STORMWATER CALCULATIONS

NHRMC ORTHOPEDIC INPATIENT HOSPITAL

2131 S. 17th Street

Wilmington, North Carolina

For

New Hanover Regional Medical Center
P.O. Box 9000
Wilmington, NC 28402

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 030869 T. JASON CLARK

7/27/2017

Final SW Calcs
9/1/17
SWP 2006014 R2
RAC

Revised July 2017 (C.O.W. SW Response)

June 2017

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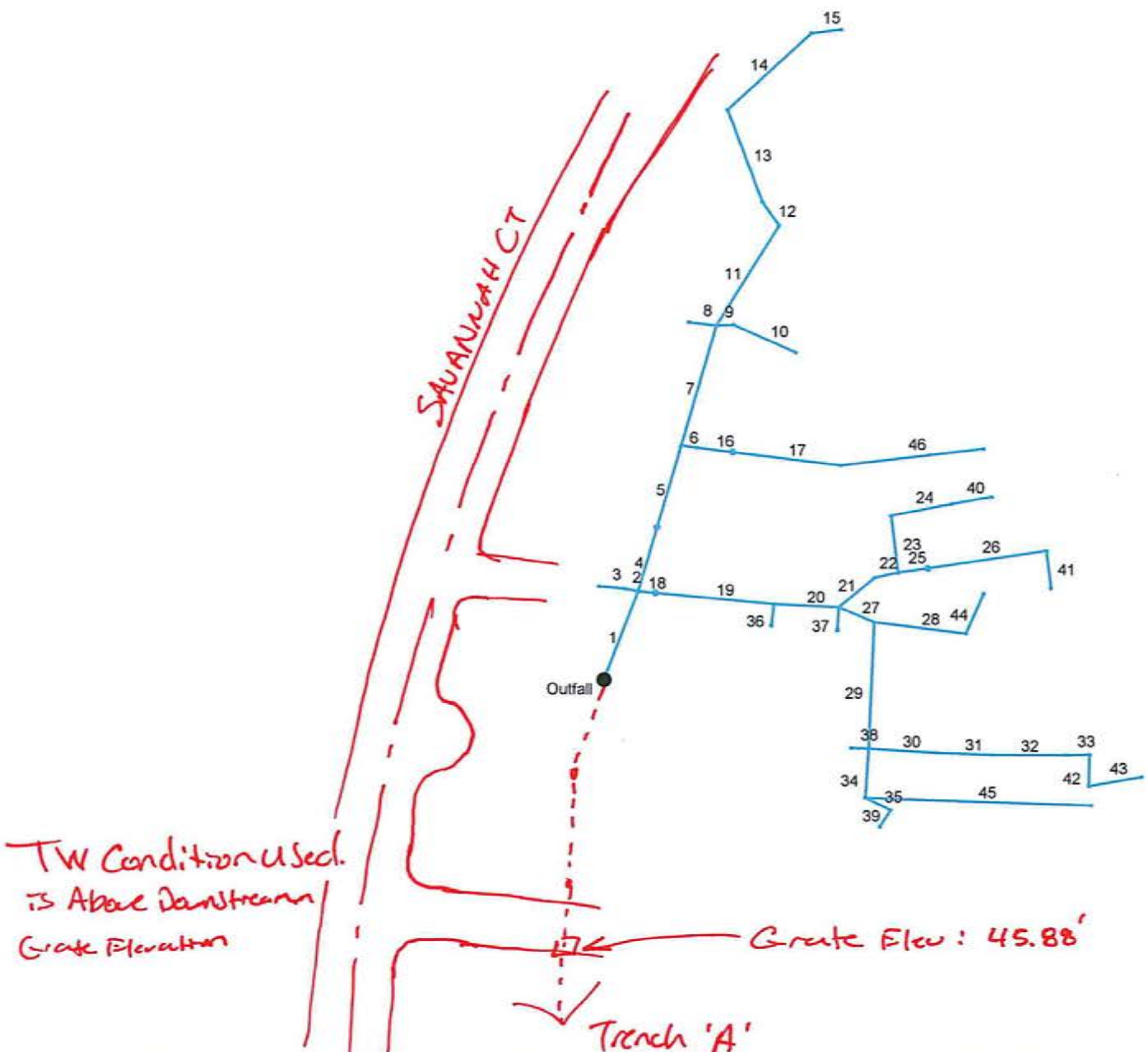
Ex Ortho- per As-Builts



Project File: Orthopedic SDs June 2017.stm	Number of lines: 46	Date: 7/25/17

Storm Sewers v10.40

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	95	0.52	6.30	0.85	0.44	5.40	5.0	19.0	5.2	27.84	36.44	5.67	30	0.79	43.38	44.13	46.50	46.94	48.53	50.41	CB-29A
2	1	12	0.29	0.38	0.90	0.26	0.35	5.0	5.7	7.1	2.45	8.13	4.89	15	1.58	46.91	47.10	47.38	47.73	50.41	50.50	CB-5A
3	2	22	0.09	0.09	0.95	0.09	0.09	5.0	5.0	7.2	0.62	9.44	1.76	15	2.14	47.27	47.74	47.97	48.05	50.50	50.79	CB-25A
4	1	67	0.45	2.48	0.93	0.42	2.22	5.0	12.3	6.0	13.27	26.93	4.23	24	1.42	44.46	45.41	47.16	47.38	50.41	52.00	CI-2.2
5	4	85	0.02	2.03	0.95	0.02	1.81	5.0	11.9	6.0	10.87	30.74	4.54	24	1.85	45.41	46.98	47.47	48.16	52.00	55.58	CB-13A
6	5	13	0.17	0.36	0.92	0.16	0.30	5.0	11.8	6.0	1.84	10.29	1.50	15	2.54	46.98	47.31	48.62	48.63	55.58	54.66	CB-14A
7	5	125	0.04	1.65	0.95	0.04	1.48	5.0	8.6	6.5	9.70	26.91	4.59	24	1.42	46.98	48.75	48.51	49.86	55.58	58.34	CB-15A
8	7	24	0.02	0.02	0.95	0.02	0.02	5.0	5.0	7.2	0.14	7.69	2.08	15	1.42	55.03	55.37	55.15	55.51	58.34	58.12	CB-24A
9	7	15	0.21	0.70	0.92	0.19	0.59	5.0	5.4	7.1	4.18	16.08	7.93	15	6.20	52.99	53.92	53.42	54.75	58.34	58.00	CB-16A
10	9	60	0.49	0.49	0.80	0.39	0.39	5.0	5.0	7.2	2.83	5.40	3.32	15	0.70	53.92	54.34	55.03	55.02	58.00	58.15	CB-17A
11	7	115	0.03	0.89	0.95	0.03	0.84	5.0	6.2	7.0	5.87	6.76	5.95	15	1.10	50.98	52.24	51.88	53.22	58.34	60.24	CB-19A
12	11	28	0.03	0.86	0.95	0.03	0.81	5.0	6.1	7.0	5.69	3.86	4.64	15	0.36	52.37	52.47	53.62	53.84	60.24	60.26	CB-20A
13	12	98	0.16	0.83	0.92	0.15	0.78	5.0	5.7	7.1	5.55	6.59	5.02	15	1.04	52.56	53.58	53.85	54.53	60.26	59.20	CB-21A
14	13	106	0.33	0.67	0.95	0.31	0.64	5.0	5.2	7.2	4.57	6.46	4.50	15	1.00	53.68	54.74	54.79	55.61	59.20	58.20	CB-22A
15	14	26	0.34	0.34	0.95	0.32	0.32	5.0	5.0	7.2	2.33	6.46	3.06	15	1.00	54.84	55.10	55.85	55.71	58.20	58.20	CB-23A
16	6	32	0.03	0.19	0.95	0.03	0.15	5.0	11.2	6.1	0.91	8.62	3.75	15	1.78	52.36	52.93	52.63	53.30	54.66	56.10	DI-14B
17	16	94	0.03	0.16	0.95	0.03	0.12	5.0	8.9	6.5	0.78	8.89	2.25	15	1.89	52.93	54.71	53.43	55.05	56.10	57.65	CI-18A
18	1	15	0.21	2.92	0.92	0.19	2.38	5.0	18.9	5.2	12.31	42.36	2.51	30	1.07	44.51	44.67	47.34	47.35	50.41	50.80	CI-2.1
19	18	103	0.00	2.71	0.00	0.00	2.19	5.0	18.3	5.2	11.45	42.96	2.92	30	1.10	44.67	45.80	47.37	47.38	50.80	52.80	JB-2.1A
20	19	56	0.00	2.59	0.00	0.00	2.10	5.0	18.0	5.3	11.07	53.42	4.19	30	1.70	45.80	46.75	47.49	47.86	52.80	54.50	JB-2.1B
21	20	43	0.18	0.85	0.94	0.17	0.79	5.0	7.5	6.7	5.34	38.56	3.28	24	2.91	46.75	48.00	48.24	48.81	54.50	56.40	CI-2.7

Ex Ortho- per As-Builts

Number of lines: 46

Run Date: 7/25/17

NOTES:Intensity = 121.80 / (Inlet time + 23.50) ^ 0.84; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station Line	To Line	Len (ft)	Drng Area Incr (ac)	Drng Area Total (ac)	Rnoff coeff (C)	Area x C Incr	Area x C Total	Tc Inlet (min)	Tc Syst (min)	Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev Dn (ft)	Invert Elev Up (ft)	HGL Elev Dn (ft)	HGL Elev Up (ft)	Grnd / Rim Elev Dn (ft)	Grnd / Rim Elev Up (ft)	Line ID
22	21	21	0.00	0.67	0.00	0.00	0.62	5.0	7.2	6.8	4.23	58.40	3.28	24	6.67	48.00	49.40	49.09	50.12	56.40	57.40	SDMH-2.7A
23	22	58	0.00	0.21	0.00	0.00	0.19	5.0	6.4	6.9	1.35	11.06	3.51	15	2.93	49.95	51.65	50.37	52.11	57.40	58.60	JB-2.7B
24	23	54	0.02	0.21	0.94	0.02	0.19	5.0	5.6	7.1	1.38	9.42	4.40	15	2.13	53.45	54.60	53.77	55.06	58.60	60.40	DI-2.8
25	22	26	0.10	0.46	0.88	0.09	0.43	5.0	6.2	7.0	3.00	6.33	3.73	15	0.96	49.40	49.65	50.30	50.35	57.40	58.50	DI-2.7C
26	25	104	0.17	0.36	0.95	0.16	0.34	5.0	5.4	7.1	2.44	6.17	3.26	15	0.91	49.65	50.60	50.57	51.23	58.50	61.00	DI-2.9
27	20	34	0.03	1.73	0.87	0.03	1.31	5.0	14.8	5.6	7.36	35.17	3.70	30	0.74	46.75	47.00	48.08	47.90	54.50	56.00	CI-2.7A
28	27	80	0.15	0.38	0.85	0.13	0.25	5.0	5.6	7.1	1.79	16.53	6.20	15	6.55	50.76	56.00	51.04	56.53	56.00	58.30	CI-2.11
29	27	128	0.20	1.32	0.88	0.18	1.03	5.0	13.4	5.8	5.99	25.63	3.35	30	0.39	47.00	47.50	48.21	48.34	56.00	53.00	CI-2.10
30	29	58	0.28	0.51	0.92	0.26	0.40	5.0	12.3	6.0	2.41	27.54	2.45	24	1.48	47.50	48.36	48.60	48.90	53.00	53.00	CI-2.13
31	30	50	0.00	0.23	0.00	0.00	0.15	5.0	9.7	6.4	0.93	12.79	1.34	24	0.32	48.41	48.57	49.04	49.05	53.00	53.50	JB-2.15B
32	31	63	0.00	0.23	0.00	0.00	0.15	5.0	7.9	6.7	0.98	5.12	2.23	18	0.24	48.81	48.96	49.25	49.40	53.50	53.80	JB-2.15A
33	32	20	0.06	0.23	0.70	0.04	0.15	5.0	7.7	6.7	0.98	2.76	3.20	12	0.60	49.08	49.20	49.49	49.62	53.80	53.75	DI-2.15
34	29	50	0.08	0.29	0.95	0.08	0.23	5.0	11.5	6.1	1.43	14.30	0.95	24	0.40	47.50	47.70	48.58	48.58	53.00	51.25	CI-2.12
35	34	25	0.04	0.12	0.95	0.04	0.07	5.0	6.0	7.0	0.51	6.64	0.51	18	0.40	47.70	47.80	48.59	48.59	51.25	50.65	CI-PC8
36	19	22	0.12	0.12	0.72	0.09	0.09	5.0	5.0	7.2	0.62	3.04	2.91	12	0.73	47.94	48.10	48.25	48.43	52.80	52.40	SDMH-2.22
37	20	23	0.01	0.01	0.32	0.00	0.00	5.0	5.0	7.2	0.02	5.25	0.03	12	2.17	47.00	47.50	48.28	48.28	54.50	52.00	YI-2.17
38	29	15	0.32	0.32	0.67	0.21	0.21	5.0	5.0	7.2	1.55	11.26	2.83	12	10.00	47.50	49.00	48.55	49.53	53.00	52.00	YI-2.18
39	35	19	0.08	0.08	0.44	0.04	0.04	5.0	5.0	7.2	0.25	6.33	1.27	12	3.16	47.80	48.40	48.59	48.61	50.65	51.50	YI-2.19
40	24	35	0.19	0.19	0.92	0.17	0.17	5.0	5.0	7.2	1.26	6.90	2.66	15	1.14	54.60	55.00	55.22	55.44	60.40	61.00	DI-2.8A
41	26	38	0.19	0.19	0.95	0.18	0.18	5.0	5.0	7.2	1.30	5.78	4.71	12	2.63	55.00	56.00	55.32	56.48	61.00	61.75	DI-2.9A
42	33	32	0.07	0.17	0.94	0.07	0.10	5.0	7.1	6.8	0.71	5.63	2.23	12	2.50	49.20	50.00	49.76	50.35	53.75	52.95	CI-2.16

Ex Ortho- per As-Builts

Number of lines: 46

Run Date: 7/25/17

NOTES:Intensity = 121.80 / (Inlet time + 23.50) ^ 0.84; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
43	42	46	0.10	0.10	0.39	0.04	0.04	5.0	5.0	7.2	0.28	3.71	1.49	12	1.09	50.00	50.50	50.48	50.72	52.95	54.50	DI-2.16B
44	28	43	0.23	0.23	0.54	0.12	0.12	5.0	5.0	7.2	0.90	3.84	2.30	12	1.16	56.00	56.50	56.71	56.90	58.30	59.70	DI-2.11A
45	34	195	0.09	0.09	0.95	0.09	0.09	5.0	5.0	7.2	0.62	7.01	1.65	15	1.18	47.70	50.00	48.60	50.31	51.25	52.85	Trench Drain
46	17	125	0.13	0.13	0.70	0.09	0.09	5.0	5.0	7.2	0.66	5.13	2.14	15	0.63	54.71	55.50	55.17	55.82	57.65	60.50	CI-18B

Ex Ortho- per As-Builts | Number of lines: 46 | Run Date: 7/25/17

NOTES:Intensity = 121.80 / (Inlet time + 23.50) ^ 0.84; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	95	0.52	6.30	0.85	0.44	5.40	5.0	16.4	6.9	36.97	36.44	7.53	30	0.79	43.38	44.13	47.50	48.27	48.53	50.41	CB-29A
2	1	12	0.29	0.38	0.90	0.26	0.35	5.0	5.6	8.7	3.02	8.13	2.47	15	1.58	46.91	47.10	49.06	49.09	50.41	50.50	CB-5A
3	2	22	0.09	0.09	0.95	0.09	0.09	5.0	5.0	8.9	0.76	9.44	0.62	15	2.14	47.27	47.74	49.17	49.18	50.50	50.79	CB-25A
4	1	67	0.45	2.48	0.93	0.42	2.22	5.0	10.9	7.7	17.08	26.93	5.44	24	1.42	44.46	45.41	48.69	49.08	50.41	52.00	CI-2.2
5	4	85	0.02	2.03	0.95	0.02	1.81	5.0	10.6	7.7	13.96	30.74	4.44	24	1.85	45.41	46.98	49.23	49.55	52.00	55.58	CB-13A
6	5	13	0.17	0.36	0.92	0.16	0.30	5.0	10.5	7.7	2.36	10.29	1.92	15	2.54	46.98	47.31	49.80	49.82	55.58	54.66	CB-14A
7	5	125	0.04	1.65	0.95	0.04	1.48	5.0	7.9	8.2	12.21	26.91	4.89	24	1.42	46.98	48.75	49.63	50.00	55.58	58.34	CB-15A
8	7	24	0.02	0.02	0.95	0.02	0.02	5.0	5.0	8.9	0.17	7.69	2.21	15	1.42	55.03	55.37	55.16	55.53	58.34	58.12	CB-24A
9	7	15	0.21	0.70	0.92	0.19	0.59	5.0	5.4	8.8	5.14	16.08	8.48	15	6.20	52.99	53.92	53.48	54.84	58.34	58.00	CB-16A
10	9	60	0.49	0.49	0.80	0.39	0.39	5.0	5.0	8.9	3.48	5.40	3.67	15	0.70	53.92	54.34	55.15	55.09	58.00	58.15	CB-17A
11	7	115	0.03	0.89	0.95	0.03	0.84	5.0	5.9	8.6	7.27	6.76	5.93	15	1.10	50.98	52.24	52.23	53.69	58.34	60.24	CB-19A
12	11	28	0.03	0.86	0.95	0.03	0.81	5.0	5.9	8.7	7.04	3.86	5.74	15	0.36	52.37	52.47	53.72	54.06	60.24	60.26	CB-20A
13	12	98	0.16	0.83	0.92	0.15	0.78	5.0	5.6	8.7	6.85	6.59	5.58	15	1.04	52.56	53.58	54.08	55.19	60.26	59.20	CB-21A
14	13	106	0.33	0.67	0.95	0.31	0.64	5.0	5.2	8.8	5.62	6.46	4.58	15	1.00	53.68	54.74	55.34	56.15	59.20	58.20	CB-22A
15	14	26	0.34	0.34	0.95	0.32	0.32	5.0	5.0	8.9	2.86	6.46	2.33	15	1.00	54.84	55.10	56.39	56.44	58.20	58.20	CB-23A
16	6	32	0.03	0.19	0.95	0.03	0.15	5.0	10.0	7.8	1.16	8.62	4.03	15	1.78	52.36	52.93	52.67	53.35	54.66	56.10	DI-14B
17	16	94	0.03	0.16	0.95	0.03	0.12	5.0	8.2	8.2	0.98	8.89	2.40	15	1.89	52.93	54.71	53.50	55.10	56.10	57.65	CI-18A
18	1	15	0.21	2.92	0.92	0.19	2.38	5.0	16.3	6.9	16.35	42.36	3.33	30	1.07	44.51	44.67	48.98	49.01	50.41	50.80	CI-2.1
19	18	103	0.00	2.71	0.00	0.00	2.19	5.0	15.9	6.9	15.16	42.96	3.09	30	1.10	44.67	45.80	49.03	49.17	50.80	52.80	JB-2.1A
20	19	56	0.00	2.59	0.00	0.00	2.10	5.0	15.6	7.0	14.64	53.42	2.98	30	1.70	45.80	46.75	49.18	49.25	52.80	54.50	JB-2.1B
21	20	43	0.18	0.85	0.94	0.17	0.79	5.0	7.0	8.4	6.68	38.56	2.62	24	2.91	46.75	48.00	49.32	49.29	54.50	56.40	CI-2.7

Ex Ortho- per As-Builts | Number of lines: 46 | Run Date: 7/25/17

NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85; Return period =Yrs. 50 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
22	21	21	0.00	0.67	0.00	0.00	0.62	5.0	6.8	8.5	5.28	58.40	3.34	24	6.67	48.00	49.40	49.40	50.21	56.40	57.40	SDMH-2.7A
23	22	58	0.00	0.21	0.00	0.00	0.19	5.0	6.1	8.6	1.67	11.06	3.42	15	2.93	49.95	51.65	50.49	52.16	57.40	58.60	JB-2.7B
24	23	54	0.02	0.21	0.94	0.02	0.19	5.0	5.5	8.8	1.70	9.42	4.68	15	2.13	53.45	54.60	53.81	55.12	58.60	60.40	DI-2.8
25	22	26	0.10	0.46	0.88	0.09	0.43	5.0	6.0	8.6	3.71	6.33	4.13	15	0.96	49.40	49.65	50.37	50.43	57.40	58.50	DI-2.7C
26	25	104	0.17	0.36	0.95	0.16	0.34	5.0	5.3	8.8	3.01	6.17	3.54	15	0.91	49.65	50.60	50.67	51.30	58.50	61.00	DI-2.9
27	20	34	0.03	1.73	0.87	0.03	1.31	5.0	13.0	7.3	9.60	35.17	1.99	30	0.74	46.75	47.00	49.32	49.33	54.50	56.00	CI-2.7A
28	27	80	0.15	0.38	0.85	0.13	0.25	5.0	5.5	8.7	2.20	16.53	6.60	15	6.55	50.76	56.00	51.07	56.59	56.00	58.30	CI-2.11
29	27	128	0.20	1.32	0.88	0.18	1.03	5.0	11.8	7.5	7.76	25.63	1.81	30	0.39	47.00	47.50	49.33	49.36	56.00	53.00	CI-2.10
30	29	58	0.28	0.51	0.92	0.26	0.40	5.0	10.9	7.7	3.11	27.54	2.40	24	1.48	47.50	48.36	49.36	48.97	53.00	53.00	CI-2.13
31	30	50	0.00	0.23	0.00	0.00	0.15	5.0	8.8	8.1	1.18	12.79	1.32	24	0.32	48.41	48.57	49.15	49.16	53.00	53.50	JB-2.15B
32	31	63	0.00	0.23	0.00	0.00	0.15	5.0	7.4	8.3	1.22	5.12	2.38	18	0.24	48.81	48.96	49.31	49.46	53.50	53.80	JB-2.15A
33	32	20	0.06	0.23	0.70	0.04	0.15	5.0	7.2	8.4	1.23	2.76	3.40	12	0.60	49.08	49.20	49.55	49.67	53.80	53.75	DI-2.15
34	29	50	0.08	0.29	0.95	0.08	0.23	5.0	10.3	7.8	1.83	14.30	0.62	24	0.40	47.50	47.70	49.40	49.41	53.00	51.25	CI-2.12
35	34	25	0.04	0.12	0.95	0.04	0.07	5.0	5.8	8.7	0.64	6.64	0.36	18	0.40	47.70	47.80	49.41	49.41	51.25	50.65	CI-PC8
36	19	22	0.12	0.12	0.72	0.09	0.09	5.0	5.0	8.9	0.77	3.04	0.98	12	0.73	47.94	48.10	49.30	49.31	52.80	52.40	SDMH-2.22
37	20	23	0.01	0.01	0.32	0.00	0.00	5.0	5.0	8.9	0.03	5.25	0.04	12	2.17	47.00	47.50	49.39	49.39	54.50	52.00	YI-2.17
38	29	15	0.32	0.32	0.67	0.21	0.21	5.0	5.0	8.9	1.90	11.26	3.19	12	10.00	47.50	49.00	49.36	49.59	53.00	52.00	YI-2.18
39	35	19	0.08	0.08	0.44	0.04	0.04	5.0	5.0	8.9	0.31	6.33	0.40	12	3.16	47.80	48.40	49.41	49.41	50.65	51.50	YI-2.19
40	24	35	0.19	0.19	0.92	0.17	0.17	5.0	5.0	8.9	1.55	6.90	2.85	15	1.14	54.60	55.00	55.29	55.49	60.40	61.00	DI-2.8A
41	26	38	0.19	0.19	0.95	0.18	0.18	5.0	5.0	8.9	1.60	5.78	5.01	12	2.63	55.00	56.00	55.36	56.54	61.00	61.75	DI-2.9A
42	33	32	0.07	0.17	0.94	0.07	0.10	5.0	6.7	8.5	0.89	5.63	2.40	12	2.50	49.20	50.00	49.83	50.39	53.75	52.95	CI-2.16

Ex Ortho- per As-Builts

Number of lines: 46

Run Date: 7/25/17

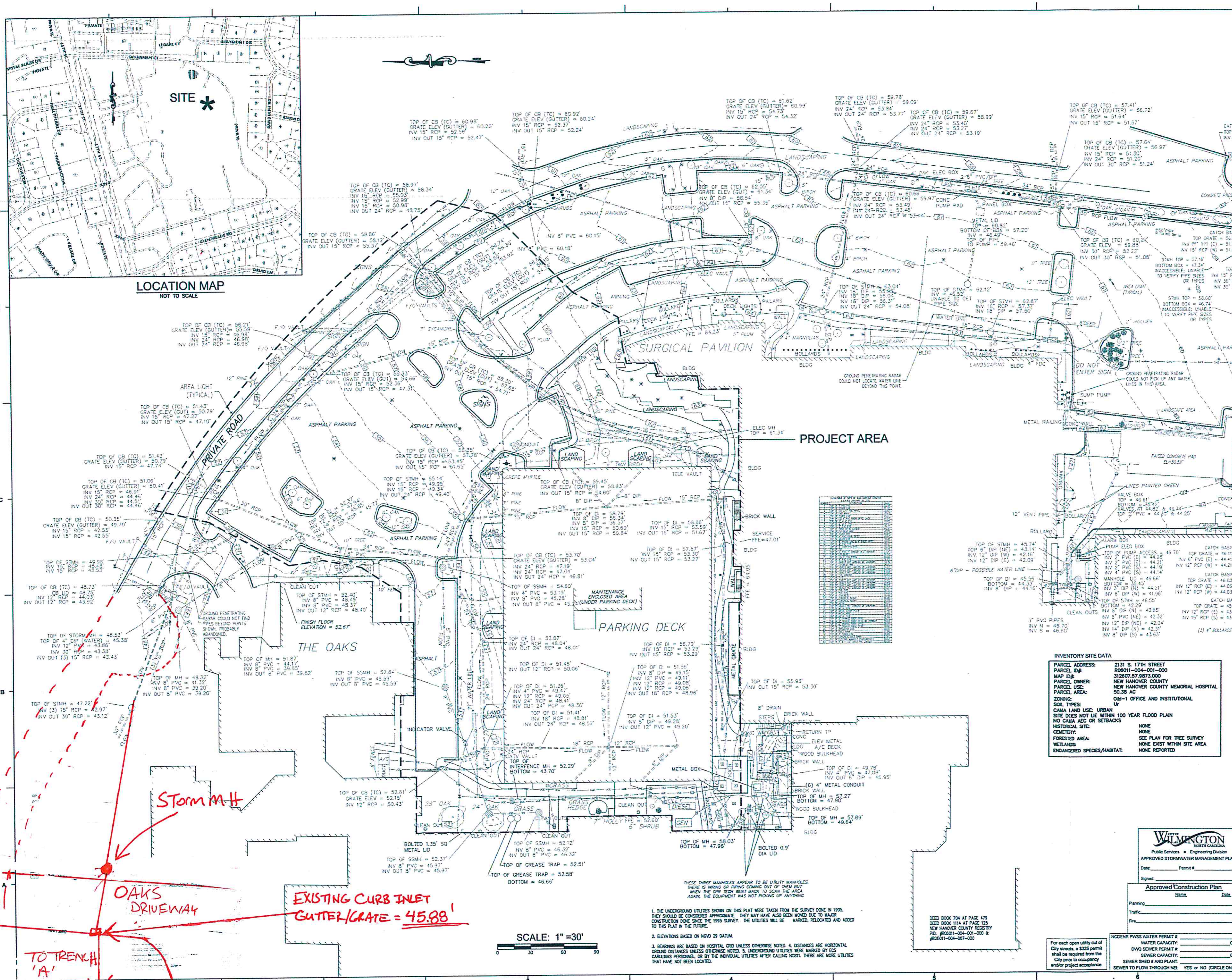
NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85; Return period =Yrs. 50 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
43	42	46	0.10	0.10	0.39	0.04	0.04	5.0	5.0	8.9	0.35	3.71	1.58	12	1.09	50.00	50.50	50.54	50.74	52.95	54.50	DI-2.16B
44	28	43	0.23	0.23	0.54	0.12	0.12	5.0	5.0	8.9	1.10	3.84	2.47	12	1.16	56.00	56.50	56.79	56.94	58.30	59.70	DI-2.11A
45	34	195	0.09	0.09	0.95	0.09	0.09	5.0	5.0	8.9	0.76	7.01	1.71	15	1.18	47.70	50.00	49.41	50.34	51.25	52.85	Trench Drain
46	17	125	0.13	0.13	0.70	0.09	0.09	5.0	5.0	8.9	0.81	5.13	2.26	15	0.63	54.71	55.50	55.23	55.85	57.65	60.50	CI-18B

Ex Ortho- per As-Builts | Number of lines: 46 | Run Date: 7/25/17

NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85; Return period =Yrs. 50 ; c = cir e = ellip b = box



1. THE UNDERGROUND UTILITIES SHOWN ON THIS PLAT WERE TAKEN FROM THE SURVEY DONE IN 1995. THEY SHOULD BE CONSIDERED APPROXIMATE. THEY MAY HAVE ALSO BEEN MOVED DUE TO MAJOR CONSTRUCTION DONE SINCE THE 1995 SURVEY. THE UTILITIES WILL BE MARKED, RELOCATED AND ADDED TO THIS PLAT IN THE FUTURE.

2. ELEVATIONS BASED ON NGVD 29 DATUM.

3. BEARINGS ARE BASED ON HOSPITAL GRID UNLESS OTHERWISE NOTED. 4. DISTANCES ARE HORIZONTAL GROUND DISTANCES UNLESS OTHERWISE NOTED. 5. UNDERGROUND UTILITIES WERE MARKED BY ECS CAROLINAS PERSONNEL, OR BY THE INDIVIDUAL UTILITIES AFTER CALLING NC811. THERE ARE MORE UTILITIES THAT HAVE NOT BEEN LOCATED.

INVENTORY SITE DATA

PARCEL ADDRESS:	2131 S. 17TH STREET
PARCEL ID#:	R06011-004-001-000
MAP ID#:	312607.57.9873.000
PARCEL OWNER:	NEW HANOVER COUNTY
PARCEL USE:	NEW HANOVER COUNTY MEMORIAL HOSPITAL
PARCEL AREA:	50.38 AC
ZONING:	O&I-1 OFFICE AND INSTITUTIONAL
SOIL TYPES:	Ur
CAMA LAND USE: URBAN	
SITE DOES NOT LIE WITHIN 100 YEAR FLOOD PLAIN	
NO CAMA AEC OR SETBACKS	
HISTORICAL SITE:	NONE
CEMETERY:	NONE
FORESTED AREA:	SEE PLAN FOR TREE SURVEY
WETLANDS:	NONE EXIST WITHIN SITE AREA
ENDANGERED SPECIES/HABITAT:	NONE REPORTED

DEED BOOK 704 AT PAGE 479
DEED BOOK 1114 AT PAGE 125
NEW HANOVER COUNTY REGISTRY
PID: R06011-004-001-000 & R06011-004-007-000

CITY OF WILMINGTON NORTH CAROLINA
Public Services • Engineering Division
APPROVED STORMWATER MANAGEMENT PLAN
Date: ______ Permit #: ______
Signed: ______

Approved Construction Plan

	Name	Date
Planning		
Traffic		
Fire		

For each open utility cut of City streets, a $325 permit shall be required from the City prior to occupancy and/or project acceptance.

NCDENR PWSS WATER PERMIT #
WATER CAPACITY: ______ GPD
DWQ SEWER PERMIT #
SEWER CAPACITY: ______ GPD
SEWER SHED # AND PLANT:
SEWER TO FLOW THROUGH NEI: YES or NO (CIRCLE ONE)

ORTHOPEDIC INPATIENT HOSPITAL

ARCHITECT:
LS3P
2528 INDEPENDENCE BLVD. SUITE 200
WILMINGTON, NORTH CAROLINA 28412
TEL 910.790.9901 FAX 910.790.3111
WWW.LS3P.COM

MEMBERS OF THE AMERICAN INSTITUTE OF ARCHITECTS

ENGINEER:
NORRIS & TUNSTALL CONSULTING ENGINEERS P.C.
902 MARKET STREET
WILMINGTON, NC 28401
PHONE (910) 343-9653
license #C-3641

SURVEYOR:
ROBERT H. GOSLEE & ASSOCIATES, PA
LAND SURVEYORS • LAND PLANNERS
FIRM LICENSE NUMBER: C-1567
513 CHESTNUT STREET
WILMINGTON, NORTH CAROLINA 28401
910-763-1941
FILE No.: 6011040IU

REVISIONS:

No.	Description	Date

SHEET NAME:
INVENTORY SITE PLAN

PROJ# 16036
DES. JST
CHK. JST
DRWN. SLF
DATE 4/25/17

NORTH CAROLINA SEAL 19851 ENGINEER JOHN S. TUNSTALL

SHEET:
I-1

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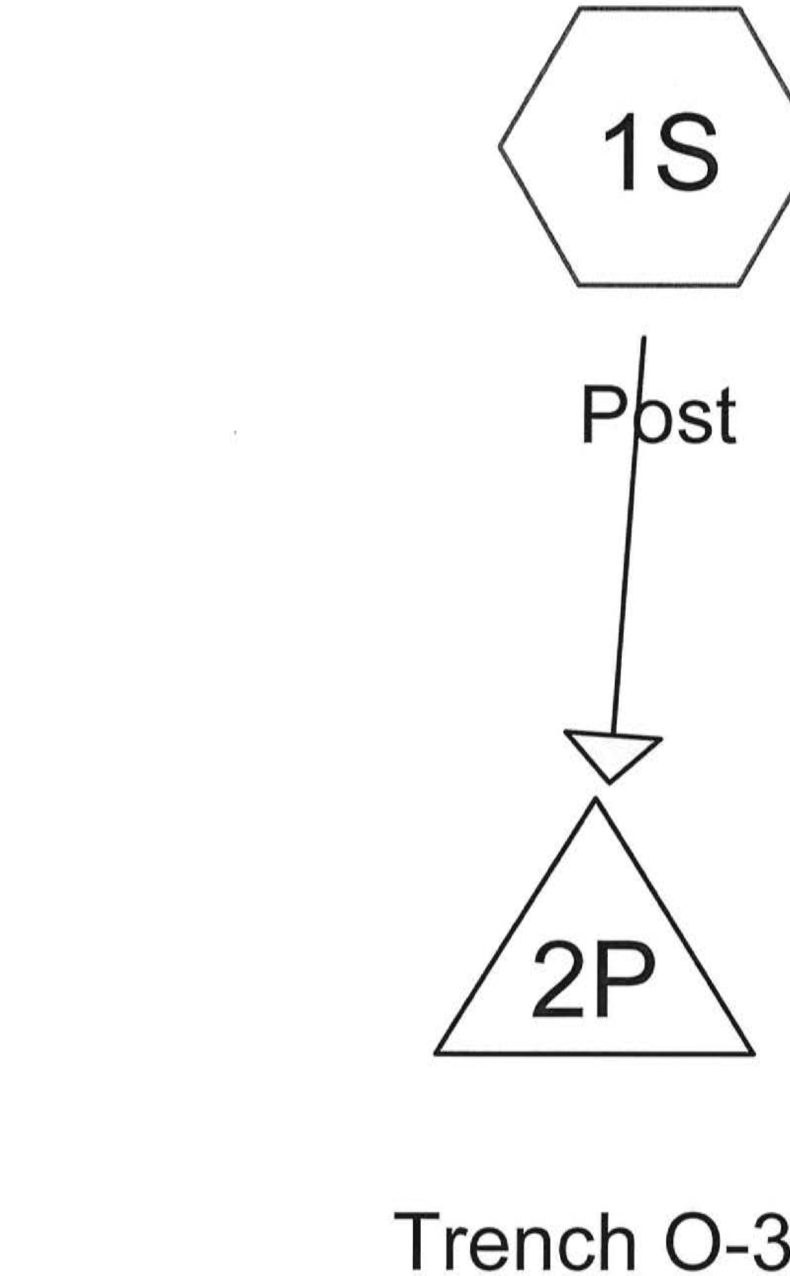
PERMIT SET



Drainage Diagram for Infiltration Trench O-3
Prepared by Norris & Tunstall Consulting Engineers 7/25/17
HydroCAD® 7.10 s/n 002070 © 2005 HydroCAD Software Solutions LLC

Time span=5.00-24.00 hrs, dt=0.02 hrs, 951 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post Runoff Area=4,865 sf Runoff Depth=0.00"
Tc=0.0 min CN=53 Runoff=0.00 cfs 0.000 af

Pond 2P: Trench O-3 Peak Elev=48.50' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 0.112 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"

Subcatchment 1S: Post

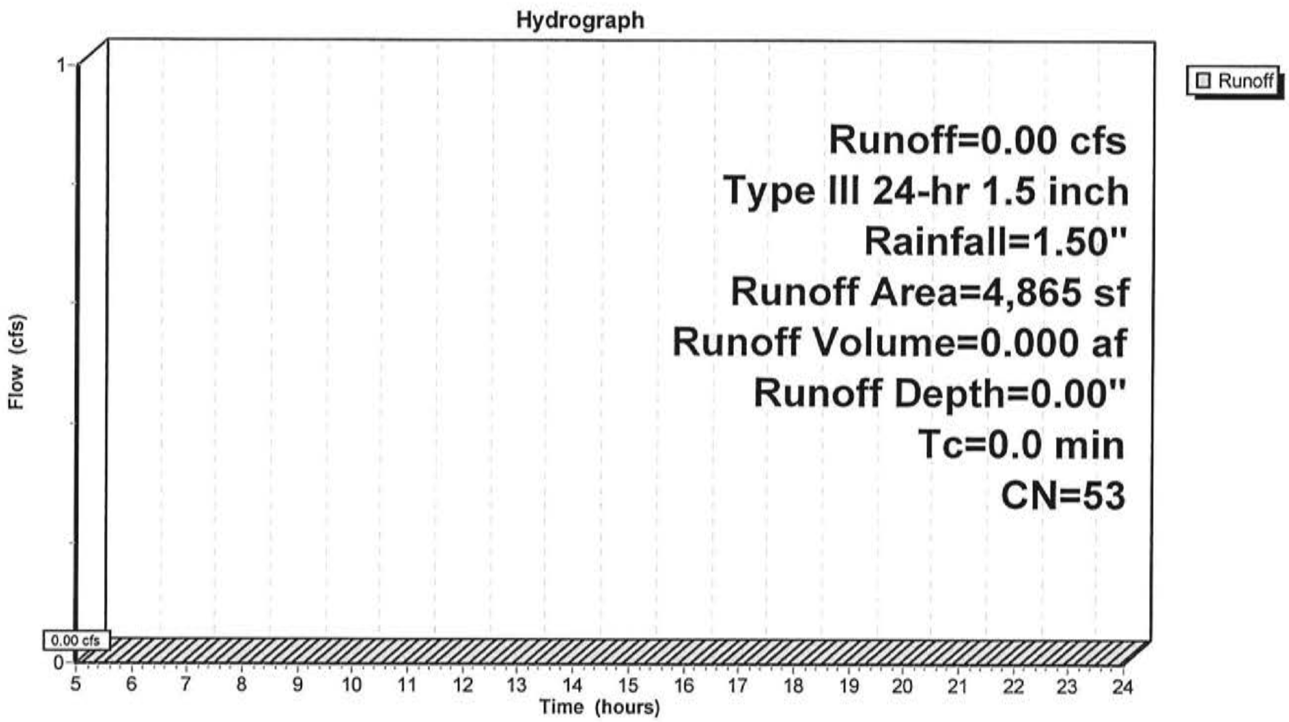
[46] Hint: Tc=0 (Instant runoff peak depends on dt)
[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 1.5 inch Rainfall=1.50"

Area (sf)	CN	Description
3,213	30	Lawn
1,652	98	IMPERVIOUS
4,865	53	Weighted Average

Subcatchment 1S: Post



Pond 2P: Trench O-3

Inflow Area =	0.112 ac, Inflow Depth = 0.00"	for 1.5 inch event	
Inflow =	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Outflow =	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Discarded =	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Primary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 48.50' @ 5.00 hrs Surf.Area= 260 sf Storage= 0 cf
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	48.50'	167 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 520 cf Overall - 101 cf Embedded = 419 cf x 40.0% Voids
#2	49.00'	101 cf	**12.0"D x 129.00'L Horizontal Cylinder** Inside #1
		269 cf	Total Available Storage

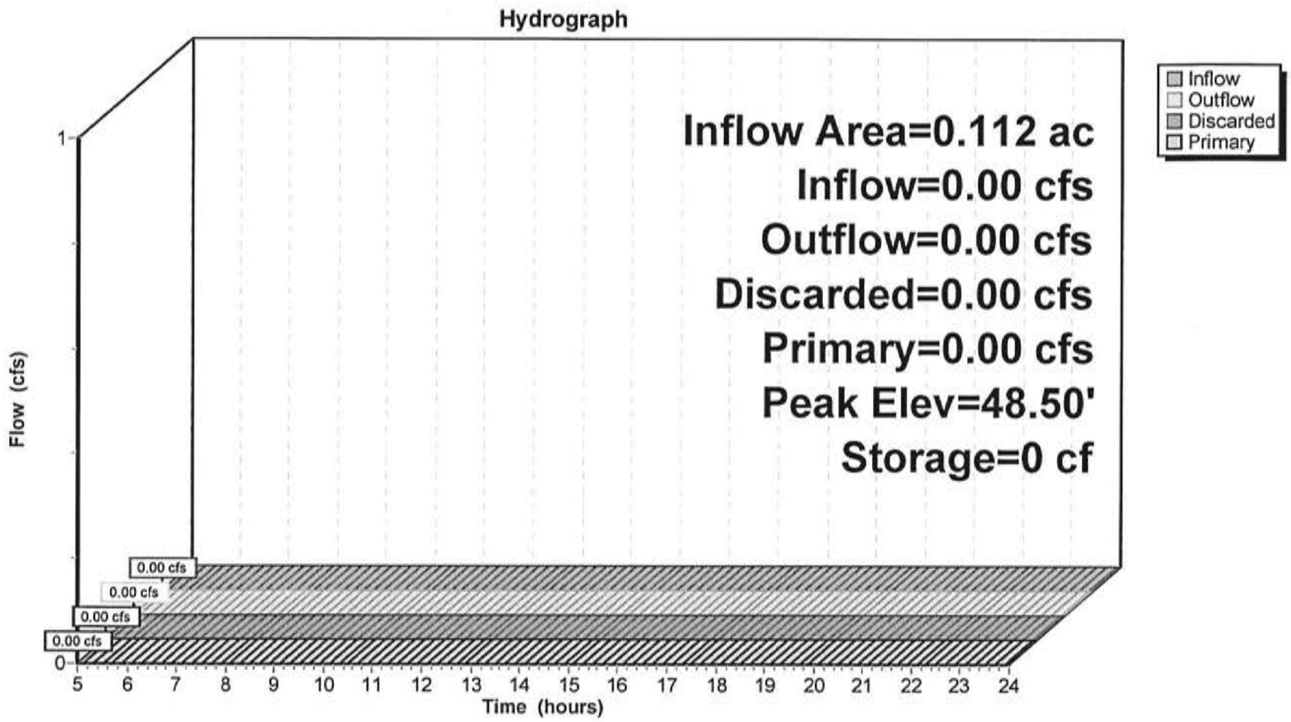
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.50	260	0	0
50.50	260	520	520

Device	Routing	Invert	Outlet Devices
#1	Device 2	48.50'	**12.0" x 90.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 47.80' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Primary	50.50'	**3.0' long x 2.0' high Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.00' Rise
#3	Discarded	0.00'	**5.480 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=48.50' (Free Discharge)
↑—**3=Exfiltration** (Passes 0.00 cfs of 0.03 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=48.50' (Free Discharge)
↑—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
↑—**1=Culvert** (Controls 0.00 cfs)

Pond 2P: Trench O-3



Time span=5.00-24.00 hrs, dt=0.02 hrs, 951 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post Runoff Area=4,865 sf Runoff Depth>1.77"
Tc=0.0 min CN=53 Runoff=0.25 cfs 0.016 af

Pond 2P: Trench O-3 Peak Elev=49.87' Storage=199 cf Inflow=0.25 cfs 0.016 af
Discarded=0.03 cfs 0.016 af Primary=0.00 cfs 0.000 af Outflow=0.03 cfs 0.016 af

Total Runoff Area = 0.112 ac Runoff Volume = 0.016 af Average Runoff Depth = 1.77"

Subcatchment 1S: Post

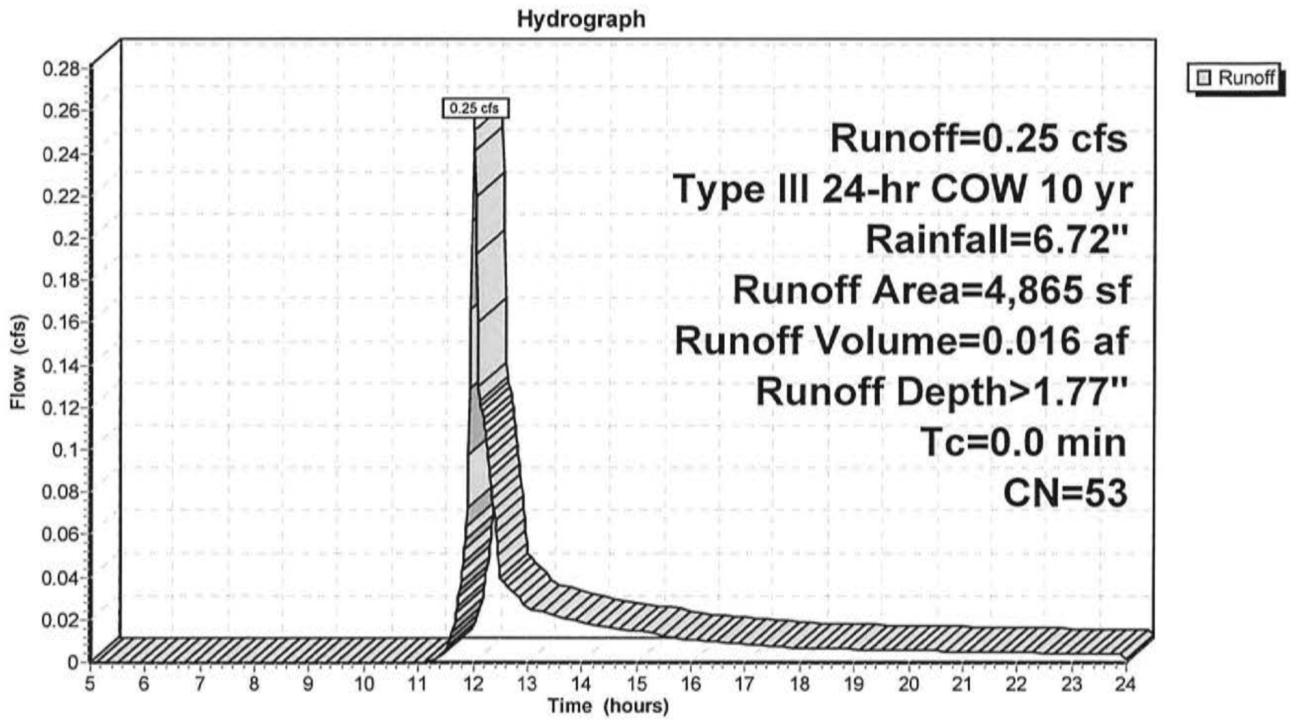
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.25 cfs @ 12.01 hrs, Volume= 0.016 af, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr COW 10 yr Rainfall=6.72"

Area (sf)	CN	Description
3,213	30	Lawn
1,652	98	IMPERVIOUS
4,865	53	Weighted Average

Subcatchment 1S: Post



Pond 2P: Trench O-3

Inflow Area =	0.112 ac,	Inflow Depth > 1.77"	for COW 10 yr event	
Inflow =	0.25 cfs @	12.01 hrs, Volume=	0.016 af	
Outflow =	0.03 cfs @	11.80 hrs, Volume=	0.016 af,	Atten= 87%, Lag= 0.0 min
Discarded =	0.03 cfs @	11.80 hrs, Volume=	0.016 af	
Primary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 49.87' @ 12.75 hrs Surf.Area= 260 sf Storage= 199 cf
Plug-Flow detention time= 46.9 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 46.6 min (915.6 - 869.1)

Volume	Invert	Avail.Storage	Storage Description
#1	48.50'	167 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 520 cf Overall - 101 cf Embedded = 419 cf x 40.0% Voids
#2	49.00'	101 cf	**12.0"D x 129.00'L Horizontal Cylinder** Inside #1
		269 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.50	260	0	0
50.50	260	520	520

Device	Routing	Invert	Outlet Devices
#1	Device 2	48.50'	**12.0" x 90.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 47.80' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Primary	50.50'	**3.0' long x 2.0' high Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.00' Rise
#3	Discarded	0.00'	**5.480 in/hr Exfiltration over Surface area**

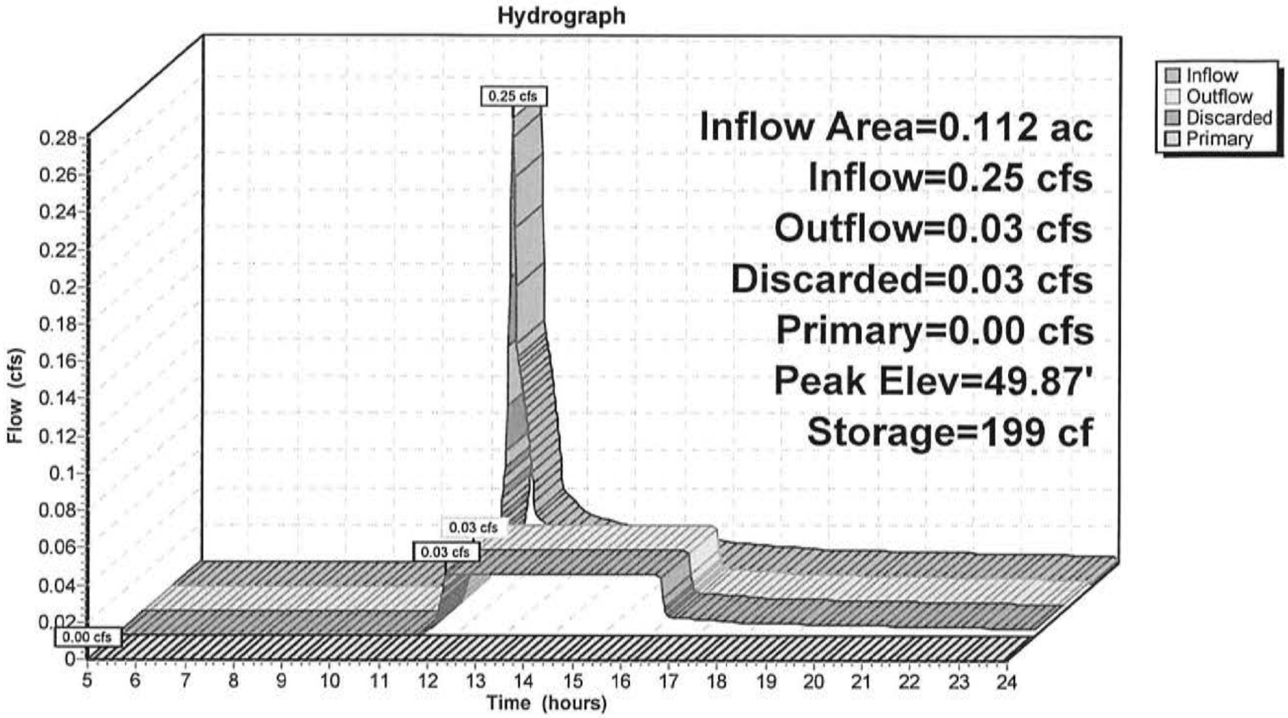
1/2 Rate

Discarded OutFlow Max=0.03 cfs @ 11.80 hrs HW=48.54' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=48.50' (Free Discharge)
↑—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  ↑—**1=Culvert** (Controls 0.00 cfs)

Ø outflow

Pond 2P: Trench O-3



DRAINAGE AREA	TOTAL AREA (SF)	ASPHALT/ C&G (SF)	SIDEWALK (SF)	PERVIOUS CONCRETE (SF)	BUILDING (SF)	
DA-1	5922	4924	0	0	0	
DA-2	8985	7924	0	0	0	
DA-3	5104	1444	0	3360	0	PC-1
DA-3A	1240	1240	0	0	0	
DA-3B	11196	4608	0	6625	0	PC-2
DA-4	9071	8579	70	0	0	
DA-5	21295	11714	2598	0	2184	
DA-6	8830	2880	0	5740	0	PC-3
DA-6A	5464	1500	1844	0	33	
DA-7	7850	2575	558	4600	0	PC-4
DA-8	8179	3760	4091	0	0	
DA-9	1806	1268	538	0	0	
DA-10	8455	1534	743	0	6178	
DA-11	6318	3937	1443	0	0	
DA-12	6350	2896	732	0	0	
DA-13	4388	3285	615	0	0	
DA-14A	8680	7420	380	0	0	
DA-14B	3390	3390	0	0	0	
DA-14C	3960	3960	0	0	0	
DA-14D	2430	1480	0	0	0	
DA -14E	940	940	0	0	0	
DA-14F	3884	0	1060	2624	0	PC-5
DA-14G	7828	3400	0	4428	0	PC-6
DA-14H	2106	0	749	1287	0	PC-7
DA-14I	450	0	0	0	0	
DA-15	4378	0	583	0	0	
DA-16	5512	0	0	0	5512	
DA-17	529	18	0	0	0	
DA-18	3453	106	512	0	0	
DA-19	3344	0	703	0	0	
DA-20	4865	0	1652	0	0	
DA-21	1669	217	0	1452	0	PC-8
DA-22	1669	217	0	1452	0	PC-9

PERVIOUS CONCRETE	AREA OF PERVIOUS (Ap) (SF)	AREA OF IMP DRAINING TO PC (Ac) (SF)	Ratio	Infiltration Rate (in/hr)	Min Aggregate Depth - 1.5" Storm (IN)	Min Aggregate Depth - 10-yr Storm (IN)
PC-1	3360	1444	0.430	10.02	5.36	-95.2
PC-2	6625	4608	0.696	10.02	6.36	-90.6
PC-3	5740	2880	0.502	10.02	5.63	-94.0
PC-4	4600	3133	0.681	10.02	6.30	-90.8
PC-5	1260	1060	0.841	8.75	6.90	-72.8
PC-6	4428	3400	0.768	8.75	6.63	-74.1
PC-7	1287	749	0.582	8.75	5.93	-77.3
PC-8	1452	217	0.149	8.75	4.31	-84.9
PC-9	1452	217	0.149	8.75	4.31	-84.9

*** ECS provided Soils Reports on January 27, 2017 and March 7, 2017.

*PC-1thru PC-4 correspond to ECS Report Dates March 7, 2017. Three (3) Borings were taken in the areas of the Proposed Pervious Concrete.
Results show the infiltration rates vary between 10.02 in/hr and 21.43 in/hr. For the design of PC1 thru PC-4 the lowest measured rate will be used = 10.02 in/hr.

**PC-5 thru PC-9 correspond to ECS Report Dated January 27, 2017. Two (2) Boring were taken at each location.
Results: Measured Infiltration Rates were 10.96 in/hr and 8.75 in/hr. All PC designs in this area will use the lowest measured rate = 8.75 in/hr.

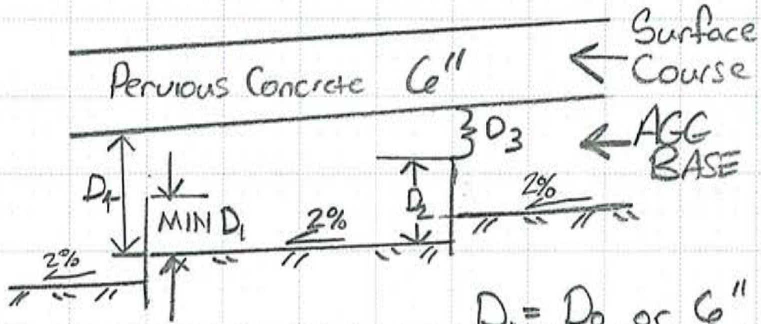
*****PC-9 is its own Separate drainage area, not in Basin 1B (Drainage area to Infiltration Bed 'A')**

Date	Design	NORRIS & TUNSTALL — CONSULTING ENGINEERS P.C. —	Wilmington, NC Brunswick County, NC	Sheet Of
4/4/17	JJC			
Check	Job NHRMC Ortho		For Pervious Concrete	Job No. 16036

Pervious Concrete	Area of Pervious (SF) (A_p)	Area of Imp Draining to PC (SF) (A_c)	Ratio	i (in/hr)	Min Agg Depth (1.5") (in) (D_o)
PC-1	3,360	1,444	0.43	10.02	5.36
PC-2	6,625	4,608	0.696	10.02	6.36
PC-3	5,740	2,808	0.502	10.02	5.63
PC-4	4,600	3,133	0.681	10.02	6.3
PC-5	1,260	1,060	0.841	8.75	6.9
PC-6	4,428	3,400	0.768	8.75	6.63
PC-7	1,287	749	0.582	8.75	5.93
PC-8	1,452	217	0.149	8.75	4.31
PC-9	1,452	217	0.149	8.75	4.31

- Surface Grade ≃ 5%
- Max Allowed SubGrade = 2% ∴ Baffles Are Required. Space @ 20'

Grade Change Between 5% & 2% over 20 Feet = 7.2"



(NTS)

$D_1 = D_o$ or 6" whichever is greater

$D_2 = 7.2" + D_o$

$D_3 = 4"$

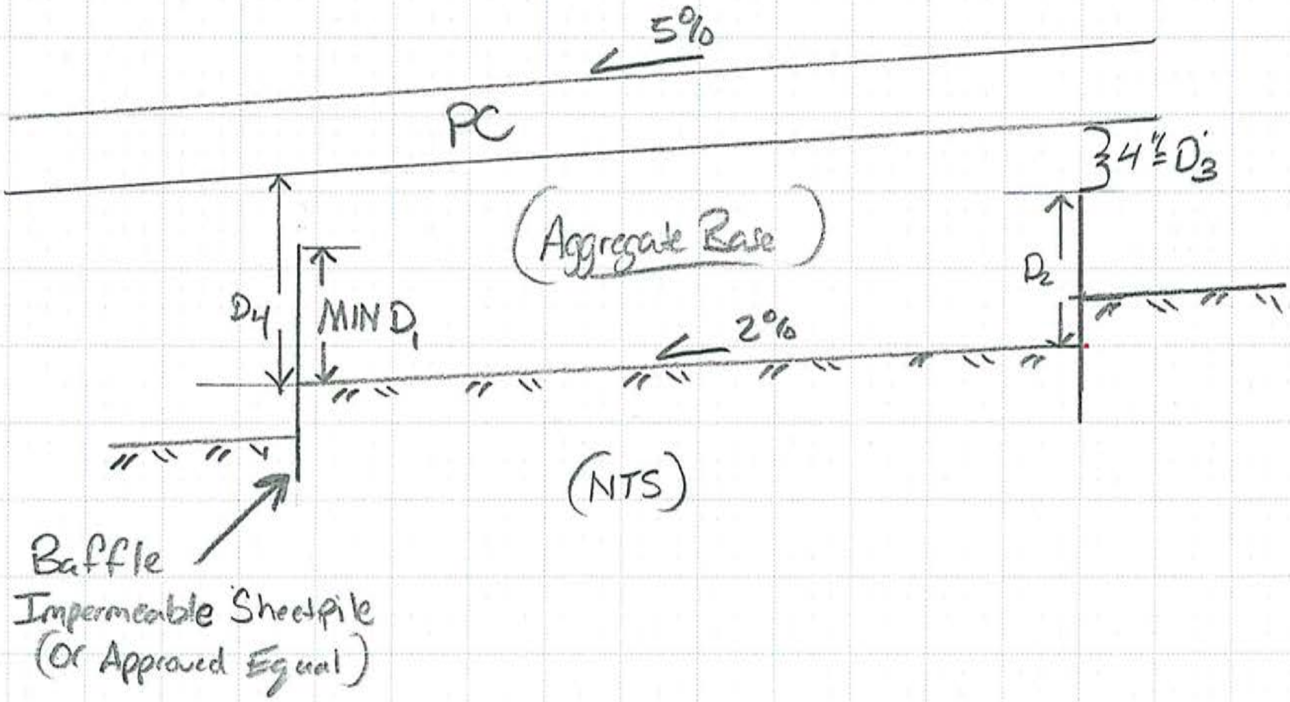
$D_4 = D_2 + D_3$

Date	Design	**NORRIS & TUNSTALL** CONSULTING ENGINEERS P.C.	Wilmington, NC Brunswick County, NC	Sheet / Of
4/4/17				

Check	Job	For	Job No.
	NHRMC Ortho	SW	16036

Table 1

Pervious Concrete	Min Depth D_1 (in)	Min Depth D_2 (in)	Depth D_3 (in)	Depth D_4 (in)
PC-1	6"	12.56"	4"	16.56"
PC-2	6.36"	13.56"	4"	17.56"
PC-3	6"	12.83"	4"	16.83"
PC-4	6.3"	13.5"	4"	17.5"
PC-5	6.9"	14.1"	4"	18.1"
PC-6	6.63"	13.83"	4"	17.83"
PC-7	6"	13.13"	4"	17.13"
PC-8	6"	11.51"	4"	15.51"
PC-9	6"	11.51"	4"	15.51"



Date	Design	NORRIS & TUNSTALL — CONSULTING ENGINEERS P.C. — Wilmington, NC Brunswick County, NC	Sheet Of
Check	Job: NHRMC Ortho	For: Pervious Concrete	Job No.: 16036

(*) PC-9 ⇒ DA 22 is a Stand Alone BMP to Infiltrate the 10-yr Storm.

*Required B/C It is an Area Outside of the Original DA to Infiltration Basin 'A' (Bed A) - We Aren't Modifying the DA to Bed 'A', As it was Designed and Sized by Others.

PC-9 - Infiltrates the entire 10 yr Storm (Due to existing Infiltration Rates All PC Sections Infiltrate The 10-yr Storm)

All PC is Designed to State Standards
Soil - 'A' Credit 75% BUA

SHWT CHECK

PC #	Low Pt Surface Elev ELEV FT (MSL)	Low PT Sub Grade Aggregate FT (MSL)	Soils Report Measured SHWT ELEV FT (MSL)	
PC-1	52	51.0	45	✓
PC-2	53.2	52.17	45.35	✓
PC-3	53.8	52.8	48.01	✓ = AVG ⇒ (45.35 + 50.67)/2
PC-4	57.2	56.17	50.67	✓
PC-5	56	54.92	46.5	✓
PC-6	53	51.92	46.5	✓
PC-7	53.5	52.5	46.5	✓
PC-8	50.65	49.65	46.5	✓
PC-9	51.6	50.6	46.5	✓

all ok

Date	Design	NORRIS & TUNSTALL CONSULTING ENGINEERS P.C.	Wilmington, NC Brunswick County, NC	Sheet / Of
2/27/17	JC			
Check	Job: NHRMC Ortho	For: SW Trench O-3		Job No. 16036

Infiltration Trench O-3 (DA-20)

DA = 4,865 SF / 0.112 Ac. %Imp = 34%

Imp = 1,652 SF / 0.038 Ac.

$R_v = 0.05 + .9(0.34) = 0.356$

$V_{1.5} = 3630 \times 1.5" \times 0.356 \times 0.112\ Ac = 217\ CF$

$Min\ SA = \frac{DV}{FS \times (K \times T)} = \frac{217\ CF}{(10.96\ in/hr \times \frac{72}{24 hr}) \times 2} = 6.6\ SF$

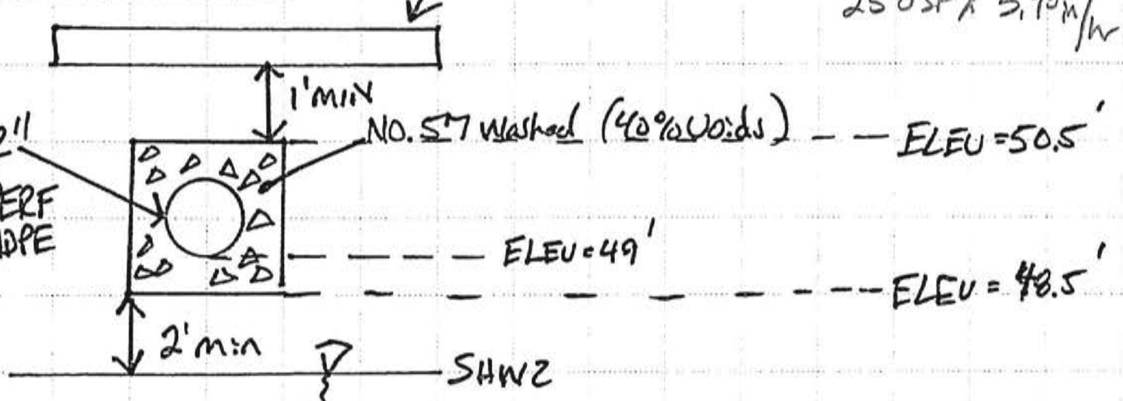
★ Note: The DA For Trench O-3 is outside Approved DA For Infiltration Trench Bed - 'A'. New Trench O.3 is Designed For Zero (Ø) Discharge During the 10-yr Storm.

★ Per 1/27/17 ECS Soils Report
B-1 SHWTe 90in
i = 10.96 in/hr

Volume Provided

$t_{1.5"} = \frac{217\ CF \times 12"/FT}{258\ SF \times 5.48\ in/hr} = 1.84\ hr / 0.042\ Days$

@ 1/2 Rate ✓ OK



Provided Length = 129 LF

$2' \times 2'$ Trench → A = 4 SF

12" PERF HDPE → A = 0.785 SF

Trench A = 0.785 SF + (4 SF − 0.785 SF) × 0.4 = 2.07 SF/FT

129 LF × 2.07 SF/FT = 267 CF ✓ OK

Q_{10} = 0.00 CFS (OUTFLOW) SEE (Hydroflow Output)

@ 1/2 Measured infiltration Rate (USE 5.48 in/hr) ✓ OK

16036

ECS SOUTHEAST, LLP

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

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

January 27, 2017

Mr. John Tunstall, P.E.
Norris & Tunstall Consulting Engineers
902 Market Street
Wilmington, North Carolina 28401

Reference: Report of Seasonal High Water Table Estimation and Infiltration Testing
NHRMC Orthopedic Building
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.3816

Dear Mr. Tunstall:

ECS Southeast, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing within the stormwater best management practice (BMP) area(s) at the proposed Orthopedic Building at New Hanover Regional Medical Center (NHRMC) off of Savannah Court in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

Field Testing

On January 24, 2017, ECS conducted an exploration of the subsurface soil and groundwater conditions at two requested locations shown on the attached Boring Location Plan (Figure 1). ECS met onsite with Mr. John Tunstall with Norris & Tunstall and determined the boring locations. The purpose of this exploration was to obtain subsurface information of the in situ soils for the stormwater BMP area(s). ECS explored the subsurface soil and groundwater conditions by advancing one hand auger boring into the existing ground surface at each of the requested boring locations. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS also recorded the SHWT and groundwater elevation observed at the time of the hand auger borings. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring locations.

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

Location	SHWT	Groundwater
B-1	90 inches	>114 inches
B-2	84 inches	>114 inches

ECS has conducted two infiltration tests 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 and calculated up to 30 minute intervals. If an exact hydraulic conductivity is necessary for these locations, then ECS recommends collecting samples by advancing Shelby tubes and performing laboratory permeability testing.

Field Test Results

Below is a summary of the infiltration test results:

Location	Description	Depth	Inches/ hour
B-1	Brown fine SAND	66 inches	10.96
B-2	Brown fine SAND	60 inches	8.75

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.

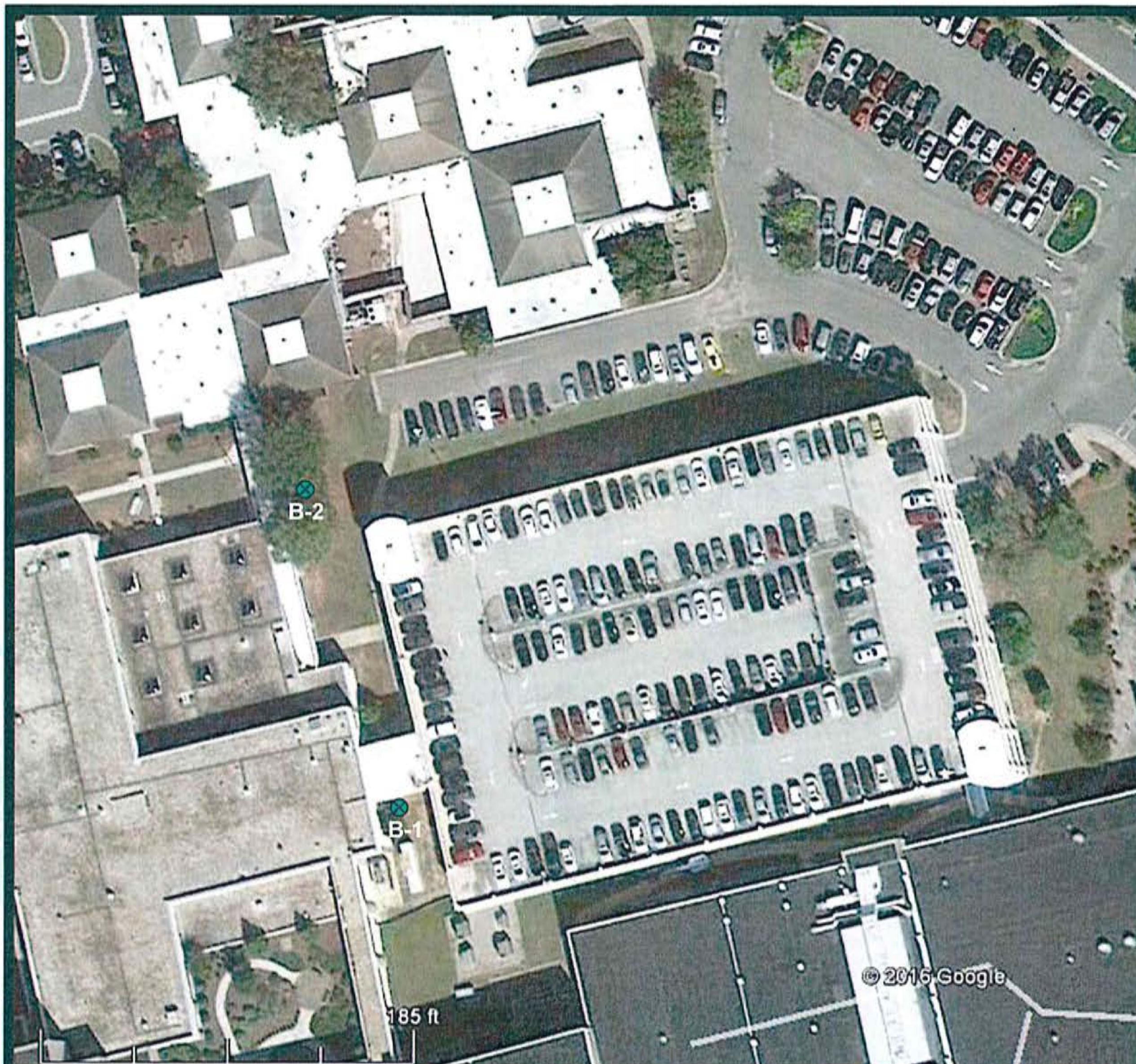
Respectfully,

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 BORING LOCATIONS

N W E S

SCALE SHOWN ABOVE

NHRMC Orthopedic Building
Wilmington, New Hanover County, North Carolina

ECS Project # 49.3816
January 24, 2017
KBW

Figure 1– Boring Location Plan

Provided by: Google Earth

Infiltration Testing Form
NHRMC Orthopedic Building
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.3816
January 24, 2017

Location	Depth	USCS	Soil Description
B-1	0-90"	SP	Brown/orange/gray fine SAND
	90"-100"	SM	Black fine SAND w/ silt
	100"-114"	SP	Gray fine SAND

Seasonal High Water Table was estimated to be at 90 inches below the existing grade elevation.
Groundwater was not encountered up to 114 inches below the existing grade elevation.
Test was conducted at 66 inches below existing grade elevation
Infiltration Rate: 10.96 inches per hour

Location	Depth	USCS	Soil Description
B-2	0-84"	SP	Brown/orange/gray fine SAND
	84"-114"	SM	Black silty SAND

Seasonal High Water Table was estimated to be at 84 inches below the existing grade elevation.
Groundwater was not encountered up to 114 inches below the existing grade elevation.
Test was conducted at 60 inches below existing grade elevation
Infiltration Rate: 8.75 inches per hour

Important Information About Your
Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from alight industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ-sometimes significantly from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

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 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.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone:' 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

16034

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

March 7, 2017

Mr. John Tunstall, P.E.
Norris & Tunstall Consulting Engineers
902 Market Street
Wilmington, North Carolina 28401

Reference: Report of Seasonal High Water Table Estimation and Infiltration Testing
NHRMC Orthopedic Building Parking
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.3816

Dear Mr. Tunstall:

ECS Southeast, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing within the stormwater best management practice (BMP) area(s) at the proposed Orthopedic Building Parking area at New Hanover Regional Medical Center (NHRMC) off of Savannah Court in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

Field Testing

On March 6, 2017, ECS conducted an exploration of the subsurface soil and groundwater conditions at three requested locations shown on the attached Boring Location Plan (Figure 1). ECS located the borings by using a site plan provided by Norris & Tunstall Engineering. The purpose of this exploration was to obtain subsurface information of the in situ soils for the stormwater BMP area(s). ECS explored the subsurface soil and groundwater conditions by advancing one hand auger boring into the existing ground surface at each of the requested boring locations. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS also recorded the SHWT and groundwater elevation observed at the time of the hand auger borings. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring locations.

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

Location	SHWT	Groundwater
B-1	96 inches	>114 inches
B-2	92 inches	>114 inches
B-3	40 inches	84 inches

ECS has conducted three infiltration tests 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 and calculated up to 30 minute intervals. If an exact hydraulic conductivity is necessary for these locations, then ECS recommends collecting samples by advancing Shelby tubes and performing laboratory permeability testing.

Field Test Results

Below is a summary of the infiltration test results:

Location	Description	Depth	Inches/ hour
B-1	Brown fine SAND w/ silt	24 inches	11.56
B-2	Brown fine SAND w/ silt	24 inches	10.02
B-3	White fine to med. SAND	24 inches	21.43

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

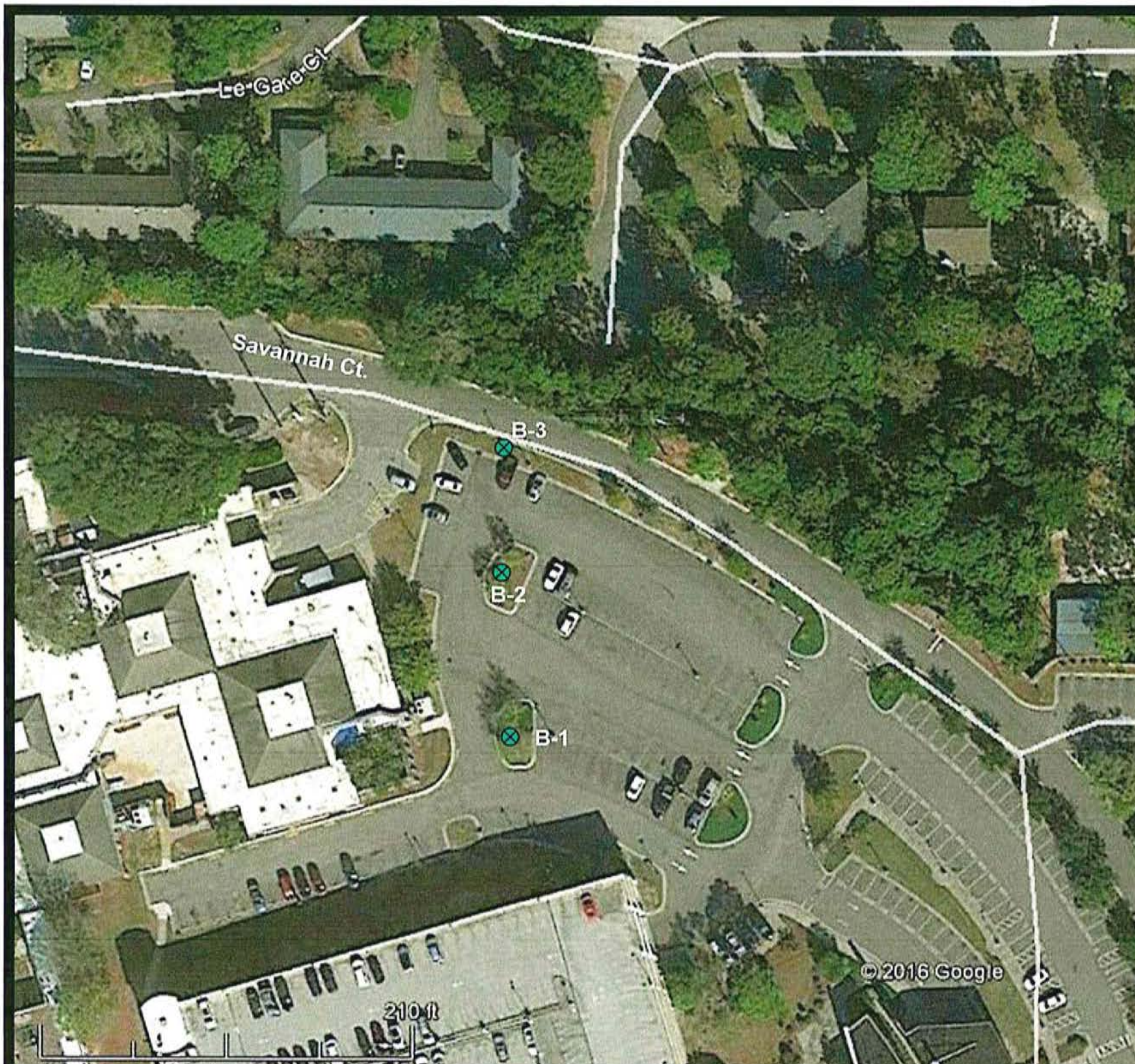
K. Brooks Wall

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

W. Brandon Fulton

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 BORING LOCATIONS

SCALE SHOWN ABOVE

NHRMC Orthopedic Building Parking
Wilmington, New Hanover County, North Carolina

ECS Project # 49.3816
March 6, 2017
KBW

Figure 1– Boring Location Plan

Provided by: Google Earth

Infiltration Testing Form
NHRMC Orthopedic Building Parking Area
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.3816
March 6, 2017

Location	Depth	USCS	Soil Description
B-1	0-96"	SP	Brown fine SAND w/silt
	96"-114"	SM	Black silty SAND

Seasonal High Water Table was estimated to be at 96 inches below the existing grade elevation.
Groundwater was not encountered up to 114 inches below the existing grade elevation.
Test was conducted at 24 inches below existing grade elevation
Infiltration Rate: 11.56 inches per hour

Location	Depth	USCS	Soil Description
B-2	0-92"	SP	Brown fine SAND w/silt
	92"-114"	SM	Black silty SAND

Seasonal High Water Table was estimated to be at 92 inches below the existing grade elevation.
Groundwater was not encountered up to 114 inches below the existing grade elevation.
Test was conducted at 24 inches below existing grade elevation
Infiltration Rate: 10.02 inches per hour

Location	Depth	USCS	Soil Description
B-3	0-18"	SP	Brown fine SAND w/silt
	18"-40"	SP	White fine to med. SAND
	40"-84"	SM	Black silty SAND

Seasonal High Water Table was estimated to be at 40 inches below the existing grade elevation.
Groundwater was encountered at 84 inches below the existing grade elevation.
Test was conducted at 24 inches below existing grade elevation
Infiltration Rate: 21.43 inches per hour

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Geotechnical Engineering Report

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ASFE
The Best People on Earth

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