	

Water Quality Volume Estimation

Simple Method

Design Storm Rainfall Depth	1.50 in	(1.5" Coastal, 1" Other)
Runoff Coeff. (Rv = 0.05 + 0.009 (% Imperv.)) =	0.95 ac/ac	
Runoff Volume, V (design rainfall)(Rv)(DA) =	429 cf	

Discrete NRCS Curve Number Method

Design Storm Rainfall Depth (P) =	1.50 in	(1.5" Coastal, 1" Other)
Soil Retention (S = (1000/CN) - 10) =	0.204 in	
Runoff Depth (Q* = ((P - 0.2S) ² / (P + 0.8S)) =	1.28 in	
Runoff Volume V (Q* x DA) =	385 cf	

Permeable Pavement

Area of Permeable Pavement (Ap) =	1,827 sf	0.042 ac
Area of Additional Built-Upon Area (Aa) =	1,785 sf	0.041 ac
Area of Pervious Surfaces =	0 sf	0.000 ac
Total Drainage Area =	3,612 sf	0.083 ac


Bottom Elevation of Subbase Aggregate =	21.83 ft
Porosity of Aggregate, P =	40%
Runoff Volume to be Contained in Aggregate, V =	385 cf
Ponding Depth of Runoff Volume in Aggregate =	7.41 in
D = (p(1+R)/n)	
Elev. of Runoff Volume Ponding in Aggregate =	22.45 ft

Selected Depth of Aggregate =	8.0 in
Storage Volume of Aggregate =	487 cf

Infiltration Rate of Subgrade Soils =	0.470 in/hr
Depth of Design Storm =	1.50 in
Aa/Ap =	0.98
Safety Factor (SF) =	0.2

Drawdown Time = $P(1+R)/24*SF*i$	1.3 days
	32 hrs

Time of Concentration

	DATE 4/20/18	
PROJECT NAME New Hanover Health & Human Services	PROJECT NO 16-176	
LOCATION Wilmington, NC	BY KAL	

BASIN: A
Pre and Post Development

Sheet Flow

Manning's Coefficient (n)	0.41
Flow Length	50 ft
2-yr, 24-hr Rainfall Depth	3.6 in
Hydraulic Change in Elevation	2.0 ft
Slope	0.040 ft/ft
Time of Concentration (T _c)	9.0 min

Shallow Concentrated Flow

Flow Length	1650 ft
Hydraulic Change in Elevation	20.0 ft
Watercourse Slope	0.012 ft/ft
Average Velocity	1.8 ft/s
Time of Concentration (T _c)	15.3 min

(From TR-55 Figure 3.1, 2nd Ed. 1986)

Channel Flow

No. 1
Channel

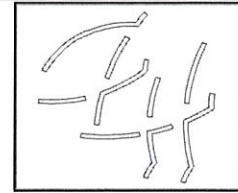
Side Slope	2 :1
Depth	4.0 ft
Channel Base / Pipe Dia.	4.0 ft
Cross Sectional Area	48.00 sf
Wetted Perimeter	21.89 ft
Hydraulic Radius	2.19 ft
Channel/Pipe Slope	0.0139 ft/ft
Hydraulic Change in Elevation	7.5 ft
Manning's Coefficient (n)	0.025
Velocity	11.82 ft/s
Flow Length	540 ft
Time of Concentration (T _c)	0.8 min

Subarea T_c 25.0 min

**Storm Drainage System
10 Year**

**TIME OF CONCENTRATION
SCS METHOD**

DATE
4/20/18



PROJECT NAME
New Hanover Health & Human Services

PROJECT NO
16-176

LOCATION
Wilmington, NC

BY
KAL

BASIN: A
Pre and Post Development

Sheet Flow

Manning's Coefficient (n)	0.41
Flow Length	50 ft
2-yr, 24-hr Rainfall Depth	3.6 in
Hydraulic Change in Elevation	2.0 ft
Slope	0.040 ft/ft
Time of Concentration (T_c)	9.0 min

Shallow Concentrated Flow

Flow Length	1650 ft
Hydraulic Change in Elevation	20.0 ft
Watercourse Slope	0.012 ft/ft
Average Velocity	1.8 ft/s
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(From TR-55 Figure 3.1, 2nd Ed. 1986)

Channel Flow **No. 1**
Channel

Side Slope	2 :1
Depth	4.0 ft
Channel Base / Pipe Dia.	4.0 ft
Cross Sectional Area	48.00 sf
Wetted Perimeter	21.89 ft
Hydraulic Radius	2.19 ft
Channel/Pipe Slope	0.0139 ft/ft
Hydraulic Change in Elevation	7.5 ft
Manning's Coefficient (n)	0.025
Velocity	11.82 ft/s
Flow Length	540 ft
Time of Concentration (T_c)	0.8 min

Subarea T_c 25.0 min





10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
9-4-18

PROJECT NO
16-176

BY
AS

CHECKED BY
-

DESIGN PHASE

PRELIM / /

CONSTR / /

REVISION / /

RECORD / /

OTHER / /

(SPECIFY)

CONTINUED →

STORM DRAINAGE SCHEDULE

n= 0.013

g= 252

h= 30

I= 7.20

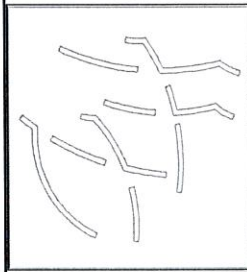
FROM	TO	INLET AREA (SF)	INLET AREA (AC)	IMPERVIOUS (%)	INLET Cc RUNOFF COEFF.	INLET DISCHARGE (CFS)	TOTAL AREAS (AC)	INLET TIME (MIN)	PIPE TIME (MIN)	Tc TIME OF CONC. (MIN)	I INTENSITY (IN/HR)	Cc RUNOFF COEFF.
A1	A2	1,810,425	41.56	6	0.25	46.65	41.56	25.00	0.00	25.00	4.58	0.25
A2	A3	171,345	3.93	70	0.73	20.53	45.50	10.50	0.28	25.28	4.56	0.29
A3	A4	2,280	0.05	0	0.20	0.08	45.55	5.00	0.45	25.45	4.54	0.29
A4	A5	0	0.00	0	0.20	0.00	45.55	5.00	0.57	25.57	4.53	0.29
A5	A6	0	0.00	0	0.20	0.00	45.55	5.00	1.02	26.02	4.50	0.29
A6	A7	0	0.00	0	0.20	0.00	45.55	5.00	1.31	26.31	4.48	0.29
A7	A7A	0	0.00	0	0.20	0.00	45.55	5.00	1.43	26.43	4.47	0.29
A7A	A8	0	0.00	0	0.20	0.00	45.55	5.00	1.46	26.46	4.46	0.29
A30	A31	5,860	0.13	65	0.68	0.42	0.13	5.00	0.00	5.00	7.20	0.68
A31	A32	0	0.00	0	0.20	0.00	0.13	5.00	0.53	5.53	7.09	0.68
A32	A33	3,014	0.07	50	0.58	0.29	0.20	5.00	0.66	5.66	7.07	0.64
A33	A5	3,311	0.08	50	0.58	0.31	0.28	5.00	0.90	5.90	7.02	0.63
A34	A33	3,612	0.08	50	0.58	0.22	0.08	5.00	0.00	16.00	5.48	0.58
B1	B2	11,570	0.27	90	0.88	1.06	0.27	5.00	0.00	5.00	7.20	0.88
B2	B3	0	0.00	0	0.20	0.00	0.27	5.00	0.04	5.04	7.19	0.88
B3	B4	11,120	0.26	90	0.88	1.61	0.52	5.00	0.15	5.15	7.17	0.88
B4	B5	15,290	0.35	90	0.88	2.21	0.87	5.00	0.59	5.59	7.08	0.88
B5	B6	9,680	0.22	75	0.76	1.22	1.09	5.00	0.97	5.97	7.01	0.85
B6	B7	0	0.00	0	0.20	0.00	1.09	5.00	1.00	6.00	7.00	0.85
B7	B8	2,820	0.06	70	0.73	0.34	1.16	5.00	1.05	6.05	6.99	0.85
B8	B9	1,940	0.04	15	0.31	0.10	1.20	5.00	1.13	6.13	6.97	0.83
B9	B10	22,250	0.51	70	0.73	2.67	1.71	5.00	1.53	6.53	6.90	0.80
B10	B11	6,600	0.15	30	0.43	0.46	1.87	5.00	1.77	6.77	6.85	0.77
B11	A7	0	0.00	0	0.20	0.00	1.87	5.00	1.82	6.82	6.84	0.77
B80	B8	4,550	0.10	90	0.88	0.42	0.10	5.00	0.00	5.00	7.20	0.88

	10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements			DATE	DESIGN PHASE	
	PROJECT NAME			9-4-18	PRELIM	/x /
	New Hanover Health and Human Resources			PROJECT NO	CONSTR	/ /
	LOCATION			16-176	REVISION	/ /
Wilmington, NC			BY	RECORD	/ /	
			AS	OTHER	/ /	
			CHECKED BY	(SPECIFY)	/ /	

STORM DRAINAGE SCHEDULE - CONTINUED

n=	0.013
g=	252
h=	30
l=	7.20

FROM	TO	Q	DISCHARGE (CFS)	Q	SIDE-STREAM (CFS)	SLOPE	DIA. (IN)	CAPACITY (FULL) (CFS)	V FULL (FPS)	LENGTH (FT)	SEGMENT TIME (MIN)	UPPER INV. (FT)	LOWER INV. (FT)	UPSTREAM TOP ELEV. (FT)	PIPE COVER (FT)
A1	A2	46.65	0.00	-0.0002	42	46.7	4.8	81	0.28	18.50	18.52	23.80	1.48		
A2	A3	59.42	0.00	-0.0002	42	59.4	6.2	62	0.17	18.52	18.53	23.00	0.66		
A3	A4	59.29	0.00	0.0124	48	159.7	12.7	93	0.12	17.95	16.80	24.50	2.19		
A4	A5	63.61	4.45	0.0069	48	119.5	9.5	260	0.46	16.70	14.90	25.30	4.24		
A5	A6	64.62	1.49	0.0072	48	122.1	9.7	166	0.29	14.80	13.60	23.40	4.24		
A6	A7	64.32	0.00	0.0079	48	127.6	10.1	76	0.12	13.50	12.90	23.40	5.54		
A7	A7A	82.75	18.56	0.0000	42	82.8	8.6	16	0.03	12.73	12.73	21.00	4.45		
A7A	A8	82.72	0.00	0.0000	42	82.7	8.6	70	0.14	12.73	12.73	19.90	3.35		
A30	A31	0.66	0.00	0.0102	10	2.2	4.0	128	0.53	21.00	19.70	23.85	1.94		
A31	A32	0.65	0.00	0.0118	10	2.4	4.4	34	0.13	19.70	19.30	23.50	2.89		
A32	A33	0.93	0.00	0.0069	18	8.8	4.9	72	0.24	18.80	18.30	23.58	3.14		
A33	A5	1.49	0.26	0.0062	18	8.3	4.7	24	0.09	18.20	18.05	23.58	3.74		
A34	A33	0.26	0.00	0.0094	15	6.3	5.1	64	0.21	18.90	18.30	23.58	3.32		
B1	B2	1.79	0.12	0.0056	12	2.7	3.4	9	0.04	20.47	20.42	24.00	2.44		
B2	B3	1.79	0.00	0.0050	12	2.5	3.2	20	0.10	20.32	20.22	24.50	3.09		
B3	B4	3.38	0.00	0.0051	15	4.6	3.8	100	0.44	20.12	19.61	24.00	2.52		
B4	B5	5.52	0.00	0.0056	18	7.9	4.4	100	0.38	19.51	18.95	23.90	2.75		
B5	B6	6.65	0.00	0.0056	24	16.9	5.4	9	0.03	18.85	18.80	23.10	2.07		
B6	B7	6.64	0.00	0.0289	24	38.5	12.2	38	0.05	18.00	16.90	22.35	2.17		
B7	B8	6.96	0.00	0.0250	24	35.8	11.4	56	0.08	16.80	15.40	22.40	3.42		
B8	B9	7.04	0.00	0.0055	24	16.7	5.3	128	0.40	15.30	14.60	19.80	2.32		
B9	B10	9.52	0.00	0.0056	30	30.6	6.2	90	0.24	14.50	14.00	19.50	2.27		
B10	B11	9.90	0.00	0.0091	30	39.1	8.0	22	0.05	13.90	13.70	19.85	3.22		
B11	A7	18.56	8.67	0.0125	30	45.9	9.3	8	0.01	13.60	13.50	22.00	5.67		
B80	B8	0.66	0.00	0.0192	10	3.0	5.6	13	0.04	16.85	16.60	20.35	2.59		



10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
9-4-18

PROJECT NO
16-176

BY
AS

CHECKED BY
-

DESIGN PHASE	
PRELIM	/x/
CONSTR	/ /
REVISION	/ /
RECORD	/ /
OTHER	/ /
(SPECIFY)	

n= 0.013

g= 252

h= 30

l= 7.20

HYDRAULIC GRADE LINE

CONTINUED →

FROM	TO	PIPE AREA (FT)	HYDRAULIC RADIUS (FT)	SIDESTREAM SUMMATION (CFS)	Hf	HEAD LOSS				BEND LOSS				BEND LOSS K	FRICTION SLOPE (FT/FT)	FRICTION VELOCITY (FPS)
						Hc	He	Hb	Ht	90° = 0.70	70° = 0.61	50° = 0.47	30° = 0.28			
A1	A2	9.6211	0.8750	0.00	0.59	0.31	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.0072	8.89
A2	A3	9.6211	0.8750	0.00	0.73	0.50	0.43	0.00	1.66	0.00	0.00	0.00	0.00	0.00	0.0118	11.32
A3	A4	12.5664	1.0000	0.00	0.16	0.09	0.70	0.94	1.87	0.00	0.00	0.00	0.00	0.00	0.0017	4.68
A4	A5	12.5664	1.0000	4.45	0.50	0.10	0.12	0.24	0.96	0.00	0.00	0.00	0.00	0.00	0.0019	5.02
A5	A6	12.5664	1.0000	5.94	0.33	0.10	0.14	0.27	0.84	0.00	0.00	0.00	0.00	0.00	0.0020	5.10
A6	A7	12.5664	1.0000	5.94	0.15	0.10	0.14	0.15	0.55	0.00	0.00	0.00	0.00	0.00	0.0020	5.08
A7	A7A	9.6211	0.8750	24.50	0.11	0.28	0.14	0.15	0.68	0.00	0.00	0.00	0.00	0.00	0.0067	8.54
A7A	A8	9.6211	0.8750	24.50	0.47	0.28	0.40	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.0067	8.54
A30	A31	0.5454	0.2083	0.00	0.12	0.01	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.0009	1.21	
A31	A32	0.5454	0.2083	0.00	0.03	0.01	0.01	0.01	0.06	0.00	0.00	0.00	0.00	0.0009	1.19	
A32	A33	1.7671	0.3750	0.00	0.01	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.0001	0.52	
A33	A5	1.7671	0.3750	0.26	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0002	0.84	
A34	A33	1.2272	0.3125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.21	
B1	B2	0.7854	0.2500	0.12	0.02	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.0025	2.27	
B2	B3	0.7854	0.2500	0.12	0.05	0.02	0.03	0.04	0.14	0.00	0.00	0.00	0.00	0.0025	2.27	
B3	B4	1.2272	0.3125	0.12	0.27	0.03	0.03	0.02	0.35	0.00	0.00	0.00	0.00	0.0027	2.75	
B4	B5	1.7671	0.3750	0.12	0.27	0.04	0.04	0.06	0.41	0.00	0.00	0.00	0.00	0.0027	3.11	
B5	B6	3.1416	0.5000	0.12	0.01	0.02	0.05	0.09	0.17	0.00	0.00	0.00	0.00	0.0009	2.11	
B6	B7	3.1416	0.5000	0.12	0.03	0.02	0.02	0.05	0.12	0.00	0.00	0.00	0.00	0.0009	2.10	
B7	B8	3.1416	0.5000	0.12	0.05	0.02	0.02	0.01	0.10	0.00	0.00	0.00	0.00	0.0009	2.10	
B8	B9	3.1416	0.5000	0.12	0.12	0.02	0.03	0.05	0.22	0.00	0.00	0.00	0.00	0.0010	2.23	
B9	B10	4.9087	0.6250	0.12	0.05	0.01	0.03	0.00	0.09	0.00	0.00	0.00	0.00	0.0005	1.93	
B10	B11	4.9087	0.6250	0.12	0.01	0.02	0.02	0.03	0.08	0.00	0.00	0.00	0.00	0.0006	2.01	
B11	A7	4.9087	0.6250	8.79	0.02	0.05	0.02	0.04	0.14	0.00	0.00	0.00	0.00	0.0020	3.76	
B80	B8	0.5454	0.2083	0.00	0.01	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.0009	1.20	

10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources
LOCATION
Wilmington, NC

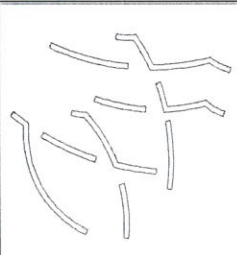
DATE	9-4-18	DESIGN PHASE	PRELIM <input checked="" type="checkbox"/>
PROJECT NO	16-176	CONSTR	<input type="checkbox"/>
BY	AS	REVISION	<input type="checkbox"/>
AS		RECORD	<input type="checkbox"/>
CHECKED BY		OTHER	<input type="checkbox"/>
		(SPECIFY)	

- DESIGN CRITERIA:
- DESIGN FOR THE 10 YR STORM
 - ASSUME TIME OF CONCENTRATION TO AN INDIVIDUAL INLET = 5 MIN.
 - INTENSITY = $g/(h+T)$, FOR 10 YR STORM
 - MANNINGS "n" FACTOR= .013
 - RATIONAL METHOD: C= .20 GRASS, C= .95 PAVEMENT

HYDRAULIC GRADE LINE - CONTINUED

n= 0.013
g= 252
h= 30
l= 7.20

FROM	TO	OUTLET W.S. ELEV (FT)	INLET W.S. ELEV.		FLOW CONDITION CONTROL	FREE-BOARD (FT)	UPSTREAM INLET TYPE	COMMENTS
			OUTLET CONTROL (FT)	INLET CONTROL (FT)				
A1	A2	24.23	25.12	21.26	OUTLET	(1.32)	HW	OVERFLOW
A2	A3	22.57	24.23	21.92	OUTLET	(1.23)	JB	OVERFLOW
A3	A4	20.70	22.57	20.91	OUTLET	1.93	DI	OK
A4	A5	19.74	20.70	19.81	OUTLET	4.60	MH	OK
A5	A6	18.90	19.74	17.94	OUTLET	3.66	MH	OK
A6	A7	18.35	18.90	16.63	OUTLET	4.50	MH	OK
A7	A7A	17.67	18.35	17.67	OUTLET	2.65	MH	OK
A7A	A8	15.53	16.68	17.67	INLET	2.23	MH	OK
A30	A31	20.18	20.30	Tailwater Elev= 15.53	INLET	2.37	CO	OK
A31	A32	19.77	19.83	20.18	INLET	3.32	CO	OK
A32	A33	19.75	19.77	19.56	OUTLET	3.31	CB	OK
A33	A5	19.74	19.75	18.98	OUTLET	3.33	CB	OK
A34	A33	19.75	19.76	Tailwater Elev= 19.74	OUTLET	3.32	CB	OK
B1	B2	21.86	21.91	19.53	OUTLET	3.32	CB	OK
B2	B3	21.72	21.86	Tailwater Elev= 19.75	OUTLET	1.59	CB	OK
B3	B4	21.37	21.72	21.04	OUTLET	2.64	MH	OK
B4	B5	20.96	21.37	21.07	OUTLET	1.78	CB	OK
B5	B6	20.79	21.37	20.68	OUTLET	2.03	CB	OK
B6	B7	20.96	20.96	21.37	OUTLET	1.64	CB	OK
B7	B8	18.98	19.10	20.04	INLET	3.16	MH	OK
B8	B9	18.88	18.98	18.01	OUTLET	2.92	CB	OK
B9	B10	18.66	18.88	16.52	OUTLET	0.92	DI	OK
B10	B11	18.57	18.66	15.91	OUTLET	0.34	CB	OK
B11	A7	18.49	18.57	15.33	OUTLET	0.78	CB	OK
B80	B8	18.35	18.49	15.47	OUTLET	3.51	MH	OK
B80	B8	18.88	18.90	Tailwater Elev= 18.35	OUTLET	1.45	CO	OK

	10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements		DATE 9-4-18	DESIGN PHASE PRELIM <input checked="" type="checkbox"/> / CONSTR <input type="checkbox"/> / REVISION <input type="checkbox"/> / RECORD <input type="checkbox"/> / OTHER <input type="checkbox"/> / (SPECIFY)
	PROJECT NAME New Hanover Health and Human Resources		PROJECT NO 16-176	
	LOCATION Wilmington, NC		BY AS	
			CHECKED BY _	

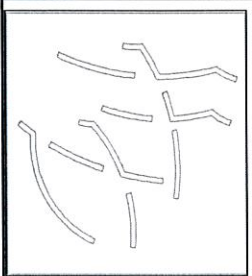
$n = 0.013$ $g = 252$ $h = 30$ $I = 7.20$	STORM DRAINAGE SCHEDULE		CONTINUED →									
FROM	TO	INLET AREA (SF)	INLET AREA (AC)	IMPERVIOUS (%)	INLET Cc RUNOFF COEFF.	INLET DISCHARGE (CFS)	TOTAL AREAS (AC)	INLET TIME (MIN)	PIPE TIME (MIN)	Tc TIME OF CONC. (MIN)	I INTENSITY (IN/HR)	Cc RUNOFF COEFF.

C1	C2	8,260	0.19	90	0.88	0.76	0.19	5.00	0.00	5.00	7.20	0.88
C2	C3	3,970	0.09	95	0.91	0.60	0.28	5.00	0.16	5.16	7.17	0.89
C3	C4	7,680	0.18	90	0.88	1.11	0.46	5.00	0.38	5.38	7.12	0.88
C4	C5	9,560	0.22	90	0.88	1.38	0.68	5.00	0.54	5.54	7.09	0.88
C5	B11	0	0.00	0	0.20	0.00	0.68	5.00	0.61	5.61	7.08	0.88
C20	C21	11,910	0.27	75	0.76	0.96	0.27	5.00	0.00	5.00	7.20	0.76
C21	C2	800	0.02	95	0.91	0.12	0.29	5.00	0.10	5.10	7.18	0.77
C23	C22	4,270	0.10	95	0.91	0.41	0.10	5.00	0.00	5.00	7.20	0.91
C22	C2	2,570	0.06	90	0.88	0.37	0.06	5.00	0.00	5.00	7.20	0.88
C30	C31	10,110	0.23	85	0.84	0.89	0.23	5.00	0.00	5.00	7.20	0.84
C31	C3	7,270	0.17	95	0.91	1.10	0.40	5.00	0.35	5.35	7.13	0.87
D1	D2	910	0.02	0	0.18	0.02	0.02	5.00	0.00	5.00	7.20	0.18
D2	D3	670	0.02	0	0.18	0.02	0.04	5.00	0.33	5.33	7.13	0.08
D3	D4	0	0.00	0	0.18	0.00	0.04	5.00	0.50	5.50	7.10	0.10
D4	B1	1,240	0.03	0	0.18	0.04	0.06	5.00	0.52	5.52	7.09	0.14
D5	D6	910	0.02	0	0.18	0.02	0.02	5.00	0.00	5.00	7.20	0.18
D6	D4	930	0.02	0	0.18	0.03	0.06	5.00	0.52	5.52	7.09	0.13
E1	E2	2,610	0.06	95	0.91	0.25	0.06	5.00	0.00	5.00	7.20	0.91
E2	E3	29,570	0.68	85	0.84	4.09	0.74	5.00	0.25	5.25	7.15	0.84
E3	A4	0	0.00	0	0.20	0.00	0.74	5.00	0.28	5.28	7.14	0.84

	10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements		DATE	DESIGN PHASE	
	PROJECT NAME		9-4-18	PRELIM	/x/
	New Hanover Health and Human Resources		PROJECT NO	CONSTR	/ /
	LOCATION Wilmington, NC		16-176	REVISION	/ /
		BY	RECORD	/ /	
		AS	OTHER	/ /	
		CHECKED BY	(SPECIFY)		

STORM DRAINAGE SCHEDULE - CONTINUED													
FROM	TO	Q DISCHARGE (CFS)	Q SIDE- STREAM (CFS)	SLOPE	DIA. (IN)	CAPACITY (FULL) (CFS)	V FULL (FPS)	LENGTH (FT)	SEGMENT TIME (MIN)	UPPER INV. (FT)	LOWER INV. (FT)	UPSTREAM TOP ELEV. (FT)	PIPE COVER (FT)
		n= 0.013											
		g= 252											
		h= 30											
		l= 7.20											
C1	C2	1.19	0.00	0.0181	12	4.8	6.1	58	0.16	21.90	20.85	24.90	1.91
C2	C3	3.77	1.99	0.0080	18	9.4	5.3	69	0.22	20.15	19.60	24.25	2.46
C3	C4	7.33	2.47	0.0043	24	14.9	4.7	46	0.16	19.40	19.20	23.60	2.02
C4	C5	8.68	0.00	0.0045	24	15.3	4.8	22	0.08	19.10	19.00	23.40	2.12
C5	B11	8.67	0.00	0.0135	24	26.3	8.4	74	0.15	17.00	16.00	23.70	4.52
C20	C21	1.50	0.00	0.0068	12	2.9	3.7	22	0.10	20.75	20.60	24.40	2.56
C21	C2	1.62	0.00	0.0050	12	2.5	3.2	50	0.26	20.50	20.25	24.25	2.66
C23	C22	0.64	0.00	0.0055	12	2.6	3.3	55	0.27	20.80	20.50	25.00	3.11
C22	C2	0.37	0.00	0.0065	12	2.9	3.7	23	0.10	20.40	20.25	24.37	2.88
C30	C31	1.40	0.00	0.0069	12	3.0	3.8	80	0.35	20.60	20.05	23.60	1.91
C31	C3	2.47	0.00	0.0056	15	4.8	3.9	80	0.34	19.95	19.50	23.60	2.29
D1	D2	0.03	0.00	0.0120	8	1.3	3.8	75	0.33	27.00	26.10	30.25	2.52
D2	D3	0.02	0.00	0.0408	8	2.4	7.0	71	0.17	26.00	23.10	31.50	4.77
D3	D4	0.03	0.00	0.0750	8	3.3	9.5	12	0.02	23.00	22.10	31.50	7.77
D4	B1	0.12	0.05	0.0104	8	1.2	3.5	48	0.23	22.00	21.50	29.00	6.27
D5	D6	0.03	0.00	0.0108	8	1.3	3.6	65	0.30	25.00	24.30	27.00	1.27
D6	D4	0.05	0.00	0.0254	8	1.9	5.5	67	0.20	24.20	22.50	28.00	3.07
E1	E2	0.39	0.00	0.0091	12	3.4	4.3	66	0.25	21.80	21.20	25.00	2.11
E2	E3	4.45	0.00	0.0111	15	6.8	5.5	9	0.03	21.10	21.00	24.50	2.04
E3	A4	4.45	0.00	0.0047	15	4.4	3.6	64	0.30	20.00	19.70	24.50	3.14

10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements



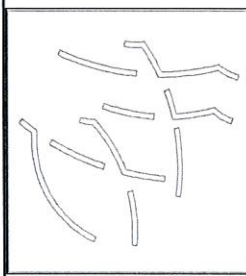
DATE	DESIGN PHASE
9-4-18	PRELIM <input checked="" type="checkbox"/> / <input type="checkbox"/>
PROJECT NO	CONSTR <input type="checkbox"/> / <input type="checkbox"/>
16-176	REVISION <input type="checkbox"/> / <input type="checkbox"/>
BY	RECORD <input type="checkbox"/> / <input type="checkbox"/>
AS	OTHER <input type="checkbox"/> / <input type="checkbox"/>
CHECKED BY	(SPECIFY)

PROJECT NAME: New Hanover Health and Human Resources
 LOCATION: Wilmington, NC

HYDRAULIC GRADE LINE

CONTINUED →

FROM	TO	PIPE AREA (FT ²)	HYDRAULIC RADIUS (FT)	SIDESTREAM SUMMATION (CFS)	Hf	HEAD LOSS					BEND LOSS K	FRICTION SLOPE (FT/FT)	FRICTION VELOCITY (FPS)
						90° = 0.70	70° = 0.61	50° = 0.47	30° = 0.28	20° = 0.16			
						80° = 0.66	60° = 0.55	40° = 0.38	25° = 0.22	15° = 0.10			
C1	C2	0.7854	0.2500	0.00	0.07	0.01	0.00	0.00	0.07	0.00	0.0011	1.52	
C2	C3	1.7671	0.3750	1.99	0.09	0.02	0.01	0.00	0.12	0.10	0.0013	2.13	
C3	C4	3.1416	0.5000	4.46	0.05	0.02	0.02	0.05	0.14	0.70	0.0010	2.32	
C4	C5	3.1416	0.5000	4.46	0.03	0.03	0.03	0.05	0.14	0.55	0.0015	2.75	
C5	B11	3.1416	0.5000	4.46	0.11	0.03	0.04	0.07	0.25	0.61	0.0015	2.75	
C20	C21	0.7854	0.2500	0.00	0.04	0.01	0.00	0.00	0.05	0.00	0.0018	1.91	
C21	C2	0.7854	0.2500	0.00	0.10	0.02	0.02	0.03	0.17	0.55	0.0021	2.05	
C23	C22	0.7854	0.2500	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.0003	0.82	
C22	C2	0.7854	0.2500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0001	0.47	
C30	C31	0.7854	0.2500	0.00	0.12	0.01	0.00	0.00	0.14	0.00	0.0015	1.78	
C31	C3	1.2272	0.3125	0.00	0.12	0.02	0.02	0.00	0.15	0.00	0.0015	2.01	
D1	D2	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.08	
D2	D3	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.06	
D3	D4	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.0000	0.08	
D4	B1	0.3491	0.1667	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0001	0.33	
D5	D6	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.08	
D6	D4	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.15	
E1	E2	0.7854	0.2500	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.0001	0.50	
E2	E3	1.2272	0.3125	0.00	0.04	0.05	0.00	0.00	0.10	0.61	0.0047	3.62	
E3	A4	1.2272	0.3125	0.00	0.30	0.05	0.07	0.14	0.57	0.70	0.0047	3.61	



10 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE	DESIGN PHASE
9-4-18	PRELIM <input checked="" type="checkbox"/> /
PROJECT NO	CONSTR <input type="checkbox"/> /
16-176	REVISION <input type="checkbox"/> /
BY	RECORD <input type="checkbox"/> /
AS	OTHER <input type="checkbox"/> /
CHECKED BY	(SPECIFY)

DESIGN CRITERIA:

- DESIGN FOR THE 10 YR STORM
- ASSUME TIME OF CONCENTRATION TO AN INDIVIDUAL INLET = 5 MIN.
- INTENSITY = $g/(h+T)$, FOR 10 YR STORM
- MANNINGS "n" FACTOR= .013
- RATIONAL METHOD: C= .20 GRASS, C= .95 PAVEMENT

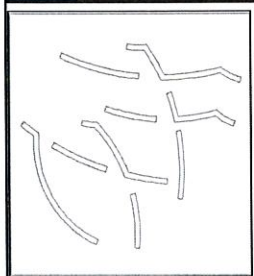
HYDRAULIC GRADE LINE - CONTINUED

n=	0.013
g=	252
h=	30
l=	7.20

FROM	TO	OUTLET W.S. ELEV (FT)		INLET W.S. ELEV.		FLOW CONDITION CONTROL	FREE-BOARD (FT)	UPSTREAM INLET TYPE	COMMENTS
		OUTLET CONTROL (FT)	W.S. ELEV (FT)	INLET CONTROL (FT)	USE (FT)				
C1	C2	22.49	22.57	Tailwater Elev= 18.88	22.50	OUTLET	1.83	CB	OK
C2	C3	22.37	22.49	21.10	22.49	OUTLET	1.26	CB	OK
C3	C4	22.23	22.37	20.64	22.37	OUTLET	0.73	CB	OK
C4	C5	22.09	22.23	20.43	22.23	OUTLET	0.67	CB	OK
C5	B11	18.57	18.82	18.33	18.82	OUTLET	4.88	MH	OK
C20	C21	22.66	22.71	Tailwater Elev= 18.57	21.41	OUTLET	1.19	CB	OK
C21	C2	22.49	22.66	21.18	22.66	OUTLET	1.09	CB	OK
C23	C22	22.50	22.52	Tailwater Elev= 22.49	21.33	OUTLET	1.98	CB	OK
C22	C2	22.49	22.50	20.91	22.50	OUTLET	1.37	CB	OK
C30	C31	22.52	22.65	Tailwater Elev= 22.49	21.24	OUTLET	0.45	CB	OK
C31	C3	22.37	22.52	20.75	22.52	OUTLET	0.58	CB	OK
D1	D2	26.33	26.33	Tailwater Elev= 22.37	27.33	INLET	2.92	DI	OK
D2	D3	23.33	23.33	26.33	26.33	INLET	5.17	DI	OK
D3	D4	22.34	22.34	23.33	23.33	INLET	8.17	DI	OK
D4	B1	22.03	22.04	22.34	22.34	INLET	6.66	DI	OK
D5	D6	24.53	24.53	Tailwater Elev= 22.03	25.33	INLET	1.67	DI	OK
D6	D4	23.03	23.03	24.53	24.53	INLET	3.47	DI	OK
E1	E2	22.95	22.96	Tailwater Elev= 23.03	22.31	OUTLET	1.54	CB	OK
E2	E3	22.85	22.95	22.29	22.95	OUTLET	1.05	CB	OK
E3	A4	20.70	21.27	21.19	21.27	OUTLET	3.23	MH	OK
				Tailwater Elev= 20.70	20.70				

**Proposed
Storm Drainage System
50 Year
With Additional Culvert Under 16th Street**

Design of site drainage system as proposed



50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
9-4-18

PROJECT NO
16-176

BY
AS

CHECKED BY
-

DESIGN PHASE	
PRELIM	/x/
CONSTR	/ /
REVISION	/ /
RECORD	/ /
OTHER	/ /
(SPECIFY)	

n= 0.013

g= 338

h= 33

l= 8.89

STORM DRAINAGE SCHEDULE

CONTINUED →

FROM	TO	INLET AREA ED	INLET AREA (AC)	IMPERVIOUS (%)	INLET Cc RUNOFF COEFF.	INLET DISCHARGE (CFS)	TOTAL AREAS (AC)	INLET TIME (MIN)	PIPE TIME (MIN)	Tc TIME OF CONC. (MIN)	I INTENSITY (IN/HR)	Cc RUNOFF COEFF.
A1	A2	1,810,425	41.56	6	0.25	59.34	41.56	25.00	0.00	25.00	5.83	0.25
A2	A3	171,345	3.93	70	0.73	25.37	45.50	10.50	0.22	25.22	5.81	0.29
A3	A4	2,280	0.05	0	0.20	0.09	45.55	5.00	0.35	25.35	5.79	0.29
A4	A5	0	0.00	0	0.20	0.00	45.55	5.00	0.47	25.47	5.78	0.29
A5	A6	0	0.00	0	0.20	0.00	45.55	5.00	0.93	25.93	5.74	0.29
A6	A7	0	0.00	0	0.20	0.00	45.55	5.00	1.21	26.21	5.71	0.29
A7	A7A	0	0.00	0	0.20	0.00	45.55	5.00	1.34	26.34	5.70	0.29
A7A	A8	0	0.00	0	0.20	0.00	45.55	5.00	1.36	26.36	5.69	0.29
A30	A31	5,860	0.13	65	0.68	0.53	0.13	5.00	0.00	5.00	8.89	0.68
A31	A32	0	0.00	0	0.20	0.00	0.13	5.00	0.53	5.53	8.77	0.68
A32	A33	3,014	0.07	50	0.58	0.35	0.20	5.00	0.66	5.66	8.74	0.64
A33	A5	3,311	0.08	50	0.58	0.39	0.28	5.00	0.90	5.90	8.69	0.63
A34	A33	3,612	0.08	50	0.58	0.28	0.08	5.00	0.00	16.00	6.90	0.58
B1	B2	11,570	0.27	90	0.88	1.35	0.27	5.00	0.00	5.00	8.89	0.88
B2	B3	0	0.00	0	0.20	0.00	0.27	5.00	0.04	5.04	8.88	0.88
B3	B4	11,120	0.26	90	0.88	1.99	0.52	5.00	0.15	5.15	8.86	0.88
B4	B5	15,290	0.35	90	0.88	2.73	0.87	5.00	0.59	5.59	8.76	0.88
B5	B6	9,680	0.22	75	0.76	1.51	1.09	5.00	0.97	5.97	8.67	0.85
B6	B7	0	0.00	0	0.20	0.00	1.09	5.00	1.00	6.00	8.67	0.85
B7	B8	2,820	0.06	70	0.73	0.42	1.16	5.00	1.05	6.05	8.66	0.85
B8	B9	1,940	0.04	15	0.31	0.12	1.20	5.00	1.13	6.13	8.64	0.83
B9	B10	22,250	0.51	70	0.73	3.29	1.71	5.00	1.53	6.53	8.55	0.80
B10	B11	6,600	0.15	30	0.43	0.57	1.87	5.00	1.77	6.77	8.50	0.77
B11	A7	0	0.00	0	0.20	0.00	1.87	5.00	1.82	6.82	8.49	0.77
B80	B8	4,550	0.10	90	0.88	0.53	0.10	5.00	0.00	5.00	8.89	0.88

	50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements		DATE	DESIGN PHASE	
	PROJECT NAME	PROJECT NO	9-4-18	PRELIM	/x /
New Hanover Health and Human Resources		16-176	CONSTR	/ /	
LOCATION	BY	AS	REVISION	/ /	
Wilmington, NC	CHECKED BY	-	RECORD	/ /	
			OTHER	/ /	
			(SPECIFY)	/ /	

STORM DRAINAGE SCHEDULE - CONTINUED																
FROM	TO	Q	DISCHARGE (CFS)	Q	SIDE-STREAM (CFS)	SLOPE	DIA. (IN)	CAPACITY (FULL) (CFS)	V FULL (FPS)	LENGTH (FT)	SEGMENT TIME (MIN)	UPPER INV. (FT)	LOWER INV. (FT)	UPSTREAM TOP ELEV. (FT)	PIPE COVER (FT)	
		n=	0.013													
		g=	338													
		h=	33													
		l=	8.89													
A1	A2		59.34		0.00	-0.0002	42	59.3	6.2	81	0.22	18.50	18.52	23.80	1.48	
A2	A3		75.67		0.00	-0.0002	42	75.7	7.9	62	0.13	18.52	18.53	23.00	0.66	
A3	A4		75.56		0.00	0.0124	48	159.7	12.7	93	0.12	17.95	16.80	24.50	2.19	
A4	A5		80.91		5.50	0.0069	48	119.5	9.5	260	0.46	16.70	14.90	25.30	4.24	
A5	A6		82.17		1.85	0.0072	48	122.1	9.7	166	0.29	14.80	13.60	23.40	4.24	
A6	A7		81.81		0.00	0.0079	48	127.6	10.1	76	0.12	13.50	12.90	23.40	5.54	
A7	A7A		104.65		22.99	0.0000	42	104.6	10.9	16	0.02	12.73	12.73	21.00	4.45	
A7A	A8		104.62		0.00	0.0000	42	104.6	10.9	70	0.11	12.73	12.73	19.90	3.35	
A30	A31		0.81		0.00	0.0102	10	2.2	4.0	128	0.53	21.00	19.70	23.85	1.94	
A31	A32		0.80		0.00	0.0118	10	2.4	4.4	34	0.13	19.70	19.30	23.50	2.89	
A32	A33		1.15		0.00	0.0069	18	8.8	4.9	72	0.24	18.80	18.30	23.58	3.14	
A33	A5		1.85		0.33	0.0062	18	8.3	4.7	24	0.09	18.20	18.05	23.58	3.74	
A34	A33		0.33		0.00	0.0094	15	6.3	5.1	64	0.21	18.90	18.30	23.58	3.32	
B1	B2		2.21		0.14	0.0056	12	2.7	3.4	9	0.04	20.47	20.42	24.00	2.44	
B2	B3		2.21		0.00	0.0050	12	2.5	3.2	20	0.10	20.32	20.22	24.50	3.09	
B3	B4		4.18		0.00	0.0051	15	4.6	3.8	100	0.44	20.12	19.61	24.00	2.52	
B4	B5		6.83		0.00	0.0056	18	7.9	4.4	100	0.38	19.51	18.95	23.90	2.75	
B5	B6		8.23		0.00	0.0056	24	16.9	5.4	9	0.03	18.85	18.80	23.10	2.07	
B6	B7		8.23		0.00	0.0289	24	38.5	12.2	38	0.05	18.00	16.90	22.35	2.17	
B7	B8		8.62		0.00	0.0250	24	35.8	11.4	56	0.08	16.80	15.40	22.40	3.42	
B8	B9		8.72		0.00	0.0055	24	16.7	5.3	128	0.40	15.30	14.60	19.80	2.32	
B9	B10		11.80		0.00	0.0056	30	30.6	6.2	90	0.24	14.50	14.00	19.50	2.27	
B10	B11		12.28		0.00	0.0091	30	39.1	8.0	22	0.05	13.90	13.70	19.85	3.22	
B11	A7		22.99		10.72	0.0125	30	45.9	9.3	8	0.01	13.60	13.50	22.00	5.67	
B80	B8		0.81		0.00	0.0192	10	3.0	5.6	13	0.04	16.85	16.60	20.35	2.59	

	50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements		DATE 9-4-18	DESIGN PHASE PRELIM <u>X</u> / <u> </u>
	PROJECT NAME New Hanover Health and Human Resources		PROJECT NO 16-176	CONSTR <u> </u> / <u> </u>
LOCATION Wilmington, NC		BY AS	REVISION <u> </u> / <u> </u>	RECORD <u> </u> / <u> </u>
		CHECKED BY _	OTHER <u> </u> / <u> </u>	(SPECIFY)

HYDRAULIC GRADE LINE CONTINUED →

FROM	TO	PIPE AREA (FT)	HYDRAULIC RADIUS (FT)	SIDESTREAM SUMMATION (CFS)	Hf	HEAD LOSS				BEND LOSS				BEND LOSS K	FRICTION SLOPE (FT/FT)	FRICTION VELOCITY (FPS)
						Hc	He	Hb	Ht	90° = 0.70	70° = 0.61	50° = 0.47	30° = 0.28			
A1	A2	9.6211	0.8750	0.00	0.95	0.50	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.0117	11.31	
A2	A3	9.6211	0.8750	0.00	1.18	0.81	0.69	0.00	2.68	0.00	0.00	0.00	0.00	0.0191	14.42	
A3	A4	12.5664	1.0000	0.00	0.25	0.14	1.13	0.25	3.04	0.47	0.70	0.70	0.0027	5.97		
A4	A5	12.5664	1.0000	5.50	0.81	0.16	0.19	0.39	1.55	0.70	0.70	0.70	0.0031	6.39		
A5	A6	12.5664	1.0000	7.35	0.54	0.16	0.22	0.44	1.37	0.70	0.70	0.70	0.0032	6.49		
A6	A7	12.5664	1.0000	7.35	0.24	0.16	0.23	0.25	0.88	0.38	0.38	0.38	0.0032	6.46		
A7	A7A	9.6211	0.8750	30.34	0.17	0.45	0.23	0.25	1.10	0.38	0.38	0.38	0.0107	10.80		
A7A	A8	9.6211	0.8750	30.34	0.75	0.45	0.63	0.00	1.83	0.00	0.00	0.00	0.0107	10.80		
A30	A31	0.5454	0.2083	0.00	0.18	0.01	0.00	0.00	0.19	0.00	0.00	0.00	0.0014	1.49		
A31	A32	0.5454	0.2083	0.00	0.05	0.01	0.01	0.02	0.08	0.55	0.55	0.55	0.0013	1.47		
A32	A33	1.7671	0.3750	0.00	0.01	0.00	0.01	0.01	0.03	0.28	0.28	0.28	0.0001	0.65		
A33	A5	1.7671	0.3750	0.33	0.01	0.00	0.00	0.00	0.02	0.70	0.70	0.70	0.0003	1.04		
A34	A33	1.2272	0.3125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.27		
B1	B2	0.7854	0.2500	0.14	0.03	0.03	0.00	0.00	0.07	0.00	0.00	0.00	0.0038	2.81		
B2	B3	0.7854	0.2500	0.14	0.08	0.03	0.04	0.07	0.22	0.55	0.55	0.55	0.0038	2.81		
B3	B4	1.2272	0.3125	0.14	0.42	0.04	0.04	0.03	0.54	0.28	0.28	0.28	0.0042	3.40		
B4	B5	1.7671	0.3750	0.14	0.42	0.06	0.06	0.08	0.62	0.47	0.47	0.47	0.0042	3.85		
B5	B6	3.1416	0.5000	0.14	0.01	0.03	0.08	0.14	0.26	0.61	0.61	0.61	0.0013	2.61		
B6	B7	3.1416	0.5000	0.14	0.05	0.03	0.04	0.07	0.19	0.70	0.70	0.70	0.0013	2.60		
B7	B8	3.1416	0.5000	0.14	0.08	0.03	0.04	0.01	0.16	0.10	0.10	0.10	0.0014	2.73		
B8	B9	3.1416	0.5000	0.14	0.19	0.03	0.04	0.08	0.34	0.70	0.70	0.70	0.0015	2.76		
B9	B10	4.9087	0.6250	0.14	0.07	0.02	0.04	0.00	0.14	0.00	0.00	0.00	0.0008	2.39		
B10	B11	4.9087	0.6250	0.14	0.02	0.02	0.03	0.05	0.12	0.55	0.55	0.55	0.0009	2.49		
B11	A7	4.9087	0.6250	10.87	0.02	0.08	0.03	0.07	0.21	0.70	0.70	0.70	0.0031	4.66		
B80	B8	0.5454	0.2083	0.00	0.02	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.0014	1.49		

50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources
LOCATION
Wilmington, NC

DATE
9-4-18
PROJECT NO
16-176
BY
AS
CHECKED BY

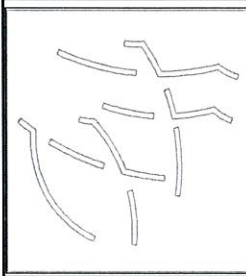
DESIGN PHASE
PRELIM
CONSTR
REVISION
RECORD
OTHER
(SPECIFY)

HYDRAULIC GRADE LINE - CONTINUED

DESIGN CRITERIA:
1. DESIGN FOR THE 50 YR STORM
2. ASSUME TIME OF CONCENTRATION TO AN INDIVIDUAL INLET = 5 MIN.
3. INTENSITY = $g/(h+T)$, FOR 50 YR STORM
4. MANNINGS "n" FACTOR= .013
5. RATIONAL METHOD: C= .20 GRASS, C= .95 PAVEMENT

n= 0.013
g= 338
h= 33
l= 8.89

FROM	TO	OUTLET W.S. ELEV (FT)	INLET W.S. ELEV.		FLOW CONDITION CONTROL	FREE-BOARD (FT)	UPSTREAM INLET TYPE	COMMENTS
			OUTLET CONTROL (FT)	INLET CONTROL (FT)				
A1	A2	30.20	31.65	21.89	OUTLET	(7.85)	HW	OVERFLOW
A2	A3	27.52	30.20	22.94	OUTLET	(7.20)	JB	OVERFLOW
A3	A4	24.48	27.52	21.51	OUTLET	(3.02)	DI	OVERFLOW
A4	A5	22.93	24.48	20.49	OUTLET	0.82	MH	OK
A5	A6	21.56	22.93	18.64	OUTLET	0.47	MH	OK
A6	A7	20.68	21.56	17.33	OUTLET	1.84	MH	OK
A7	A7A	19.58	20.68	19.58	OUTLET	0.32	MH	OK
A7A	A8	15.53	17.36	19.58	INLET	0.32	MH	OK
A30	A31	23.06	23.25	21.51	OUTLET	0.60	CO	OK
A31	A32	22.98	23.06	20.21	OUTLET	0.44	CO	OK
A32	A33	22.94	22.98	19.57	OUTLET	0.10	CB	OK
A33	A5	22.93	22.94	19.00	OUTLET	0.14	CB	OK
A34	A33	22.94	22.95	19.53	OUTLET	0.13	CB	OK
B1	B2	22.51	22.57	21.31	OUTLET	0.93	CB	OK
B2	B3	22.29	22.51	21.16	OUTLET	1.99	MH	OK
B3	B4	21.75	22.29	21.25	OUTLET	1.21	CB	OK
B4	B5	21.13	21.75	20.90	OUTLET	1.65	CB	OK
B5	B6	20.87	21.13	20.15	OUTLET	1.47	CB	OK
B6	B7	21.65	21.83	19.30	OUTLET	0.52	MH	OK
B7	B8	21.49	21.65	18.12	OUTLET	0.25	CB	OK
B8	B9	21.15	21.49	16.63	OUTLET	(1.69)	DI	OVERFLOW
B9	B10	21.01	21.15	16.00	OUTLET	(2.15)	CB	OVERFLOW
B10	B11	20.89	21.01	15.42	OUTLET	(1.66)	CB	OVERFLOW
B11	A7	20.68	20.89	15.80	OUTLET	1.11	MH	OK
B80	B8	21.49	21.51	17.36	OUTLET	(1.16)	CO	OVERFLOW



50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
9-4-18

PROJECT NO
16-176

BY
AS

CHECKED BY
-

DESIGN PHASE	
PRELIM	/X/
CONSTR	/ /
REVISION	/ /
RECORD	/ /
OTHER	/ /
(SPECIFY)	

CONTINUED →

STORM DRAINAGE SCHEDULE

n= 0.013

g= 338

h= 33

l= 8.89

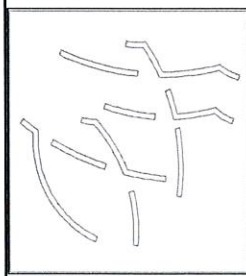
FROM	TO	INLET AREA ED	INLET AREA (AC)	IMPERVIOUS (%)	INLET Cc RUNOFF COEFF.	INLET DISCHARGE (CFS)	TOTAL AREAS (AC)	INLET TIME (MIN)	PIPE TIME (MIN)	Tc TIME OF CONC. (MIN)	I INTENSITY (IN/HR)	Cc RUNOFF COEFF.
C1	C2	8,260	0.19	90	0.88	0.97	0.19	5.00	0.00	5.00	8.89	0.88
C2	C3	3,970	0.09	95	0.91	0.74	0.28	5.00	0.16	5.16	8.86	0.89
C3	C4	7,680	0.18	90	0.88	1.37	0.46	5.00	0.38	5.38	8.81	0.88
C4	C5	9,560	0.22	90	0.88	1.71	0.68	5.00	0.54	5.54	8.77	0.88
C5	B11	0	0.00	0	0.20	0.00	0.68	5.00	0.61	5.61	8.75	0.88
C20	C21	11,910	0.27	75	0.76	1.21	0.27	5.00	0.00	5.00	8.89	0.76
C21	C2	800	0.02	95	0.91	0.15	0.29	5.00	0.10	5.10	8.87	0.77
C23	C22	4,270	0.10	95	0.91	0.52	0.10	5.00	0.00	5.00	8.89	0.91
C22	C2	2,570	0.06	90	0.88	0.46	0.06	5.00	0.00	5.00	8.89	0.88
C30	C31	10,110	0.23	85	0.84	1.13	0.23	5.00	0.00	5.00	8.89	0.84
C31	C3	7,270	0.17	95	0.91	1.35	0.40	5.00	0.35	5.35	8.81	0.87
D1	D2	910	0.02	0	0.18	0.02	0.02	5.00	0.00	5.00	8.89	0.18
D2	D3	670	0.02	0	0.18	0.02	0.04	5.00	0.33	5.33	8.82	0.08
D3	D4	0	0.00	0	0.18	0.00	0.04	5.00	0.50	5.50	8.78	0.10
D4	B1	1,240	0.03	0	0.18	0.05	0.06	5.00	0.52	5.52	8.77	0.14
D5	D6	910	0.02	0	0.18	0.02	0.02	5.00	0.00	5.00	8.89	0.18
D6	D4	930	0.02	0	0.18	0.03	0.06	5.00	0.52	5.52	8.77	0.13
E1	E2	2,610	0.06	95	0.91	0.32	0.06	5.00	0.00	5.00	8.89	0.91
E2	E3	29,570	0.68	85	0.84	5.06	0.74	5.00	0.25	5.25	8.84	0.84
E3	A4	0	0.00	0	0.20	0.00	0.74	5.00	0.28	5.28	8.83	0.84

	50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements		DATE	DESIGN PHASE	
	PROJECT NAME New Hanover Health and Human Resources		9-4-18	PRELIM	/x/
LOCATION Wilmington, NC		PROJECT NO 16-176	CONSTR	/	/
		BY AS	REVISION	/	/
		CHECKED BY	RECORD	/	/
			OTHER	/	/
			(SPECIFY)		

STORM DRAINAGE SCHEDULE - CONTINUED

n=	0.013
g=	338
h=	33
l=	8.89

FROM	TO	Q	DISCHARGE (CFS)	Q	SIDE-STREAM (CFS)	SLOPE	DIA. (IN)	CAPACITY (FULL) (CFS)	V FULL (FPS)	LENGTH (FT)	SEGMENT TIME (MIN)	UPPER INV. (FT)	LOWER INV. (FT)	UPSTREAM TOP ELEV. (FT)	PIPE COVER (FT)
C1	C2	1.48	0.00	0.0181	12	4.8	6.1	58	0.16	21.90	20.85	24.90	1.91		
C2	C3	4.66	2.46	0.0080	18	9.4	5.3	69	0.22	20.15	19.60	24.25	2.46		
C3	C4	9.07	3.06	0.0043	24	14.9	4.7	46	0.16	19.40	19.20	23.60	2.02		
C4	C5	10.73	0.00	0.0045	24	15.3	4.8	22	0.08	19.10	19.00	23.40	2.12		
C5	B11	10.72	0.00	0.0135	24	26.3	8.4	74	0.15	17.00	16.00	23.70	4.52		
C20	C21	1.85	0.00	0.0068	12	2.9	3.7	22	0.10	20.75	20.60	24.40	2.56		
C21	C2	2.00	0.00	0.0050	12	2.5	3.2	50	0.26	20.50	20.25	24.25	2.66		
C23	C22	0.80	0.00	0.0055	12	2.6	3.3	55	0.27	20.80	20.50	25.00	3.11		
C22	C2	0.46	0.00	0.0065	12	2.9	3.7	23	0.10	20.40	20.25	24.37	2.88		
C30	C31	1.73	0.00	0.0069	12	3.0	3.8	80	0.35	20.60	20.05	23.60	1.91		
C31	C3	3.06	0.00	0.0056	15	4.8	3.9	80	0.34	19.95	19.50	23.60	2.29		
D1	D2	0.03	0.00	0.0120	8	1.3	3.8	75	0.33	27.00	26.10	30.25	2.52		
D2	D3	0.02	0.00	0.0408	8	2.4	7.0	71	0.17	26.00	23.10	31.50	4.77		
D3	D4	0.03	0.00	0.0750	8	3.3	9.5	12	0.02	23.00	22.10	31.50	7.77		
D4	B1	0.14	0.07	0.0104	8	1.2	3.5	48	0.23	22.00	21.50	29.00	6.27		
D5	D6	0.03	0.00	0.0108	8	1.3	3.6	65	0.30	25.00	24.30	27.00	1.27		
D6	D4	0.07	0.00	0.0254	8	1.9	5.5	67	0.20	24.20	22.50	28.00	3.07		
E1	E2	0.49	0.00	0.0091	12	3.4	4.3	66	0.25	21.80	21.20	25.00	2.11		
E2	E3	5.51	0.00	0.0111	15	6.8	5.5	9	0.03	21.10	21.00	24.50	2.04		
E3	A4	5.50	0.00	0.0047	15	4.4	3.6	64	0.30	20.00	19.70	24.50	3.14		



50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
9-4-18

PROJECT NO
16-176

BY
AS

CHECKED BY
_

DESIGN PHASE
PRELIM /
CONSTR /
REVISION /
RECORD /
OTHER /
(SPECIFY)

HYDRAULIC GRADE LINE

CONTINUED →

n= 0.013
g= 338
h= 33
l= 8.89

BEND LOSS K's
50° = 0.47 30° = 0.28 20° = 0.16
40° = 0.38 25° = 0.22 15° = 0.10

HEAD LOSS

90° = 0.70 70° = 0.61 60° = 0.55
80° = 0.66

FROM	TO	PIPE AREA (FT)	HYDRAULIC RADIUS (FT)	SIDESTREAM SUMMATION (GFS)	Hf	HEAD LOSS				BEND LOSS K	FRICTION SLOPE (FT/FT)	FRICTION VELOCITY (FPS)
						Hc	He	Hb	Ht			
C1	C2	0.7854	0.2500	0.00	0.10	0.01	0.00	0.00	0.11	0.00	0.0017	1.87
C2	C3	1.7671	0.3750	2.46	0.14	0.03	0.02	0.01	0.19	0.10	0.0020	2.63
C3	C4	3.1416	0.5000	5.51	0.07	0.03	0.04	0.08	0.22	0.70	0.0016	2.87
C4	C5	3.1416	0.5000	5.51	0.05	0.04	0.04	0.07	0.21	0.55	0.0022	3.40
C5	B11	3.1416	0.5000	5.51	0.17	0.04	0.06	0.11	0.38	0.61	0.0022	3.40
C20	C21	0.7854	0.2500	0.00	0.06	0.02	0.00	0.00	0.08	0.00	0.0027	2.35
C21	C2	0.7854	0.2500	0.00	0.16	0.02	0.03	0.05	0.26	0.55	0.0031	2.54
C23	C22	0.7854	0.2500	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.0005	1.01
C22	C2	0.7854	0.2500	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0002	0.58
C30	C31	0.7854	0.2500	0.00	0.19	0.02	0.00	0.00	0.21	0.00	0.0023	2.19
C31	C3	1.2272	0.3125	0.00	0.18	0.02	0.03	0.00	0.23	0.00	0.0022	2.48
D1	D2	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.10
D2	D3	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.07
D3	D4	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.0000	0.09
D4	B1	0.3491	0.1667	0.07	0.01	0.00	0.00	0.00	0.01	0.00	0.0001	0.41
D5	D6	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.10
D6	D4	0.3491	0.1667	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.19
E1	E2	0.7854	0.2500	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.0002	0.62
E2	E3	1.2272	0.3125	0.00	0.07	0.08	0.00	0.00	0.15	0.61	0.0072	4.47
E3	A4	1.2272	0.3125	0.00	0.46	0.08	0.11	0.22	0.87	0.70	0.0072	4.47

50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - With No 16th St. Culvert Improvements

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
9-4-18

PROJECT NO
16-176

BY
AS

CHECKED BY
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DESIGN PHASE
PRELIM /
CONSTR /
REVISION /
RECORD /
OTHER /
(SPECIFY)

DESIGN CRITERIA:
 1. DESIGN FOR THE 50 YR STORM
 2. ASSUME TIME OF CONCENTRATION TO AN INDIVIDUAL INLET = 5 MIN.
 3. INTENSITY = $g/(h+T)$, FOR 50 YR STORM
 4. MANNINGS "n" FACTOR= .013
 5. RATIONAL METHOD: C= .20 GRASS, C= .95 PAVEMENT

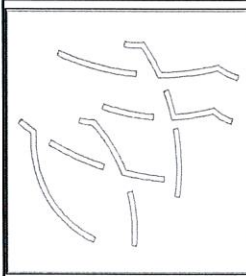
HYDRAULIC GRADE LINE - CONTINUED

n= 0.013
 g= 338
 h= 33
 I= 8.89

FROM	TO	OUTLET W.S. ELEV (FT)	INLET W.S. ELEV.		USE (FT)	FLOW CONDITION CONTROL	FREE-BOARD (FT)	UPSTREAM INLET TYPE	COMMENTS
			OUTLET CONTROL (FT)	INLET CONTROL (FT)					
				Tailwater Elev=	21.49				
C1	C2	22.78	22.90	22.55	22.90	OUTLET	1.50	CB	OK
C2	C3	22.60	22.78	21.20	22.78	OUTLET	0.97	CB	OK
C3	C4	22.38	22.60	20.76	22.60	OUTLET	0.50	CB	OK
C4	C5	22.17	22.38	20.60	22.38	OUTLET	0.52	CB	OK
C5	B11	21.01	21.39	18.50	21.39	OUTLET	2.31	MH	OK
				Tailwater Elev=	21.01				
C20	C21	23.04	23.12	21.49	23.12	OUTLET	0.78	CB	OK
C21	C2	22.78	23.04	21.28	23.04	OUTLET	0.71	CB	OK
				Tailwater Elev=	22.78				
C23	C22	22.79	22.82	21.34	22.82	OUTLET	1.68	CB	OK
C22	C2	22.78	22.79	20.91	22.79	OUTLET	1.08	CB	OK
				Tailwater Elev=	22.78				
C30	C31	22.83	23.03	21.31	23.03	OUTLET	0.07	CB	OK
C31	C3	22.60	22.83	20.84	22.83	OUTLET	0.27	CB	OK
				Tailwater Elev=	22.60				
D1	D2	26.33	26.33	27.33	27.33	INLET	2.92	DI	OK
D2	D3	23.33	23.33	26.33	26.33	INLET	5.17	DI	OK
D3	D4	22.34	22.34	23.33	23.33	INLET	8.17	DI	OK
D4	B1	22.03	22.04	22.34	22.34	INLET	6.66	DI	OK
				Tailwater Elev=	22.03				
D5	D6	24.53	24.54	25.33	25.33	INLET	1.67	DI	OK
D6	D4	23.03	23.04	24.53	24.53	INLET	3.47	DI	OK
				Tailwater Elev=	23.03				
E1	E2	23.06	23.07	22.32	23.07	OUTLET	1.43	CB	OK
E2	E3	22.91	23.06	22.59	23.06	OUTLET	0.94	CB	OK
E3	A4	20.70	21.57	21.49	21.57	OUTLET	2.93	MH	OK
				Tailwater Elev=	20.70				

Existing Site Storm Drainage System 50 Year

Existing site drainage system is provided to compare with the proposed storm drainage system



50 YEAR STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS - EXISTING SITE STORM DRAIN SYSTEM

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

DATE
7-16-18

PROJECT NO
16-176

BY
AS

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DESIGN PHASE

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REVISION / /

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OTHER / /

(SPECIFY)

n= 0.013

g= 252

h= 30

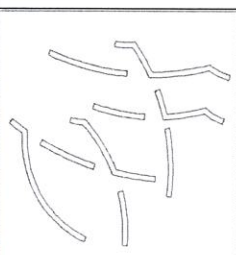
l= 7.20

STORM DRAINAGE SCHEDULE

CONTINUED →

FROM	TO	INLET AREA (SF)	INLET AREA (AC)	IMPERVIOUS (%)	INLET Cc RUNOFF COEFF.	INLET DISCHARGE (CFS)	TOTAL AREAS (AC)	INLET TIME (MIN)	PIPE TIME (MIN)	Tc TIME OF CONC. (MIN)	I INTENSITY (IN/HR)	Cc RUNOFF COEFF.
EX A1	EX A2	1,810,425	41.56	6	0.25	0.00	41.56	25.00	0.00	25.00	4.58	0.25
EX A2	EX A3	171,345	3.93	70	0.73	20.53	45.50	10.50	0.28	25.28	4.56	0.29
EX A3	EX-1	0	0.00	0	0.20	0.00	45.50	10.50	0.45	25.45	4.54	0.29
EX-2	EX-3	54,640	1.25	75	0.76	0.00	1.25	25.28	0.00	25.45	4.54	0.76
EX-3	EX-4	0	0.00	0	0.30	0.00	1.25	5.00	0.58	26.03	4.50	0.76
EX-4	EX-5	7,100	0.16	85	0.85	1.00	1.42	5.00	1.13	26.57	4.45	0.77
EX-5	EX-6	0	0.00	0	0.30	0.00	1.42	5.00	1.25	26.70	4.44	0.77
EX-6	EX A7	0	0.00	0	0.30	0.00	1.42	5.00	1.97	27.41	4.39	0.77
EX A7	EX A8	0	0.00	0	0.30	0.00	1.42	5.00	2.08	27.52	4.38	0.77
EX-9	EX-6	95,596	2.19	95	0.91	0.00	2.19	5.00	0.00	5.00	7.20	0.91
EX-10	EX-11	13,400	0.31	95	0.91	0.00	0.31	5.00	0.00	5.00	7.20	0.91
EX-11	EX-6	27,860	0.64	100	0.95	4.37	0.95	5.00	1.77	6.77	6.85	0.94
EX-12	EX-11	12,960	0.30	95	0.91	0.00	0.30	5.00	0.00	5.00	7.20	0.91

STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS



PROJECT NAME
 New Hanover Health and Human Resources
 LOCATION
 Wilmington, NC

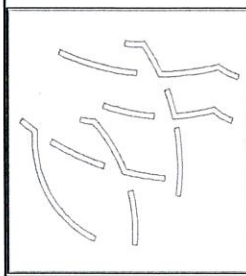
DATE
 7-16-18
 PROJECT NO
 16-176
 BY
 AS
 CHECKED BY
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DESIGN PHASE
 PRELIM /
 CONSTR /
 REVISION /
 RECORD /
 OTHER /
 (SPECIFY)

STORM DRAINAGE SCHEDULE - CONTINUED

n= 0.013
 g= 252
 h= 30
 l= 7.20

FROM	TO	Q DISCHARGE (CFS)	Q SIDE-STREAM (CFS)	SLOPE	DIA. (IN)	CAPACITY (FULL) (CFS)	V FULL (FPS)	LENGTH (FT)	SEGMENT TIME (MIN)	UPPER INV. (FT)	LOWER INV. (FT)	UPSTREAM TOP ELEV. (FT)	PIPE COVER (FT)	
		Negative slope use Orifice Eq.												
EX A1	EX A2	46.65	0.00	-0.0002	42	46.7	4.8	81	0.28	18.50	18.52	23.80	1.48	
EX A2	EX A3	59.42	0.00	-0.0002	42	59.4	6.2	62	0.17	18.52	18.53	23.00	0.66	
EX A3	EX-1	59.24	0.00	0.0192	42	75.4	7.8	24	0.05	18.53	18.07	23.39	1.04	
EX-2	EX-3	63.59	59.24	0.0085	42	50.3	5.2	182	0.58	17.37	15.82	22.50	1.31	
EX-3	EX-4	63.54	0.00	0.0005	42	12.0	1.2	41	0.55	15.82	15.80	25.72	6.08	
EX-4	EX-5	64.12	0.00	0.0090	42	51.7	5.4	40	0.12	15.80	15.44	23.97	4.35	
EX-5	EX-6	64.11	0.00	0.0056	42	40.8	4.2	182	0.72	15.44	14.42	24.74	5.48	
EX-6	EX A7	64.05	0.00	0.0315	42	96.7	10.0	66	0.11	15.42	13.34	22.22	2.98	
EX A7	EX A8	86.50	22.46	0.0000	42	86.5	9.0	74	0.14	12.73	12.73	20.20	3.65	
EX-9	EX-6	14.42	0.00	0.0052	18	4.1	2.3	175	1.26	15.33	14.42	17.93	0.96	
EX-10	EX-11	2.02	0.00	0.0129	12	2.2	2.8	296	1.77	19.04	15.21	22.54	2.41	
EX-11	EX-6	8.04	1.95	0.0127	12	2.2	2.8	62	0.37	15.21	14.42	23.41	7.11	
EX-12	EX-11	1.95	0.00	0.0017	10	0.5	0.9	296	5.52	19.24	18.74	21.57	1.42	



STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS

DATE
7-16-18

PROJECT NO
16-176

BY
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CONSTR / /

REVISION / /

RECORD / /

OTHER / /

(SPECIFY)

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC

HYDRAULIC GRADE LINE

CONTINUED →

n= 0.013

g= 252

h= 30

l= 7.20

BEND LOSS K's

90° = 0.70 70° = 0.61 50° = 0.47 30° = 0.28 20° = 0.16

80° = 0.66 60° = 0.55 40° = 0.38 25° = 0.22 15° = 0.10

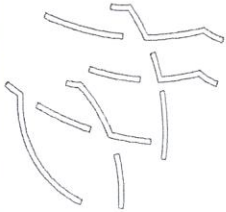
FROM TO

FROM	TO	PIPE AREA (FT)	HYDRAULIC RADIUS (FT)	SIDESTREAM SUMMATION (GFS)	Hf	HEAD LOSS				BEND LOSS			FRICTION SLOPE (FT/FT)	FRICTION VELOCITY (FPS)
						Hc	He	Hb	Ht	Hb	Ht	K		
EX A1	EX A2	9.6211	0.8750	0.00	0.59	0.31	0.00	0.00	0.89	0.00	0.00	0.00	0.0072	8.89
EX A2	EX A3	9.6211	0.8750	0.00	0.73	0.50	0.43	0.00	1.66	0.00	0.00	0.00	0.0118	11.32
EX A3	EX-1	9.6211	0.8750	0.00	0.28	0.49	0.70	1.09	2.57	0.55	0.55	0.55	0.0117	11.29
EX-2	EX-3	9.6211	0.8750	59.24	2.45	0.57	0.00	0.00	3.02	0.00	0.00	0.00	0.0135	12.12
EX-3	EX-4	9.6211	0.8750	59.24	0.55	0.57	0.80	1.25	3.17	0.55	0.55	0.55	0.0134	12.11
EX-4	EX-5	9.6211	0.8750	59.24	0.55	0.58	0.80	0.23	2.15	0.10	0.10	0.10	0.0137	12.22
EX-5	EX-6	9.6211	0.8750	59.24	2.49	0.58	0.81	1.27	5.16	0.55	0.55	0.55	0.0137	12.22
EX-6	EX A7	9.6211	0.8750	59.24	0.90	0.58	0.81	0.65	2.94	0.28	0.28	0.28	0.0137	12.20
EX A7	EX A8	9.6211	0.8750	81.70	0.54	0.31	0.81	1.27	2.93	0.55	0.55	0.55	0.0073	8.93
EX-9	EX-6	1.7671	0.3750	0.00	11.17	0.87	0.00	0.00	12.05	0.00	0.00	0.00	0.0638	15.00
EX-10	EX-11	0.7854	0.2500	0.00	3.24	0.09	0.00	0.00	3.32	0.00	0.00	0.00	0.0109	4.74
EX-11	EX-6	0.7854	0.2500	1.95	10.74	1.38	0.12	0.19	12.43	0.55	0.55	0.55	0.1732	18.85
EX-12	EX-11	0.5454	0.2083	0.00	8.01	0.17	0.00	0.00	8.18	0.00	0.00	0.00	0.0271	6.60

STORM DRAINAGE / HYDRAULIC GRADE LINE ANALYSIS

PROJECT NAME
New Hanover Health and Human Resources

LOCATION
Wilmington, NC



HYDRAULIC GRADE LINE - CONTINUED

n= 0.013
g= 252
h= 30
L= 7.20

FROM	TO	OUTLET W.S. ELEV (FT)	INLET W.S. ELEV.			FLOW CONDITION CONTROL	FREE-BOARD (FT)	UPSTREAM INLET TYPE	COMMENTS
			OUTLET CONTROL (FT)	INLET CONTROL (FT)	USE (FT)				
EX A1	EX A2	39.12	40.01	21.26	40.01	OUTLET	(16.21)	HW	OVERFLOW
EX A2	EX A3	37.46	39.12	21.92	39.12	OUTLET	(16.12)	JB	OVERFLOW
EX A3	EX-1	34.90	37.46	21.92	37.46	OUTLET	(14.07)	DI	OVERFLOW
EX-2	EX-3	31.88	34.90	21.00	34.90	OUTLET	(12.40)	PE	OVERFLOW
EX-3	EX-4	28.71	31.88	19.45	31.88	OUTLET	(6.16)	MH	OVERFLOW
EX-4	EX-5	26.56	28.71	19.47	28.71	OUTLET	(4.74)	DI	OVERFLOW
EX-5	EX-6	21.40	26.56	19.11	26.56	OUTLET	(1.82)	MH	OVERFLOW
EX-6	EX A7	18.46	21.40	19.08	21.40	OUTLET	0.82	MH	OK
EX A7	EX A8	15.53	18.46	17.97	18.46	OUTLET	1.74	MH	OK
EX-9	EX-6	21.40	33.45	18.95	33.45	OUTLET	(16.02)	CB	OVERFLOW
EX-10	EX-11	33.83	37.15	19.83	21.40	OUTLET	(14.61)	DI	OVERFLOW
EX-11	EX-6	21.40	33.83	20.23	33.83	OUTLET	(10.42)	MH	OVERFLOW
EX-12	EX-11	33.83	42.01	20.21	21.40	OUTLET	(20.94)	CB	OVERFLOW
					33.83				



January 4, 2018

Mr. Kevin Caison
New Hanover County Property Management
1650 Greenfield Street
Wilmington, North Carolina 28401

Reference: Report of Seasonal High Water Table Estimation
NHC Health & Human Services
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.5873



Dear Mr. Caison:

ECS Southeast, LLP (ECS) recently conducted an estimation of the Seasonal High Water Table (SHWT) for the proposed stormwater control measure (SCM) areas at the New Hanover County Health & Human Services in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our estimation.

Field Testing

On January 2, 2018, ECS conducted an exploration of the subsurface soil and SHWT conditions at fourteen requested locations shown on the attached Boring Location Plan (Figure 1). The purpose of this exploration was to estimate the SHWT of the in situ soils for the design of for the proposed SCM areas. The borings were located using GPS equipment. ECS explored the subsurface soil conditions by advancing one hand auger boring into the existing ground surface at the requested boring locations. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS recorded the SHWT elevation observed at the time of each hand auger boring. The attached SHWT sheet provides a summary of the subsurface conditions encountered at each hand auger boring location.

The SHWT elevations were estimated at each boring location below the existing grade elevation. Below is a summary of each boring location.

Location	SHWT
B-1	52 inches
B-2	60 inches
B-3	55 inches
B-4	66 inches
B-5	50 inches
B-6	50 inches
B-7	75 inches
B-8	Not determined
B-9	72 inches
B-10	60 inches
B-11	54 inches
B-12	40 inches
B-13	48 inches
B-14	60 inches

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

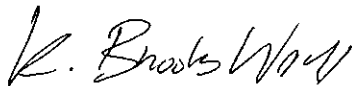
Closure

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.

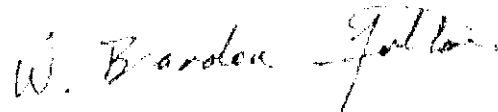
ECS appreciates the opportunity to provide our services to you on this project. If you have any questions concerning this report or this project, please contact us at (910) 686-9114.

Respectfully,

ECS SOUTHEAST, LLP

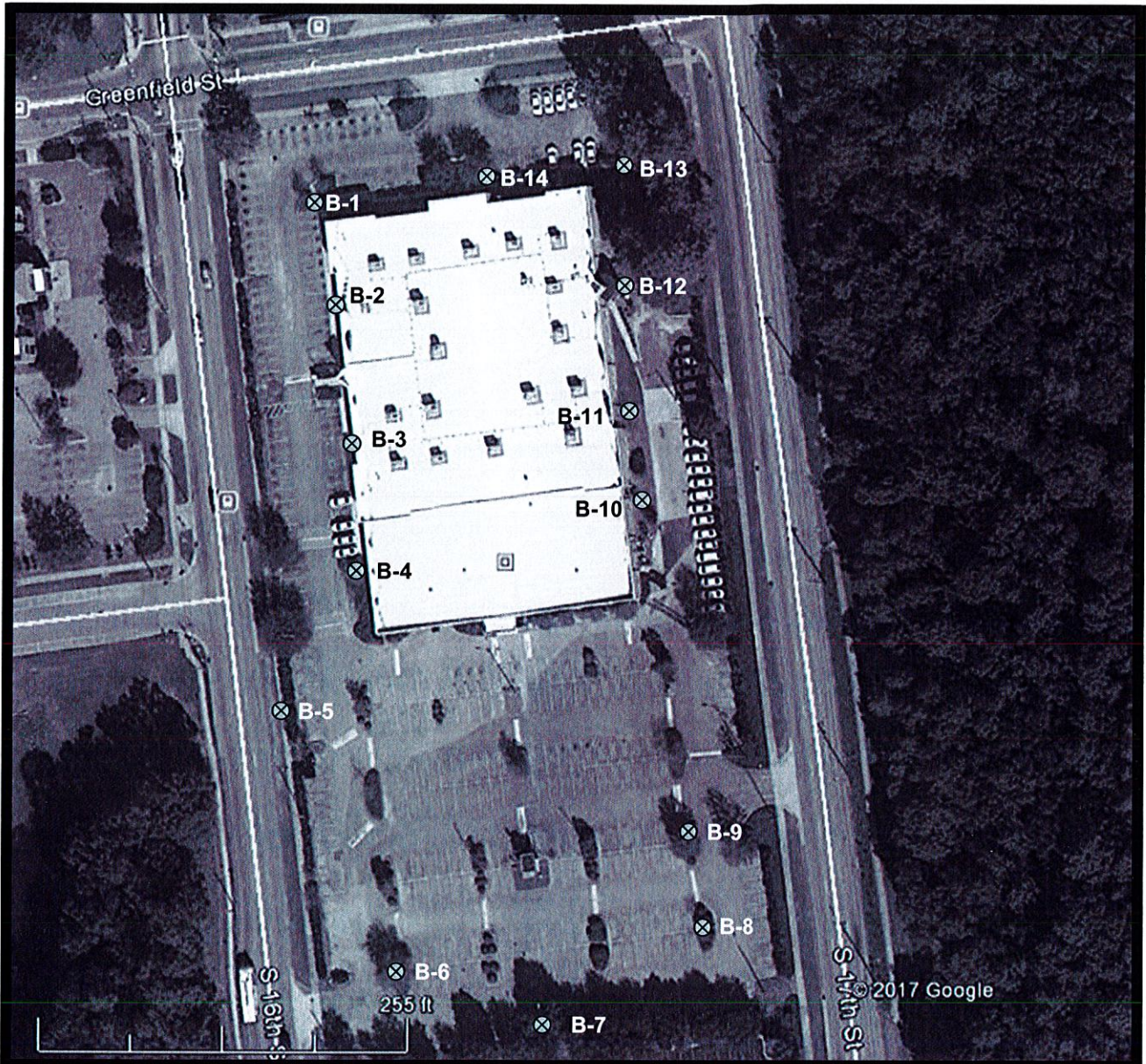


K. Brooks Wall
Project Manager
bwall@ecslimited.com
910-686-9114



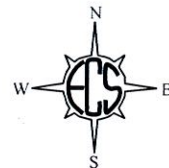
W. Brandon Fulton, PSC, PWS, LSS
Environmental Department Manager
bfulton@ecslimited.com
704-525-5152

Attachments: Boring Location Plan
 SHWT sheet
 ASFE Document



⊗ APPROXIMATE BORING LOCATIONS

SCALE SHOWN ABOVE



NHC Health & Human Services
 Wilmington, New Hanover County,
 North Carolina

ECS Project # 49.5873
 January 2, 2018
 KBW

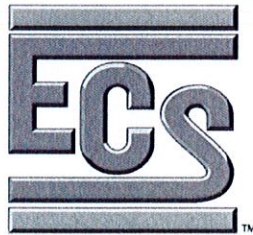


Figure 1- Boring Location Plan

Provided by: Google Earth

Seasonal High Water Table Estimation
 NHC Health & Human Services
 Wilmington, New Hanover Co., North Carolina
 ECS Project No. 49.5873
 January 2, 2018

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-1	0-15"	SM	Dark gray silty SAND
	15"-36"	SC	Gray clayey SAND w/ clay lens
	36"-62"	SP	Orange/gray fine to med. SAND

Seasonal High Water Table was estimated to be at 52 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-2	0-14"	SM	Dark gray silty SAND
	15"-36"	SW	Tan/orange fine SAND w/ clay lens
	36"-66"	CL	Gray sandy CLAY
	66"-72"	SP	Gray fine SAND

Seasonal High Water Table was estimated to be at 60 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-3	0-10"	SM	Dark gray silty SAND
	10"-40"	SC	Gray clayey SAND w/ clay lens
	40"-55"	SP	Tan/gray fine SAND
	55"-60"	GW	Gray GRAVEL

Seasonal High Water Table was estimated to be at 55 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-4	0-24"	SM	Dark gray silty SAND w/gravel
	24"-66"	SW	Gray fine SAND w/ clay lens

Seasonal High Water Table was estimated to be at 66 inches below the existing grade elevation.

Seasonal High Water Table Estimation
NHC Health & Human Services
Wilmington, New Hanover Co., North Carolina
ECS Project No. 49.5873
January 2, 2018

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-5	0-50"	SP	Tan/orange fine SAND
	50"-60"	SM	Black silty SAND

Seasonal High Water Table was estimated to be at 50 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-6	0-32"	SM	Dark gray silty SAND
	32"-50"	SP	White fine to med. SAND

Seasonal High Water Table was estimated to be at 50 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-7	0-32"	SM	Dark gray silty SAND
	32"-50"	SP	White fine to med. SAND

Seasonal High Water Table was estimated to be at 75 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-8	Auger Refusal at four attempts - Gravel		

Seasonal High Water Table not determined.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-9	0-75"	SP	Tan/orange/gray fine SAND

Seasonal High Water Table was estimated to be at 72 inches below the existing grade elevation.

Seasonal High Water Table Estimation
 NHC Health & Human Services
 Wilmington, New Hanover Co., North Carolina
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 January 2, 2018

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-10	0-20"	SM	Dark gray silty SAND
	20"-32"	SP	Gray fine SAND
	32"-55"	SM	Tan/brown silty SAND
	55"-70"	CL	Tan/orange/gray sandy CLAY

Seasonal High Water Table was estimated to be at 60 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-11	0-10"	SM	Dark gray silty SAND
	10"-28"	SP	Tan/orange fine SAND
	28"-70"	SM	Dark gray silty SAND

Seasonal High Water Table was estimated to be at 54 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-12	0-14"	SM	Dark gray silty SAND w/ clay lens
	14"-40"	SP	Brown fine SAND
	28"-70"	SC	Dark gray clayey SAND

Seasonal High Water Table was estimated to be at 40 inches below the existing grade elevation.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-13	0-10"	SM	Dark gray silty SAND
	10"-48"	SC	Gray/orange clayey SAND
	48"-60"	SM	Dark gray silty SAND

Seasonal High Water Table was estimated to be at 48 inches below the existing grade elevation.

Seasonal High Water Table Estimation
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January 2, 2018

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-14	0-24"	SM	Dark gray silty SAND
	24"-66"	SP	Gray fine SAND

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- not prepared for you,
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Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led

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Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer For Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.



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January 17, 2018

Mr. Kevin Caison
New Hanover County Property Management
1650 Greenfield Street
Wilmington, North Carolina 28401

Reference: Report of Infiltration Testing
NHC Health & Human Services
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.5873



Dear Mr. Caison:

ECS Southeast, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing within the stormwater control measure (SCM) area(s) at the New Hanover County Health & Human Services in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

Field Testing

On January 2, 2018, ECS visited the site and estimated the SHWT elevations at fourteen locations. ECS returned to the site on January 12th and 13th, 2018 to conduct infiltration testing at twelve of the fourteen requested locations shown on the attached Boring Location Plan (Figure 1). ECS used GPS equipment to locate the borings. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring locations.

ECS has conducted twelve infiltration tests (excluding B-8 and B-9) utilizing a compact constant head permeameter near the hand auger borings 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 for durations of up to 30 minutes. If a more precise hydraulic conductivity value is desired 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	Gray clayey SAND	28 inches	<0.001
B-2	Gray sandy CLAY	36 inches	<0.001
B-3	Gray fine SAND w/ clay lens	31 inches	2.55
B-4	Gray fine SAND w/ clay lens	42 inches	0.47
B-5	Tan/orange fine SAND	26 inches	11.31

B-6	Dark gray fine SAND w/ silt	26 inches	9.00	C
B-7	White fine SAND	51 inches	9.91	
B-10	Tan/brown silty SAND	36 inches	5.96	
B-11	Dark gray silty SAND	30 inches	1.35	
B-12	Brown fine SAND w/ silt	16 inches	3.40	
B-13	Gray/orange clayey SAND	24 inches	0.92	A
B-14	Gray fine SAND	36 inches	9.10	

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.

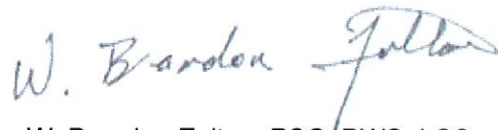
ECS appreciates the opportunity to provide our services to you on this project. If you have any questions concerning this report or this project, please contact us.

Respectfully,

ECS SOUTHEAST, LLP

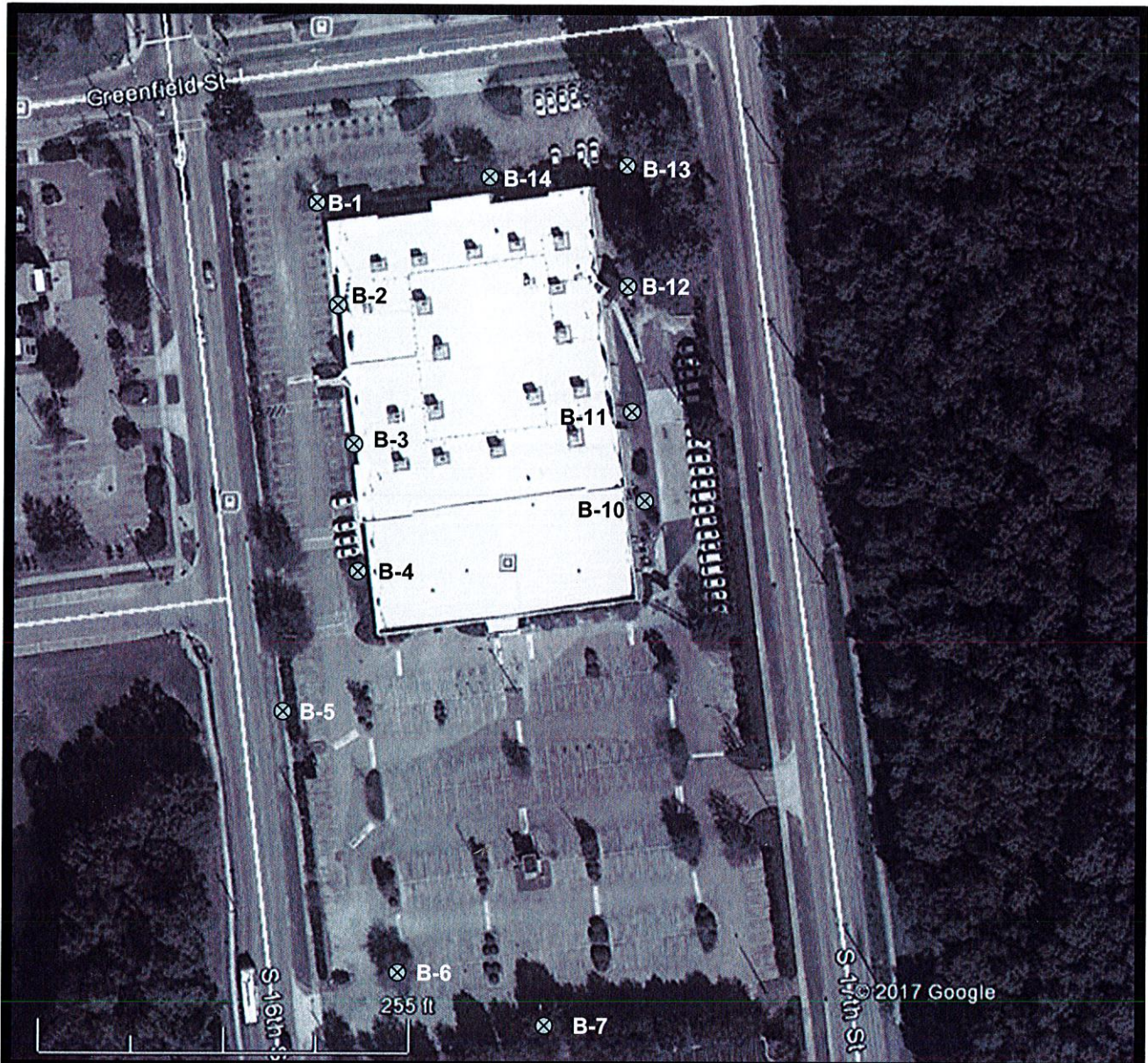


K. Brooks Wall
 Project Manager
bwall@ecslimited.com
 910-686-9114



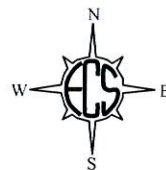
W. Brandon Fulton, PSC, PWS, LSS
 Environmental Department Manager
bfulton@ecslimited.com
 704-525-5152

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



APPROXIMATE TEST LOCATIONS

SCALE SHOWN ABOVE



NHC Health & Human Services
 Wilmington, New Hanover County,
 North Carolina

ECS Project # 49.5873
 January 12TH and 13th, 2018
 KBW

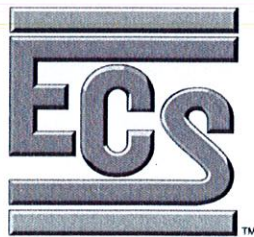


Figure 1- Boring Location Plan

Provided by: Google Earth

Infiltration Data Sheet
 NHC Health & Human Services
 Wilmington, New Hanover Co., North Carolina
 ECS Project No. 49.5873
 January 12th and 13th, 2018

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-1	0-15"	SM	Dark gray silty SAND
	15"-36"	SC	Gray clayey SAND w/ clay lens
	36"-62"	SP	Orange/gray fine to med. SAND

Seasonal High Water Table was estimated to be at 52 inches below the existing grade elevation.

Test was conducted at 28 inches below existing grade elevation

Infiltration Rate: < 0.001 inches per hour.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-2	0-14"	SM	Dark gray silty SAND
	15"-36"	SW	Tan/orange fine SAND w/ clay lens
	36"-66"	CL	Gray sandy CLAY
	66"-72"	SP	Gray fine SAND

Seasonal High Water Table was estimated to be at 60 inches below the existing grade elevation.

Test was conducted at 36 inches below existing grade elevation

Infiltration Rate: <0.001 inches per hour.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-3	0-10"	SM	Dark gray silty SAND
	10"-40"	SC	Gray fine SAND w/ clay lens
	40"-55"	SP	Tan/gray fine SAND
	55"-60"	GW	Gray GRAVEL

Seasonal High Water Table was estimated to be at 55 inches below the existing grade elevation.

Test was conducted at 31 inches below existing grade elevation

Infiltration Rate: 2.55 inches per hour.

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 NHC Health & Human Services
 Wilmington, New Hanover Co., North Carolina
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 January 12th and 13th, 2018

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-4	0-24"	SM	Dark gray silty SAND w/gravel
	24"-66"	SW	Gray fine SAND w/ clay lens

Seasonal High Water Table was estimated to be at 66 inches below the existing grade elevation.

Test was conducted at 42 inches below existing grade elevation

Infiltration Rate: 0.47 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-5	0-50"	SP	Tan/orange fine SAND
	50"-60"	SM	Black silty SAND

Seasonal High Water Table was estimated to be at 50 inches below the existing grade elevation.

Test was conducted at 26 inches below existing grade elevation

Infiltration Rate: 11.31 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-6	0-32"	SM	Dark gray fine SAND w/ silt
	32"-50"	SP	White fine to med. SAND

Seasonal High Water Table was estimated to be at 50 inches below the existing grade elevation.

Test was conducted at 26 inches below existing grade elevation

Infiltration Rate: 9.00 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-7	0-32"	SM	Dark gray silty SAND
	32"-50"	SP	White fine SAND

Seasonal High Water Table was estimated to be at 75 inches below the existing grade elevation.

Test was conducted at 51 inches below existing grade elevation

Infiltration Data Sheet
 NHC Health & Human Services
 Wilmington, New Hanover Co., North Carolina
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Infiltration Rate: 9.91 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-8	Auger Refusal at four attempts - Gravel		

Seasonal High Water Table not determined.
 No Test was conducted.

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-9	0-75"	SP	Tan/orange/gray fine SAND

Seasonal High Water Table was estimated to be at 72 inches below the existing grade elevation.
 No test was conducted

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-10	0-20"	SM	Dark gray silty SAND
	20"-32"	SP	Gray fine SAND
	32"-55"	SM	Tan/brown silty SAND
	55"-70"	CL	Tan/orange/gray sandy CLAY

Seasonal High Water Table was estimated to be at 60 inches below the existing grade elevation.
 Test was conducted at 36 inches below existing grade elevation
 Infiltration Rate: 5.96 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-11	0-10"	SM	Dark gray silty SAND
	10"-28"	SP	Tan/orange fine SAND
	28"-70"	SM	Dark gray silty SAND

Seasonal High Water Table was estimated to be at 54 inches below the existing grade elevation.
 Test was conducted at 30 inches below existing grade elevation
 Infiltration Rate: 1.35 inches per hour

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B-12	0-14"	SM	Dark gray silty SAND w/ clay lens
	14"-40"	SP	Brown fine SAND w/ silt
	28"-70"	SC	Dark gray clayey SAND

Seasonal High Water Table was estimated to be at 40 inches below the existing grade elevation.

Test was conducted at 16 inches below existing grade elevation

Infiltration Rate: 3.40 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-13	0-10"	SM	Dark gray silty SAND
	10"-48"	SC	Gray/orange clayey SAND
	48"-60"	SM	Dark gray silty SAND

Seasonal High Water Table was estimated to be at 48 inches below the existing grade elevation.

Test was conducted at 24 inches below existing grade elevation

Infiltration Rate: 0.92 inches per hour

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
B-14	0-24"	SM	Dark gray silty SAND
	24"-66"	SP	Gray fine SAND

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to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer For Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.



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