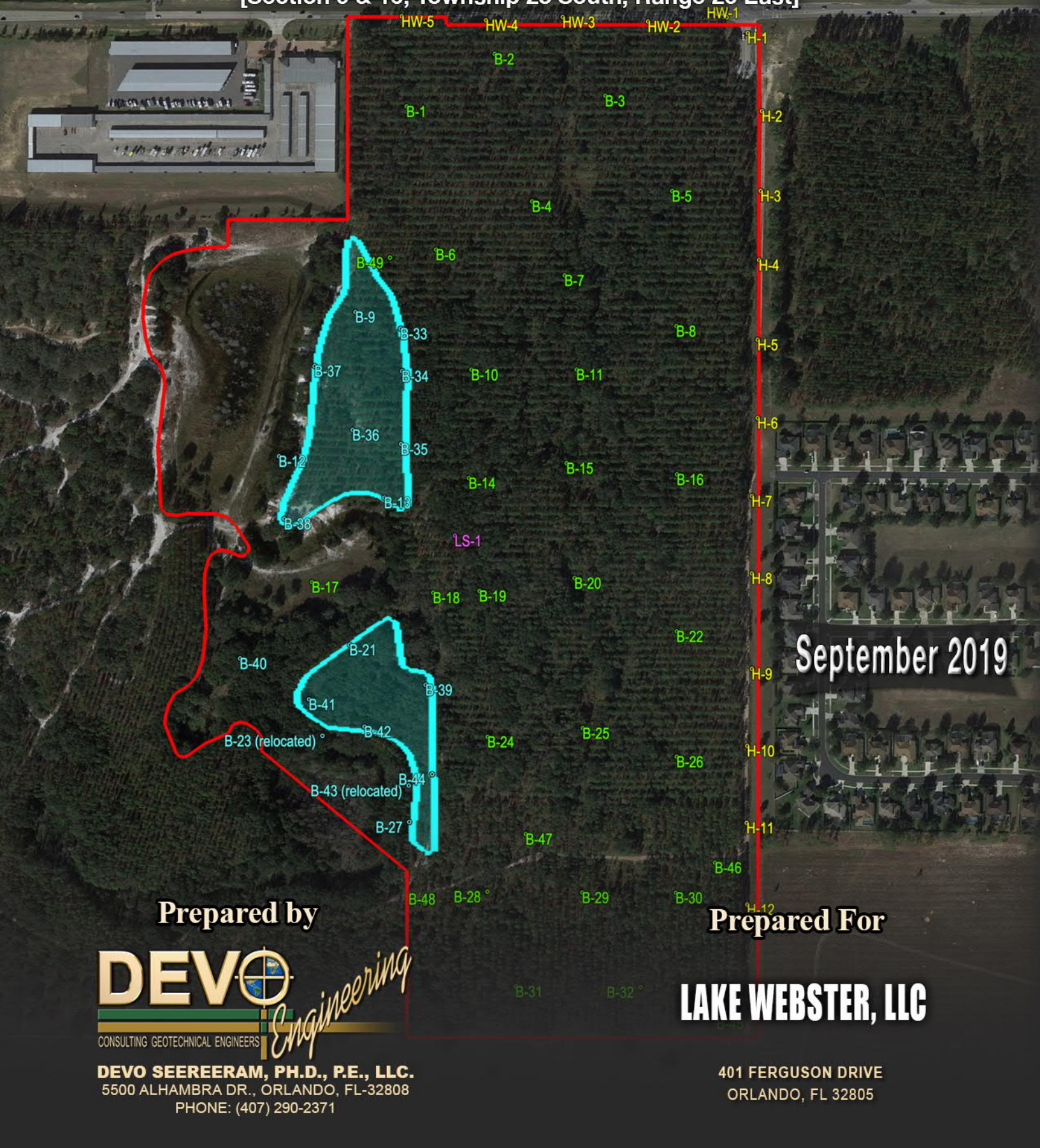
DESIGN-LEVEL GEOTECHNICAL ENGINEERING REPORT

HARTWOOD MARSH RESIDENTIAL

Proposed Single Family Residential Subdivision

120± Acres, Hartwood Marsh Road, off U.S. Highway 27, City of Clermont, Lake County, Florida

[Section 9 & 16, Township 23 South, Range 26 East]



September 2019

Prepared by

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS

DEVO SEEREERAM, PH.D., P.E., LLC.
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Prepared For

LAKE WEBSTER, LLC

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Date: September 26, 2019 | *Devo's Project No:* 19-585.18

To:

LAKE WEBSTER, LLC
401 Ferguson Drive
Orlando, FL 32805
(407)-293-6562; jeff@amickinc.com

attention: **JEFF B. FUQUA, PH.D.**

Re:

STORMWATER POND - GEOTECHNICAL ENGINEERING REPORT
HARTWOOD MARSH RESIDENTIAL
Proposed Single Family Residential Subdivision
120± Acres, Hartwood Marsh Road, off U.S. Highway 27, City of Clermont, Lake County, Florida
[Sections 9 & 16, Township 23 South, Range 26 East]

Dear Mr. Fuqua:

The purpose of this revised report is to document the pond-specific geotechnical data, stormwater recovery analyses, grading recommendations, and berm stability analysis for the proposed dry retention pond at the above-captioned subdivision. The previous version of this report was provided on July 9, 2019.

Note that a more comprehensive geotechnical report (dated August 2, 2019) for the non-pond portions of the subdivision and those data and recommendations has been provided in a separate report.

We trust that the geotechnical data, assessment, and recommendations in this report are responsive to the needs of the permitting agencies and the civil engineer at this phase of the design process. Feel free to contact us if there are any questions regarding this report.

Sincerely,

Devo Seereeram

Devo Seereeram, Ph.D., P.E.
Florida Registration No. 48303
Date: September 26, 2019

Devo Seereeram, Ph.D., P.E.
Digitally signed by Devo Seereeram, Ph.D., P.E.
Date: 2019.09.27 08:37:59 -04'00'

DEVO SEEREERAM LICENSE No. 48303 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by Devo Seereeram, P.E. on .....using a Digital Signature.

Printed copies of this document are not considered signed and sealed and the SHA authentication code must be verified on any electronic copies.

TABLE OF CONTENTS

I.0 POND TYPE & LOCATION

A conventional, dry-bottom stormwater retention pond (no underdrains, etc.) is proposed for the proposed Hartwood Marsh single-family residential subdivision in Clermont, Lake County, Florida. Exhibit 1 shows the subdivision boundary of this undeveloped land which sits on a high sandy ridge (of the Lake Wales Ridge) with a deep water table.

The pond layout within the subdivision is in Exhibit 2 and is divided into a north and a south lobe, equalized by a pipe so the lobes function as a single pond. The specific purpose of this report is to document the geotechnical data within the pond area and to present the results of the stormwater recovery analyses which are required to check for compliance with SJRWMD recovery time criteria. Fill berm specifications are also provided since the downhill side of the ponds will be bermed above natural land surface.

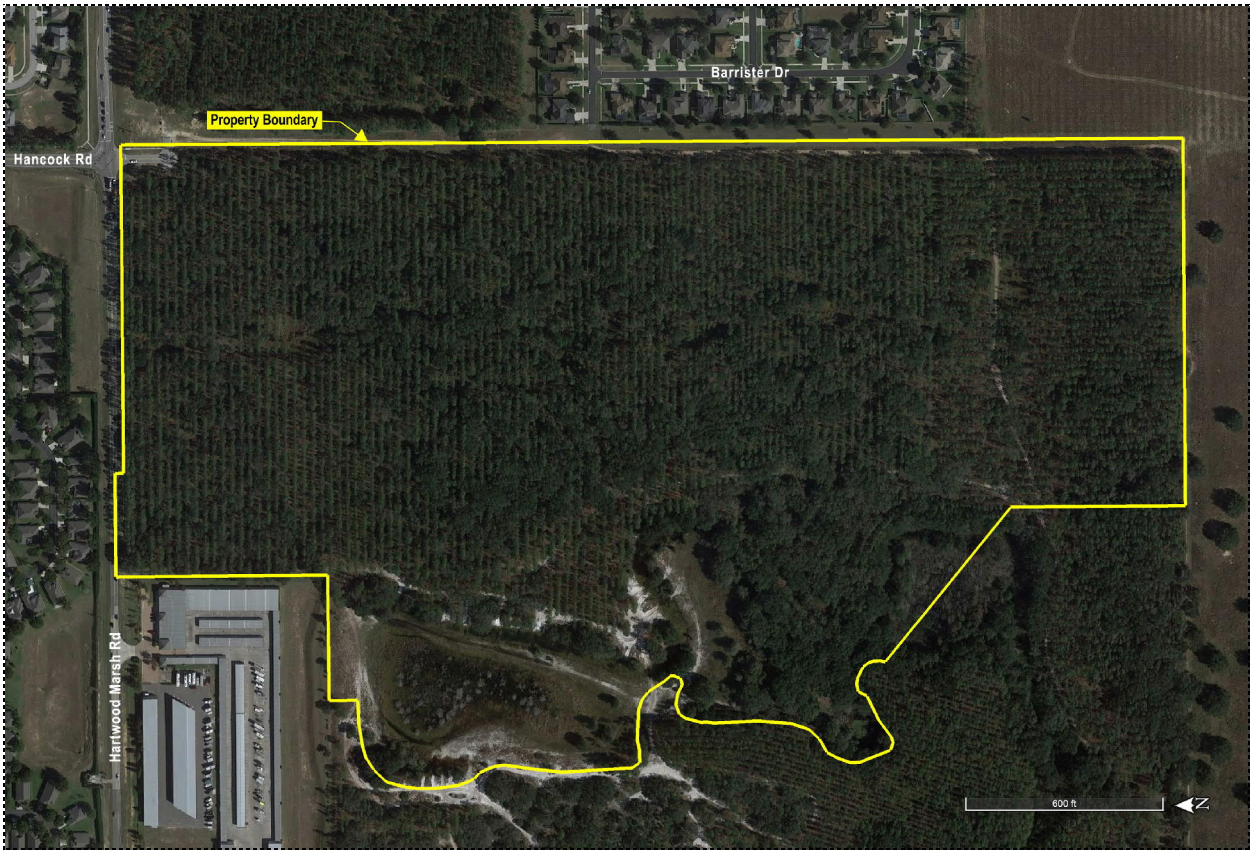


Exhibit 1. Subdivision Boundary

Exhibits 3.1 and 3.2 show the existing ground surface contours within the pond footprint and bear in mind the pond bottom elevation +92 ft NAVD when reviewing these contours. Within the bottom area of the south lobe, predevelopment ground surface is a high of about +100 ft to a low of about +94 ft. This compares to a high of +108 ft to a low of +94 ft within the bottom area of the north lobe.

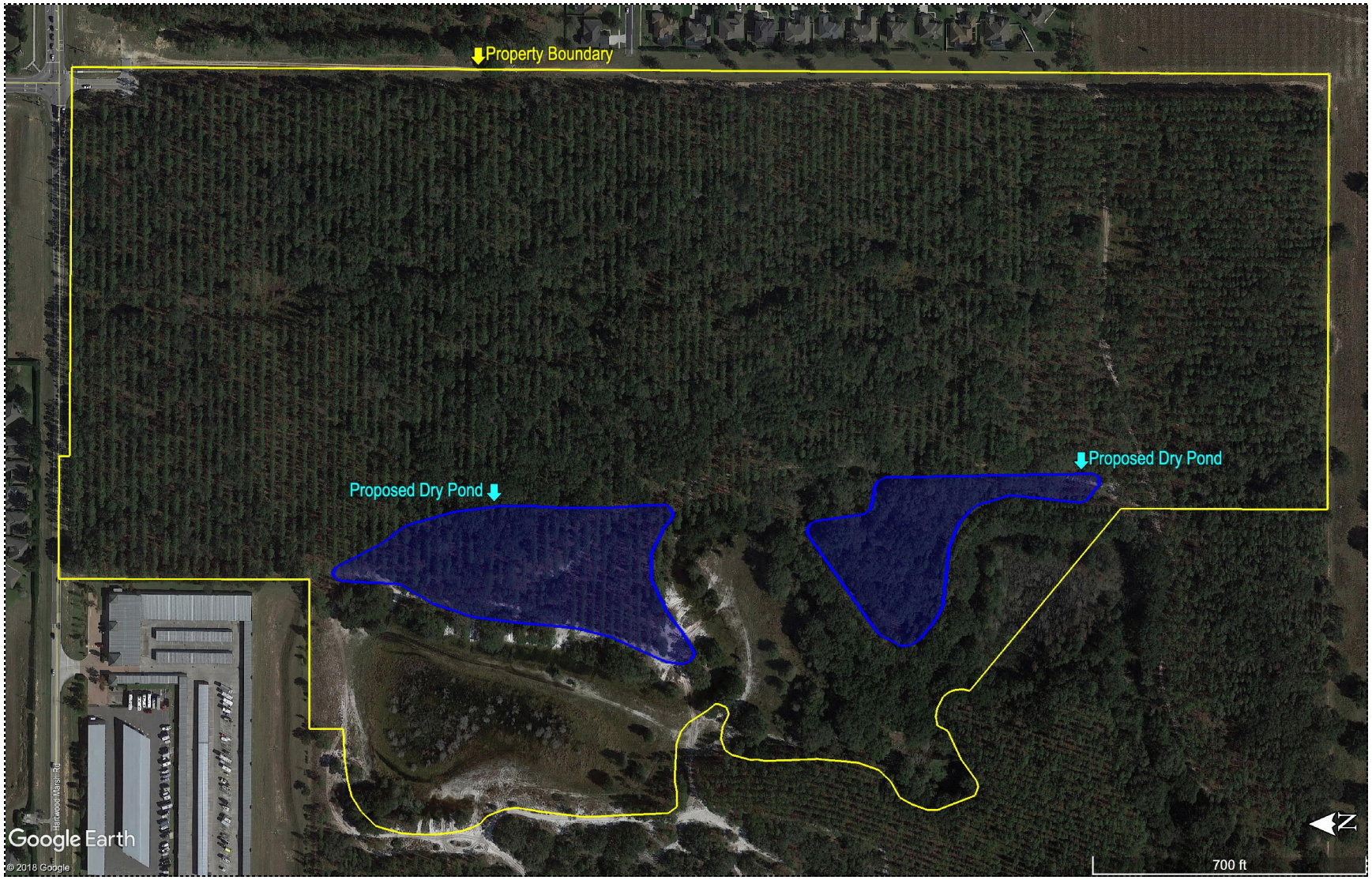


Exhibit 2. Pond Layout Within The Subdivision

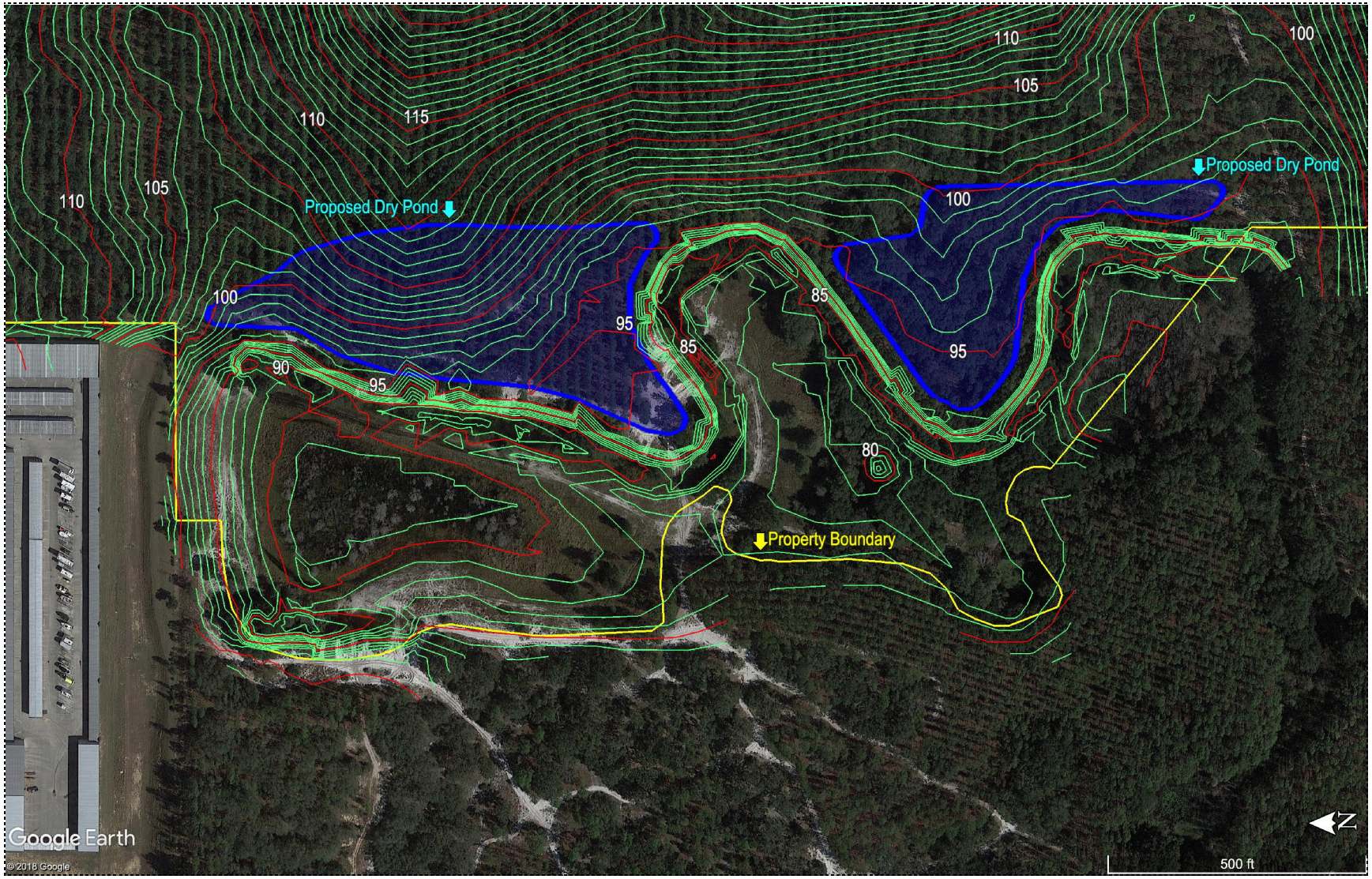


Exhibit 3.1. Pond footprint on predevelopment topography
note: pond bottom elevation at +92 ft NAVD

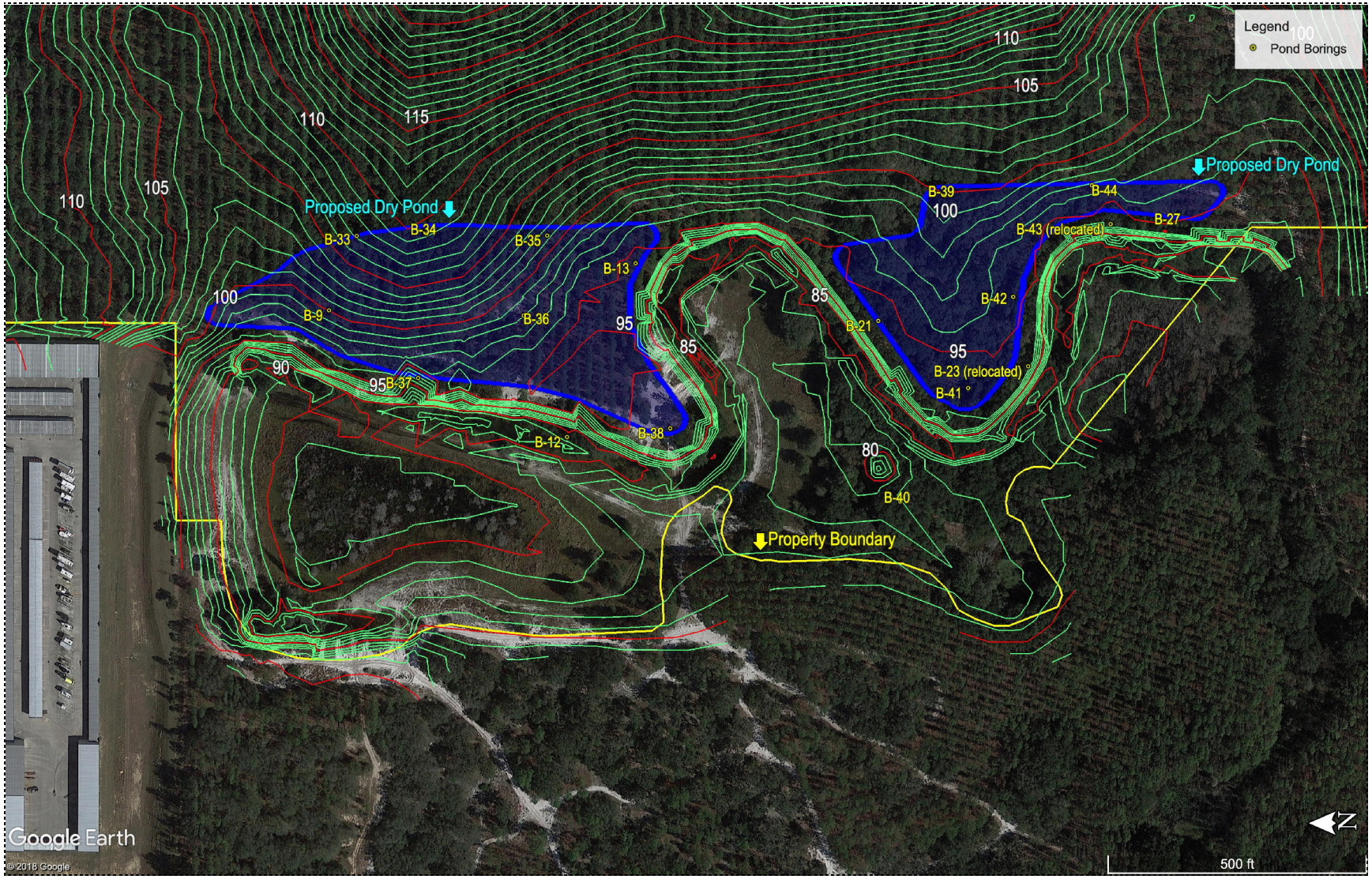


Exhibit 3.2. Predevelopment ground surface within ponds and surveyed borehole locations
note: pond bottom elevation at +92 ft NAVD

2.0 GEOTECHNICAL DATA

Eighteen (18) 30 ft deep borings were drilled within the pond footprint and these are labeled B-9, B-12, B-13, B-21, B-23, B-27 and B-33 to B-44 in Exhibit 4. Boring profiles are presented in Figures 1.1 to 1.6 (attached). Water table depth measurements and laboratory test results are annotated adjacent to these graphic soil profiles. All test locations were surveyed by the project surveyor except for B23 and B43 which were relocated due to site access. All borings show deep layers of permeable fine sands except for one small zone within the southern lobe. This zone is identified in Exhibit 5 where the base elevation of the permeable sand layer is above elevation +85 ft, compared to below elevation +65 ft in the other parts of the pond.

Exhibit 4. Boring Location Plan

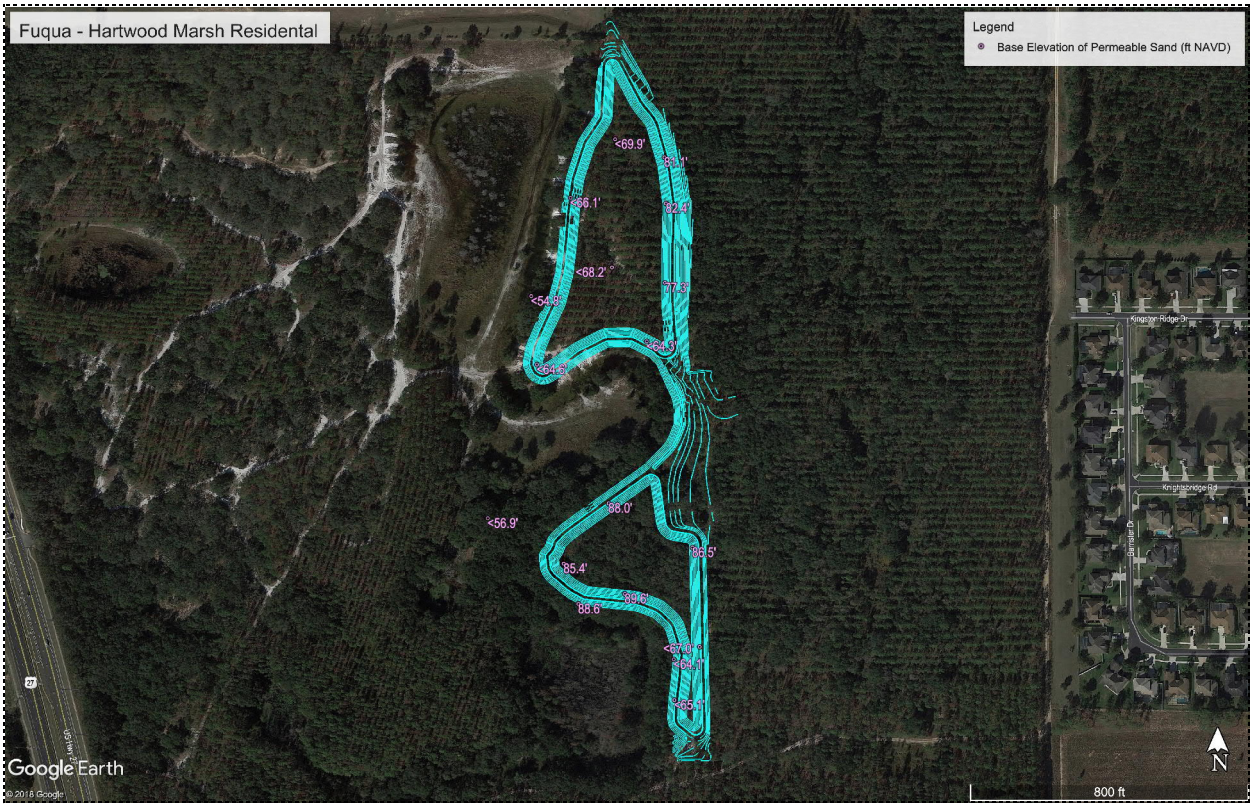


Exhibit 5. Base Elevation of Permeable Sand (ft NAVD)

Permeability tests on vertically oriented samples of the sand layer are in the general range 55 to 67 ft/day. These results are typical for the ridge areas of Clermont and are comparatively high when compared to sand permeability in other parts of Central Florida. Test results are summarized in Table 1 and are also annotated adjacent to the soil profiles in Figures 1.1 to 1.6.

Table 1. Summary of Permeability Test Results

Location	Sample Depth (ft)	Soil Description	Measured Vertical Permeability (ft/day)
SAND			
B-9	15.0 to 15.5	Very Light Brown Fine Sand	55.3
B-27	6.0 to 6.5	Light Brown Fine Sand	66.8
B-36	10.0 to 10.5	Very Light Brown Fine Sand	62.5
B-38	16.0 to 16.5	Light Brown Fine Sand	57.2
B-40	16.0 to 16.5	Brown Fine Sand	54.9
CLAYEY SAND			
B-42	12.0 to 12.5	Orange Clayey Fine Sand	26.8

Water table altitudes for measured and estimated seasonal high scenarios are shown in Exhibits 6 and 7 and these digital data are in Table 2. There was a fair amount of rainfall at Hartwood Marsh in June 2019 as a buildup to the wet season.

Table 2. Measured Water Table Elevations and Seasonal High Water Table (SHWT)

Boring No.	Ground Surface Elevation (ft NAVD)	Water Table Measured on June 26, 2019		Estimated SHWT	
		Depth Below Ground (ft)	Elevation (ft NAVD)	Depth Below Ground (ft)	Elevation (ft NAVD)
30 FT POND BORINGS					
B-9	99.9	16.40	83.5	13.4	86.5
B-12	84.8	1.20	83.6	-1.7	86.5
B-13	94.3	10.95	83.4	7.8	86.5
B-21	94.5	10.00	84.5	7.5	87.0
B-23	85.3	-0.70	86.0	-2.7	88.0
B-23A	94.1	9.65	84.5	6.7	87.5
B-27	95.1	9.10	86.0	9.1	86.0
B-33	108.1	24.73	83.4	21.6	86.5
B-34	110.4	26.75	83.7	23.4	87.0
B-35	101.3	17.25	84.1	14.3	87.0
B-36	98.2	14.85	83.4	11.7	86.5
B-37	96.1	12.75	83.4	9.6	86.5
B-38	94.6	11.45	83.2	8.1	86.5
B-39	100.5	16.45	84.1	13.6	87.0
B-40	86.9	2.60	84.3	-0.1	87.0
B-41	94.4	9.40	85.0	6.9	87.5
B-42	95.6	10.85	84.8	8.1	87.5
B-43	86.2	0.20	86.0	-1.8	88.0
B-43A	94.1	8.80	85.3	6.1	88.0
B-44	97.0	11.95	85.1	9.5	87.5

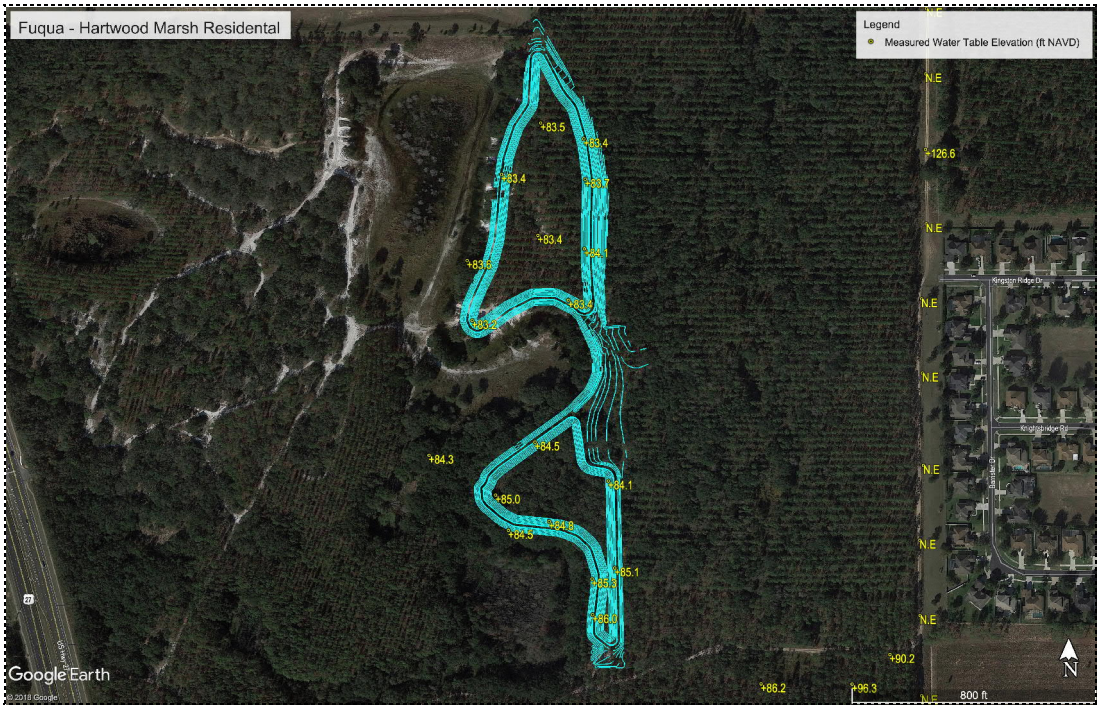


Exhibit 6. Measured Water Table Elevation (ft NAVD)

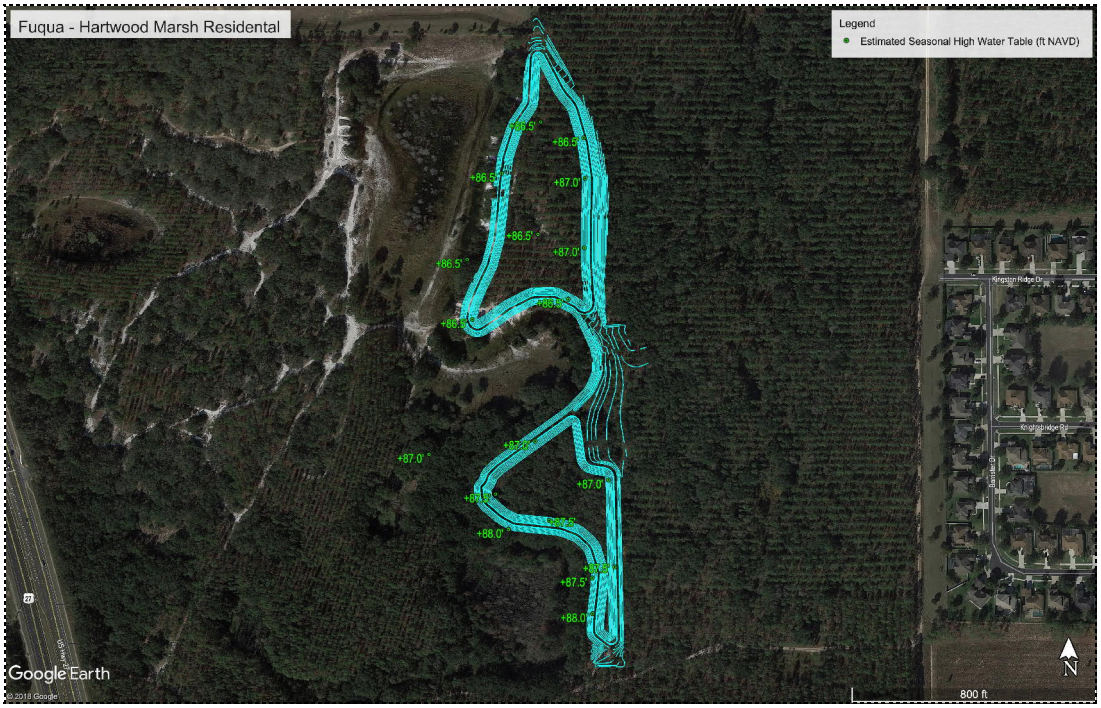


Exhibit 7. Estimated Seasonal High Water Table Elevation (ft NAVD)

3.0 RECOVERY ANALYSES

Table 3 summarizes the stage-area-volume relationship for the pond.

Table 3. Pond Stage / Storage Table				
Stage (FT)	Area (AC)	ft^2	Δ Vol. (AF)	Σ Vol. (AF)
92.0	5.46	237,838		0.000
93.0	5.84	254,390	5.650	5.650
94.0	6.21	270,508	6.030	11.680
95.0	6.58	286,625	6.400	18.070
96.0	6.97	303,613	6.780	24.850
97.0	7.36	320,602	7.170	32.010
98.0	7.76	338,026	7.560	39.570
98.5	7.95	346,302	3.930	43.500
99.0	8.95	389,862	4.230	47.720

Note that there is a high level overflow structure (5 ft weir) at an elevation of +98.5 ft NAVD. Pond fill berm side slopes are 4H:1V with a 10 ft width at the top of berm.

The idealized and other input parameters for this pond are listed in Table 4. Simulation results (PONDS Refined method Module) for the 25 yr/96 hr storm recovery is in Attachment A and the corresponding water quality volume recovery is in Attachment B. These results show that both SJRWMD criteria are satisfied for recovery.

The slope stability of the fill berm is also above 1.2 for full saturation of the slope which is an acceptable safety factor.

Table 4. Stormwater Pond {Key Parameters & Results}		
Parameter	**Unit**	**Magnitude**
Top of Bank Elevation	ft NAVD	99.0
Weir Elevation	ft NAVD	98.50
Pond Bottom Elevation	ft NAVD	92.0
Seasonal High Water Table (SHWT)	ft NAVD	87.0
Base of Aquifer (permeable sand)	ft NAVD	70.0
Horizontal Hydraulic Conductivity, Kh	ft/day	45.0
Fillable Porosity, n	%	30.0
Unsaturated vertical infiltration rate	ft/day	5.0
Projection area for unsaturated infiltration	ft^2	270,508
Separation between pond bottom & SHWT	ft	5.0
Water Quality Volume (72 hr recovery)	ac-ft	11.28
	ft^3	491,357
25 yr/96 hr volume (14 day recovery)	ac-ft	43.34
	ft^3	1,887,891
Equivalent pond length.	ft	1430
Equivalent pond width	ft	290
KEY RESULTS OF COMPUTER RUNS		
Recovery time for water quality volume	hr	12
Recovery time for 25 yr/96 hr volume	days	13
COMPUTER PRINTOUTS OF RECOVERY ANALYSES		
Attachment containing PONDS computer printout . .	-	A, B
BERM STABILITY PARAMETERS		
Top of fill berm	ft NAVD	99.0
Predevelopment ground surface in fill berm	ft NAVD	93.0
Maximum height of fill berm (downhill)	ft	6.0
Weir Elevation	ft NAVD	98.50
Top width of berm.	ft	10
Outside side slope for fill berm	?H:1V	4
Inside side slope for fill berm	?H:1V	4
Factor of safety for slope stability failure {FS≥ 1.2) .	-	1.2

4.0 POND BERM FILL RECOMMENDATIONS

Where the pond's perimeter berm is to be constructed above natural grade, the following are the recommended specifications for berm construction. With the exception of the topsoil, the soils are of a type and consistency suitable for the support of the proposed earthen berms, provided that they are prepared as described hereunder. The following berm construction specifications have been prepared as a guide to the design engineer for the Hartwood Marsh residential subdivision in Clermont, FL. These recommendations should be incorporated into the general project specifications.

1. The berm footprint plus a minimum margin of 3 feet should be cleared, stripped and grubbed to remove all surface vegetation, roots, topsoil and other deleterious materials. Materials generated during this process should be removed from the site and/or stockpiled onsite as directed by the owner/engineer.

2. Within the berm footprint, plus a minimum margin of 3 feet on either side, the resulting cleared surface and the exposed natural soils should be proof rolled to detect unstable conditions such as yielding or pumping soils. Soft areas or excessively wet soils should be excavated, removed, dried and/or replaced with suitable compacted fill, as described below.

3. No construction dewatering is anticipated.

4. The resulting cleared surface should be leveled and then compacted by means of a large self-propelled vibratory roller which has a minimum static weight of 12,000 pounds and is capable of exerting a minimum impact energy of 20,000 pounds (i.e., DYNAPAC CA-15 or equivalent) in areas more than 75 feet away from existing structure(s). Within 75 feet of an existing structure(s) and areas where the groundwater table is within 2 feet of the ground surface, compaction should be achieved with a vibratory roller in the static mode or the use of non-vibratory compaction equipment, such as a heavy rubber tired front end loader. The front end loader should have a minimum bucket size of 3 cubic yards which should remain full during the compaction operation.

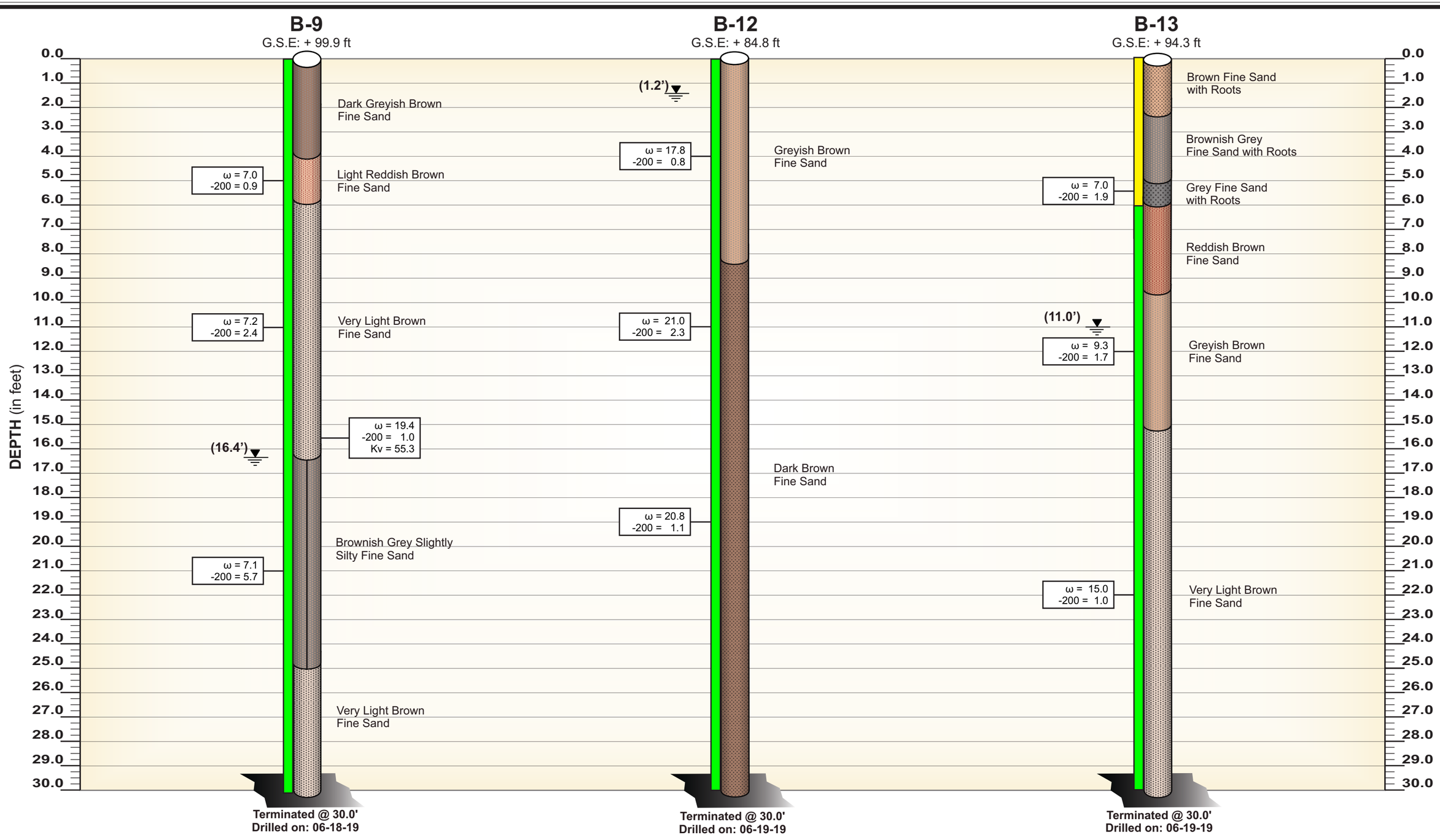
5. The compaction efforts should continue until the subsoils within the proposed berm footprint are compacted to a minimum density equivalent to 95 percent of the soils' Maximum Modified Proctor Density value (AASHTO T-180), as tested to a minimum depth of 1 foot below the bottom of the exposed subgrade.

6. Fill material required to attain finished grade should comprise the fine sands from the onsite excavation. The fill soils should be placed in lifts not exceeding 12 inches loose thickness and compacted to the minimum density specified above ($\geq$95% Modified Proctor). No tree limbs or other debris should be emplaced in the fill berm or pond bottom without the approval of the geotechnical engineer. Such inclusions in the fill berm can cause settlement and provide preferential pathways for seepage through the berm and result in berm failure. Do not bury trees or vegetation debris within the berm fill.

7. The intent of the compaction requirements outlined herein is to provide compacted soils to the top of the berm.

8. A representative of the project geotechnical engineer should be retained to provide on-site inspection and testing during the site preparation activities so that proper documentation and compliance of the recommendations outlined above can be provided.

FIGURES



NOTES:

- Suitable fill for veneer (fine sands & slightly silty fine sands)
- Suitable but w/ limitations on placement/compaction (Silty fine sands & slightly clayey fine sands)
- Unsuitable for fill (Clayey fine sand, sandy clay, clays, muck)

LEGEND :

ω = Field moisture content (%)

-200 = Percent passing US#200 Sieve

Kv = Vertical Hydraulic Conductivity (ft/Day)

Typical Correlations between SPT "N" Values and Soil Properties

Granular Materials		Silt and Clay	
Relative Density	SPT (Blows/ft)	Consistency	SPT (Blows/ft)
Very Loose	Less than 4	Very Soft	Less than 2
Loose	4 to 10	Soft	2 to 4
Meduim Dense	10 to 30	Firm	4 to 8
Very	30 to 50	Stiff	8 to 15
Very Dense	Greater than 50	Very Stiff	15 to 30
		Hard	Greater than 30

NOTES:

Borings drilled on the date noted

G.S.E Surveyed ground surface elevation (ft NAVD)

Water level measured on June 26, 2019.

N Standard Penetration Test Resistance (blos/ft)

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Checked & Approved By:	Drawn By:	Date:
DS	RB	06.27.2019

Figure Name: **SOIL PROFILES FOR B-9, B-12 & B-13**

Project Name: **Fuqua - Hartwood Marsh Residential**

Scale:	Project #	
NOTED	19-585.18	Figure 1.1

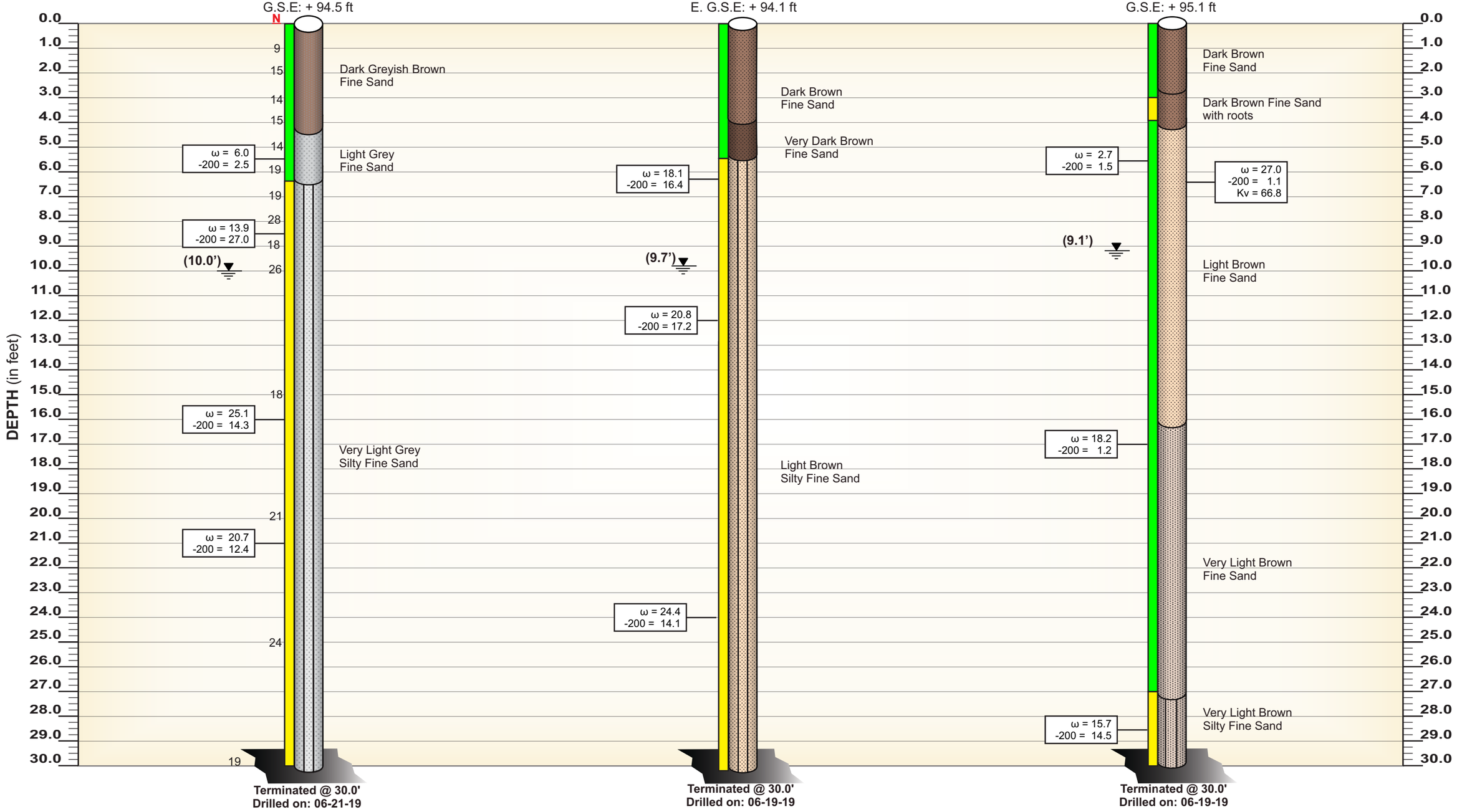

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Figure Name: **SOIL PROFILES FOR B-21, B-23 & B-27**

Project Name: **Fuqua - Hartwood Marsh Residential**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	RB	06.27.2019	NOTED	19-585.18	Figure 1.2

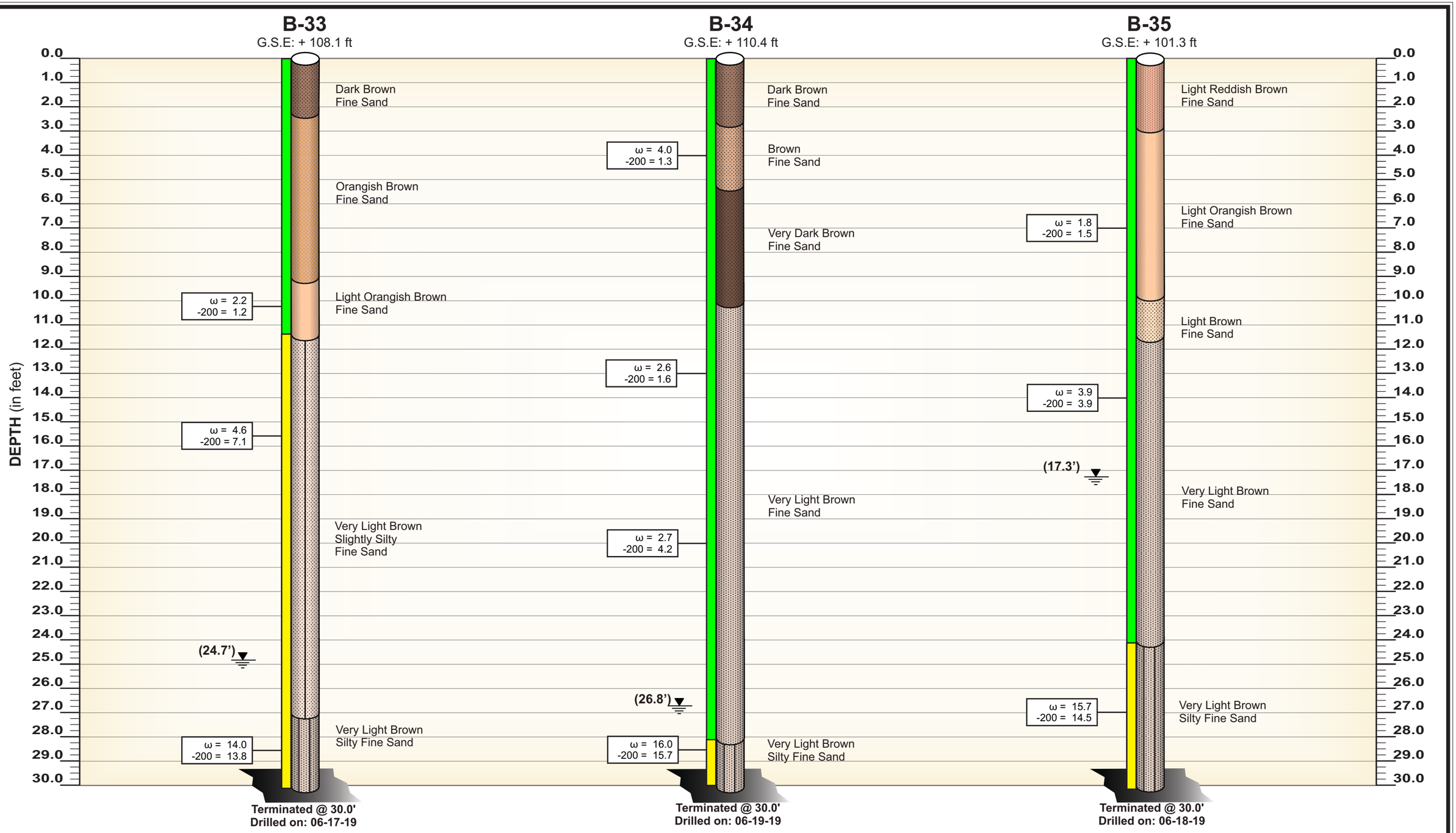

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Figure Name: **SOIL PROFILES FOR B-33, B-34 & B-35**

Project Name: **Fuqua - Hartwood Marsh Residential**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	RB	06.27.2019	NOTED	19-585.18	Figure 1.3

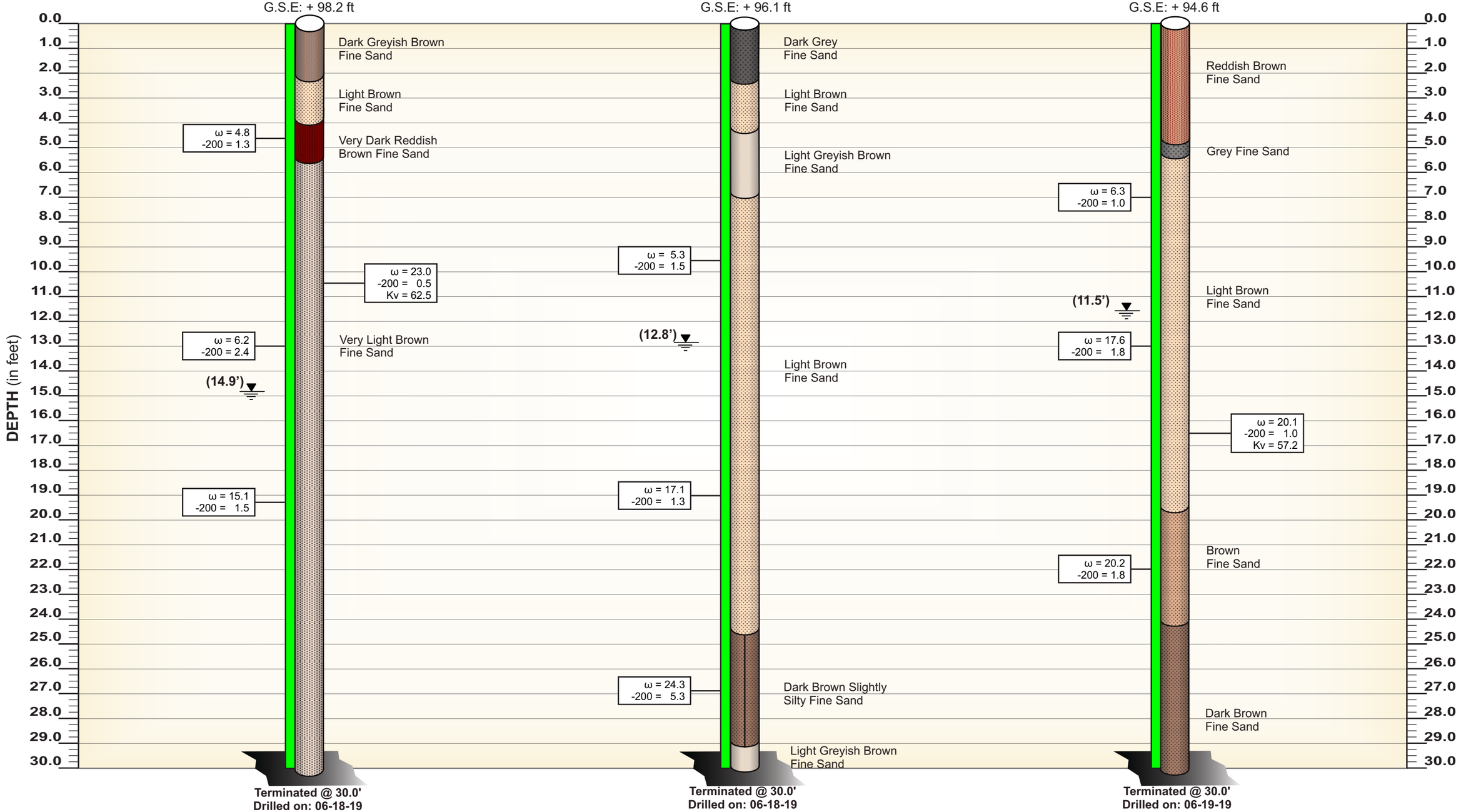

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Figure Name: **SOIL PROFILES FOR B-36, B-37 & B-38**

Project Name: **Fuqua - Hartwood Marsh Residential**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	RB	06.27.2019	NOTED	19-585.18	Figure 1.4

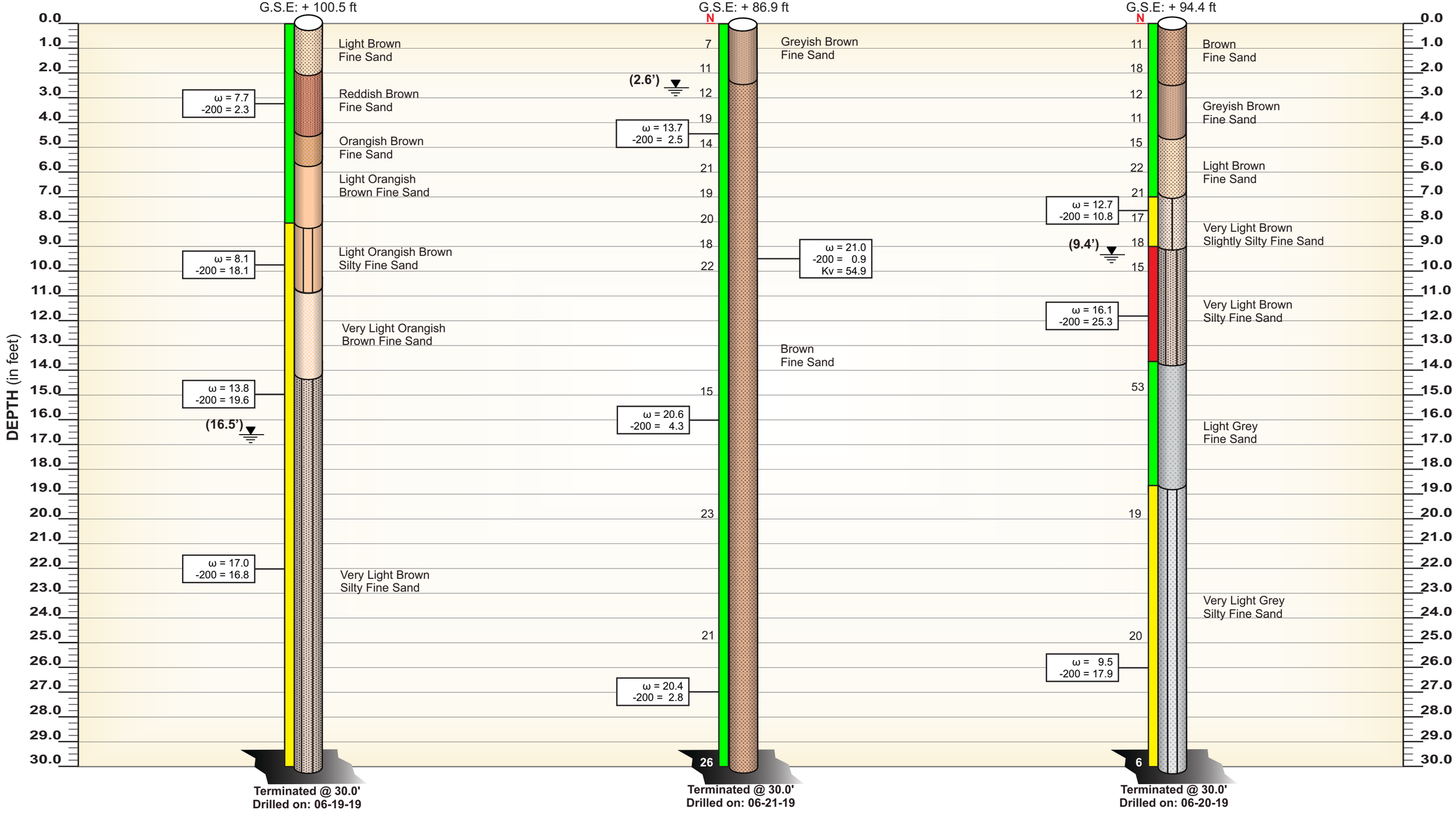

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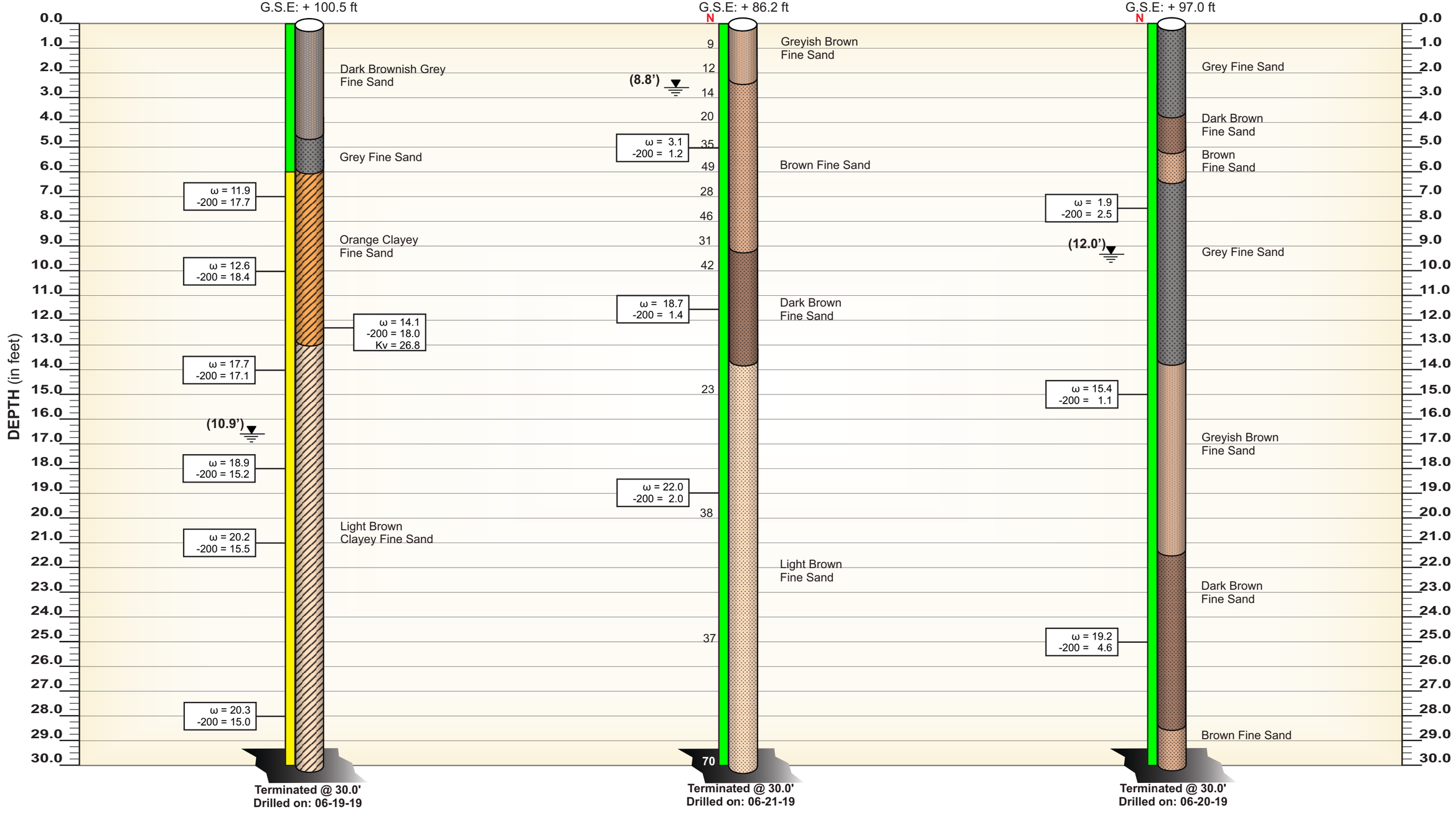
Figure Name: **SOIL PROFILES FOR B-39, B-40 & B-41**

Project Name: **Fuqua - Hartwood Marsh Residential**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	RB	06.27.2019	NOTED	19-585.18	Figure 1.5



NOTES:

- Suitable fill for veneer (fine sands & slightly silty fine sands)
- Suitable but w/ limitations on placement/compaction (Silty fine sands & slightly clayey fine sands)
- Unsuitable for fill (Clayey fine sand, sandy clay, clays, muck)

LEGEND :

ω = Field moisture content (%)

-200 = Percent passing US#200 Sieve

Kv = Vertical Hydraulic Conductivity (ft/Day)

Typical Correlations between SPT "N" Values and Soil Properties

Granular Materials		Silt and Clay	
Relative Density	SPT (Blows/ft)	Consistency	SPT (Blows/ft)
Very Loose	Less than 4	Very Soft	Less than 2
Loose	4 to 10	Soft	2 to 4
Meduim Dense	10 to 30	Firm	4 to 8
Very	30 to 50	Stiff	8 to 15
Very Dense	Greater than 50	Very Stiff	15 to 30
		Hard	Greater than 30

NOTES:

- Borings drilled on the date noted
- G.S.E Surveyed ground surface elevation (ft NAVD)
- Water level measured on June 26, 2019.
- N Standard Penetration Test Resistance (blos/ft)

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive . Orlando, Florida 32808
Phone: (407) 290-2371 . Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name: **SOIL PROFILES FOR B-42, B-43 & B-44**

Project Name: **Fuqua - Hartwood Marsh Residential**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	RB	06.27.2019	NOTED	19-585.18	Figure 1.6

ATTACHMENT A

25 YR/96 HR PRE-POST STORM VOLUME RECOVERY

PONDS Version 3.3.0278
Retention Pond Recovery - Refined Method
Copyright 2012
Devo Seereeram, Ph.D., P.E.

Project Data

Project Name:	Fuqua - Hartwood Marsh
Simulation Description:	Combined Pond - 25 YR / 96 HR Volume Run
Project Number:	19-585.18
Engineer :	Reidel Gardon
Supervising Engineer:	Devo Seereeram
Date:	09-26-2019

Aquifer Data

Base Of Aquifer Elevation, [B] (ft datum):	70.00
Water Table Elevation, [WT] (ft datum):	87.00
Horizontal Saturated Hydraulic Conductivity, [Kh] (ft/day):	45.00
Fillable Porosity, [n] (%):	30.00
Unsaturated Vertical Infiltration Rate, [Iv] (ft/day):	5.0
Maximum Area For Unsaturated Infiltration, [Av] (ft^2):	270508.0

Geometry Data

Equivalent Pond Length, [L] (ft):	1430.0
Equivalent Pond Width, [W] (ft):	290.0

Ground water mound is expected to intersect the pond bottom

Stage vs Area Data

Stage (ft datum)	Area (ft^2)
92.00	237838.0
93.00	254390.0
94.00	270508.0
95.00	286625.0
96.00	303613.0
97.00	320602.0
98.00	338026.0
98.50	346302.0
99.00	389862.0

Ditch Data

Ditch (or interceptor trench) parallel to length axis is inactive

Ditch (or interceptor trench) parallel to width axis is inactive

Discharge Structures

Discharge Structure #1 is inactive

Discharge Structure #2 is inactive

Discharge Structure #3 is inactive

Scenario Input Data

Scenario 1 :: 1887891 ft³ slug load

Hydrograph Type: Slug Load
Modflow Routing: Routed with infiltration

Treatment Volume (ft³) 1887891

Initial ground water level (ft datum) 87.00 (default)

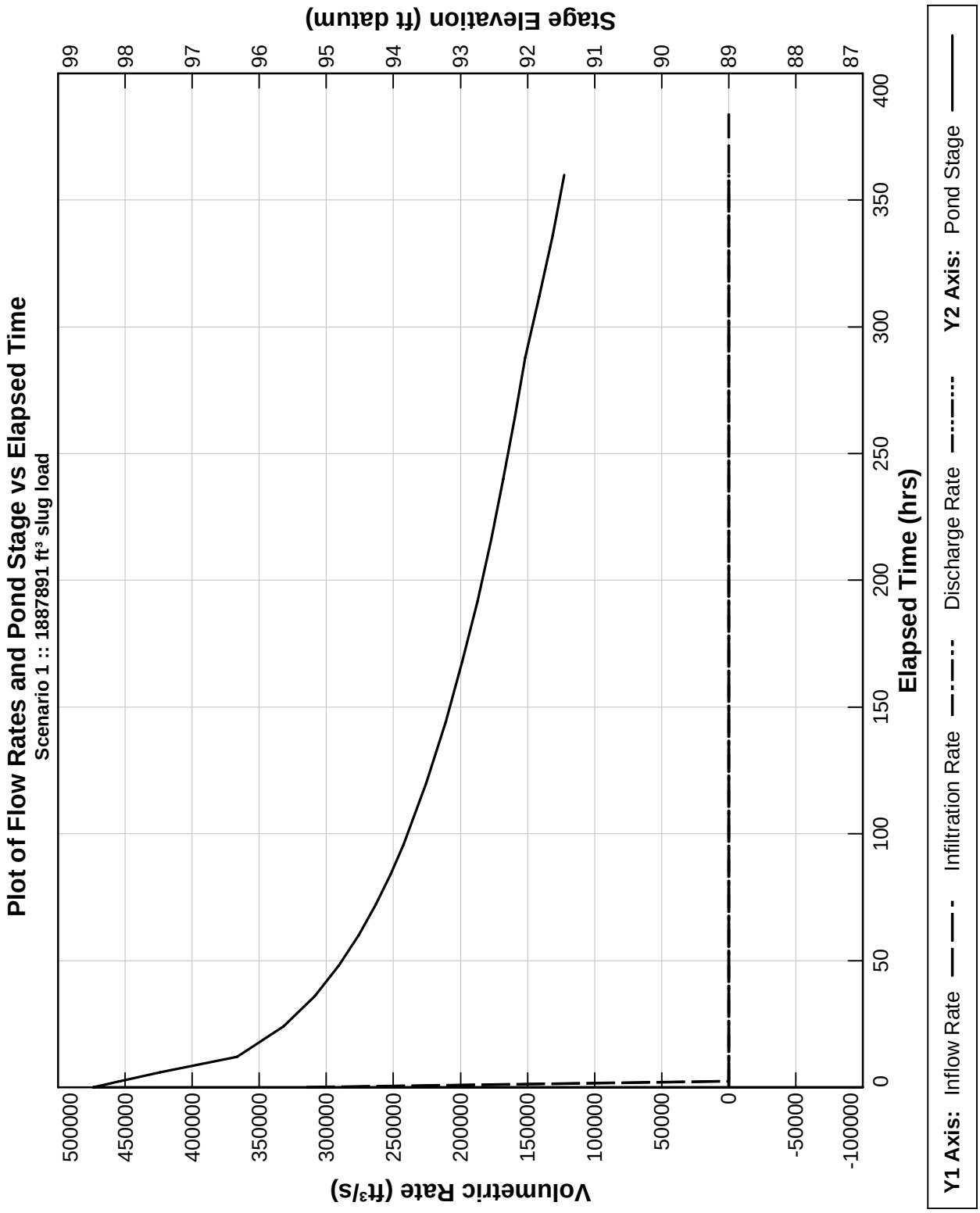
Time After Storm Event (days)	Time After Storm Event (days)	Time After Storm Event (days)	Time After Storm Event (days)	Time After Storm Event (days)
0.100	2.000	5.000	10.000	15.000
0.250	2.500	6.000	11.000	16.000
0.500	3.000	7.000	12.000	
1.000	3.500	8.000	13.000	
1.500	4.000	9.000	14.000	

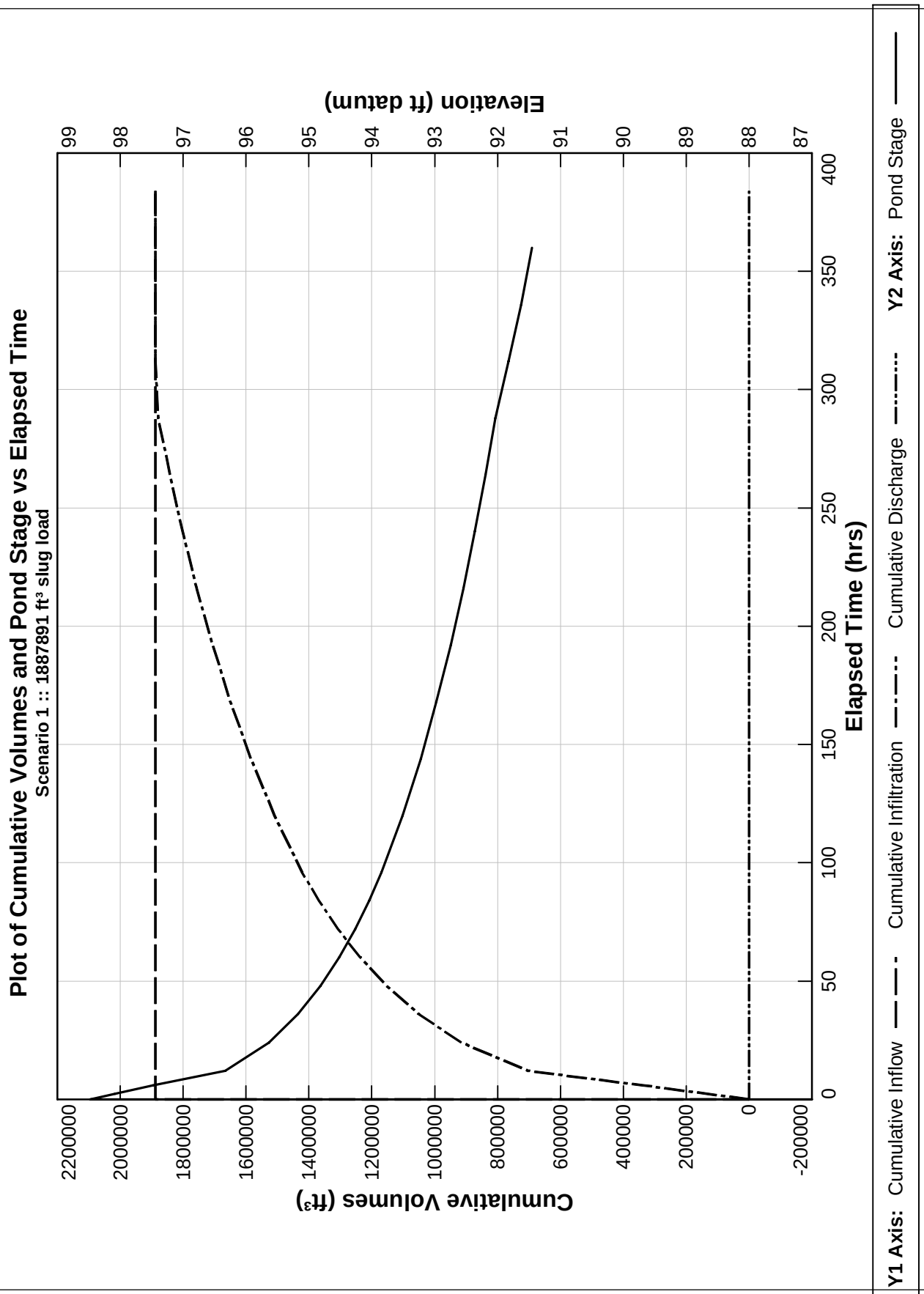
Detailed Results *:: Scenario 1 :: 1887891 ft³ slug load*

Elapsed Time (hours)	Instantaneous Inflow Rate (ft³/s)	Outside Recharge (ft/day)	Stage Elevation (ft datum)	Infiltration Rate (ft³/s)	Combined Instantaneous Discharge Rate (ft³/s)	Cumulative Inflow Volume (ft³)	Cumulative Infiltration Volume (ft³)	Combined Cumulative Discharge (ft³)	Flow Type
0.000	314648.5000	0.00000	87.00000	0.00000	0	0.000	0.0	0	N.A.
0.002	314648.5000	0.00000	98.47990	15.65440	0	1887891.000	93.9	0	U/P
2.400	0.0000	0.00000	98.08552	15.65440	0	1887891.000	135254.0	0	U/P
6.000	0.0000	0.00000	97.47849	16.14012	0	1887891.000	338135.0	0	U/P
12.000	0.0000	0.00000	96.33090	12.92153	0	1887891.000	704247.3	0	U/S
24.000	0.0000	0.00000	95.63803	4.00615	0	1887891.000	914427.9	0	S
36.000	0.0000	0.00000	95.17487	2.76150	0	1887891.000	1050379.0	0	S
48.000	0.0000	0.00000	94.81673	2.15101	0	1887891.000	1153021.0	0	S
60.000	0.0000	0.00000	94.52093	1.77614	0	1887891.000	1236226.0	0	S
72.000	0.0000	0.00000	94.26717	1.51811	0	1887891.000	1306480.0	0	S
84.000	0.0000	0.00000	94.04408	1.32774	0	1887891.000	1367391.0	0	S
96.000	0.0000	0.00000	93.84451	1.17205	0	1887891.000	1421197.0	0	S
120.000	0.0000	0.00000	93.51067	0.94607	0	1887891.000	1509768.0	0	S
144.000	0.0000	0.00000	93.22289	0.80769	0	1887891.000	1584677.0	0	S
168.000	0.0000	0.00000	92.97026	0.70223	0	1887891.000	1649336.0	0	S
192.000	0.0000	0.00000	92.74535	0.61920	0	1887891.000	1706022.0	0	S
216.000	0.0000	0.00000	92.54288	0.55219	0	1887891.000	1756334.0	0	S
240.000	0.0000	0.00000	92.35901	0.49699	0	1887891.000	1801439.0	0	S
264.000	0.0000	0.00000	92.19079	0.45076	0	1887891.000	1842213.0	0	S
288.000	0.0000	0.00000	92.03594	0.26434	0	1887891.000	1879331.0	0	S
312.000	0.0000	0.00000	91.82780	0.04954	0	1887891.000	1887891.0	0	S
336.000	0.0000	0.00000	91.62651	0.00000	0	1887891.000	1887891.0	0	S
360.000	0.0000	0.00000	91.44981	0.00000	0	1887891.000	1887891.0	0	S
384.000	0.0000	0.00000	91.29171	----	----	1887891.000	1887891.0	0	N.A.

Summary of Results *:: Scenario 1 :: 1887891 ft³ slug load*

	Time (hours)	Stage (ft datum)	Rate (ft³/s)	Volume (ft³)
Stage				
Minimum	0.000	87.00		
Maximum	0.002	98.48		
Inflow				
Rate - Maximum - Positive	0.002		314648.5000	
Rate - Maximum - Negative	None		None	
Cumulative Volume - Maximum Positive	0.002			1887891.0
Cumulative Volume - Maximum Negative	None			None
Cumulative Volume - End of Simulation	384.000			1887891.0
Infiltration				
Rate - Maximum - Positive	6.000		16.1401	
Rate - Maximum - Negative	None		None	
Cumulative Volume - Maximum Positive	312.000			1887891.0
Cumulative Volume - Maximum Negative	None			None
Cumulative Volume - End of Simulation	384.000			1887891.0
Combined Discharge				
Rate - Maximum - Positive	None		None	
Rate - Maximum - Negative	None		None	
Cumulative Volume - Maximum Positive	None			None
Cumulative Volume - Maximum Negative	None			None
Cumulative Volume - End of Simulation	384.000			0.0
Discharge Structure 1 - inactive				
Rate - Maximum - Positive	disabled		disabled	
Rate - Maximum - Negative	disabled		disabled	
Cumulative Volume - Maximum Positive	disabled			disabled
Cumulative Volume - Maximum Negative	disabled			disabled
Cumulative Volume - End of Simulation	disabled			disabled
Discharge Structure 2 - inactive				
Rate - Maximum - Positive	disabled		disabled	
Rate - Maximum - Negative	disabled		disabled	
Cumulative Volume - Maximum Positive	disabled			disabled
Cumulative Volume - Maximum Negative	disabled			disabled
Cumulative Volume - End of Simulation	disabled			disabled
Discharge Structure 3 - inactive				
Rate - Maximum - Positive	disabled		disabled	
Rate - Maximum - Negative	disabled		disabled	
Cumulative Volume - Maximum Positive	disabled			disabled
Cumulative Volume - Maximum Negative	disabled			disabled
Cumulative Volume - End of Simulation	disabled			disabled
Pollution Abatement:				
36 Hour Stage and Infiltration Volume	36.000	95.17		1050379.0
72 Hour Stage and Infiltration Volume	72.000	94.27		1306480.0


Plot of Flow Rates and Pond Stage vs Elapsed Time
Scenario 1 :: 1887891 ft³ slug load
Volumetric Rate (ft³/s)
Stage Elevation (ft datum)
Elapsed Time (hrs)
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
-50000
-100000
99
98
97
96
95
94
93
92
91
90
89
88
87
0
50
100
150
200
250
300
350
400
Y1 Axis: Inflow Rate
Infiltration Rate
Discharge Rate
Y2 Axis: Pond Stage


Plot of Cumulative Volumes and Pond Stage vs Elapsed Time
Scenario 1 :: 1887891 ft³ slug load
Cumulative Volumes (ft³)
Elevation (ft datum)
Elapsed Time (hrs)
2200000
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
-200000
99
98
97
96
95
94
93
92
91
90
89
88
87
0
50
100
150
200
250
300
350
400
Y1 Axis: Cumulative Inflow
Cumulative Infiltration
Cumulative Discharge
Y2 Axis: Pond Stage

ATTACHMENT B

WATER QUALITY VOLUME RECOVERY

PONDS Version 3.3.0278
Retention Pond Recovery - Refined Method
Copyright 2012
Devo Seereeram, Ph.D., P.E.

Project Data

Project Name:	Fuqua - Hartwood Marsh
Simulation Description:	Combined Pond - Water Quality Treatment Volume Run
Project Number:	19-585.18
Engineer :	Reidel Gardon
Supervising Engineer:	Devo Seereeram
Date:	09-26-2019

Aquifer Data

Base Of Aquifer Elevation, [B] (ft datum):	70.00
Water Table Elevation, [WT] (ft datum):	87.00
Horizontal Saturated Hydraulic Conductivity, [Kh] (ft/day):	45.00
Fillable Porosity, [n] (%):	30.00
Unsaturated Vertical Infiltration Rate, [Iv] (ft/day):	5.0
Maximum Area For Unsaturated Infiltration, [Av] (ft^2):	270508.0

Geometry Data

Equivalent Pond Length, [L] (ft):	1430.0
Equivalent Pond Width, [W] (ft):	290.0

Ground water mound is expected to intersect the pond bottom

Stage vs Area Data

Stage (ft datum)	Area (ft^2)
92.00	237838.0
93.00	254390.0
94.00	270508.0
95.00	286625.0
96.00	303613.0
97.00	320602.0
98.00	338026.0
98.50	346302.0
99.00	389862.0

Ditch Data

Ditch (or interceptor trench) parallel to length axis is inactive

Ditch (or interceptor trench) parallel to width axis is inactive

Discharge Structures

Discharge Structure #1 is inactive

Discharge Structure #2 is inactive

Discharge Structure #3 is inactive

Scenario Input Data

Scenario 1 :: 491357 ft³ slug load

Hydrograph Type: Slug Load
Modflow Routing: Routed with infiltration

Treatment Volume (ft³) 491357

Initial ground water level (ft datum) 87.00 (default)

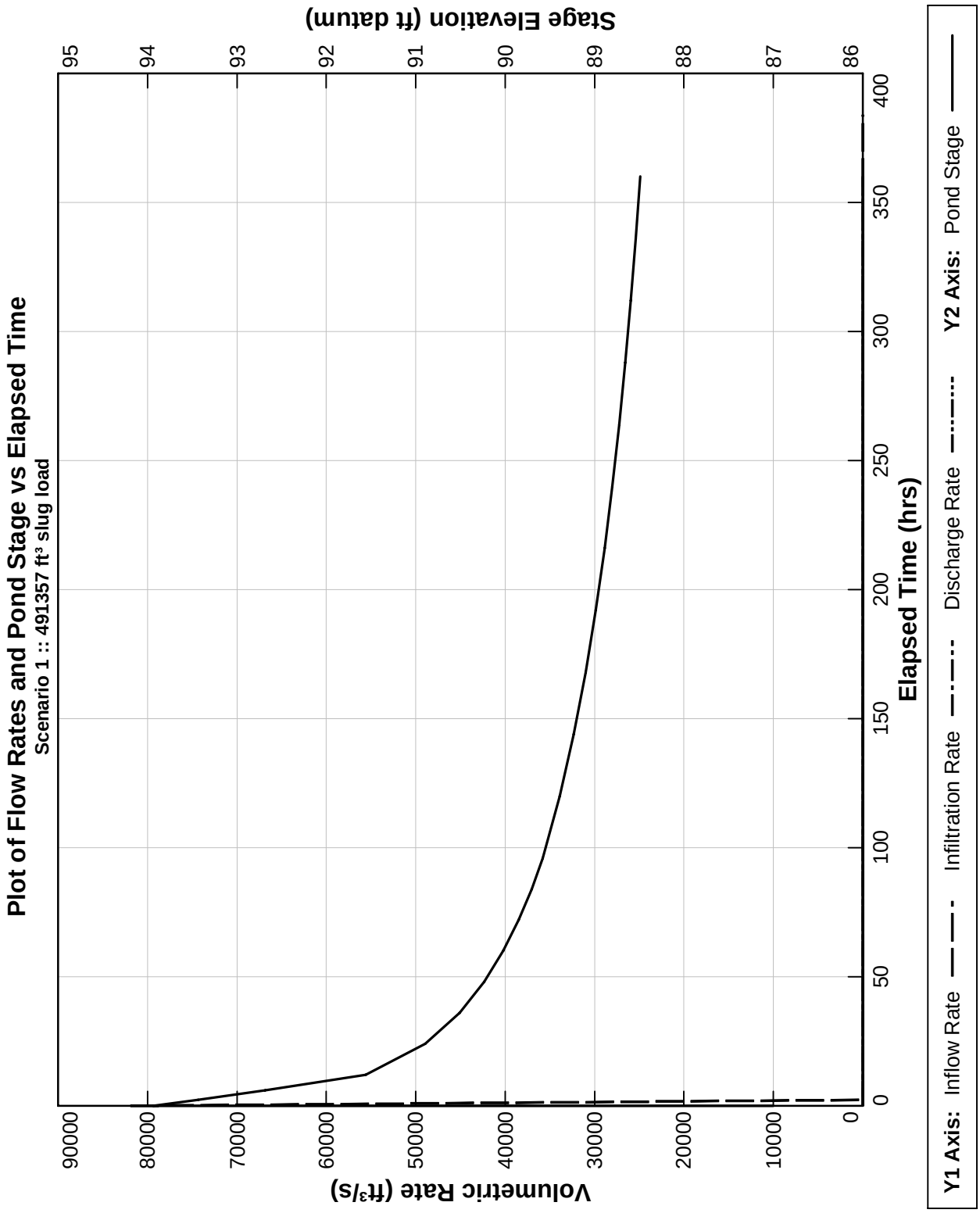
Time After Storm Event (days)	Time After Storm Event (days)	Time After Storm Event (days)	Time After Storm Event (days)	Time After Storm Event (days)
0.100	2.000	5.000	10.000	15.000
0.250	2.500	6.000	11.000	16.000
0.500	3.000	7.000	12.000	
1.000	3.500	8.000	13.000	
1.500	4.000	9.000	14.000	

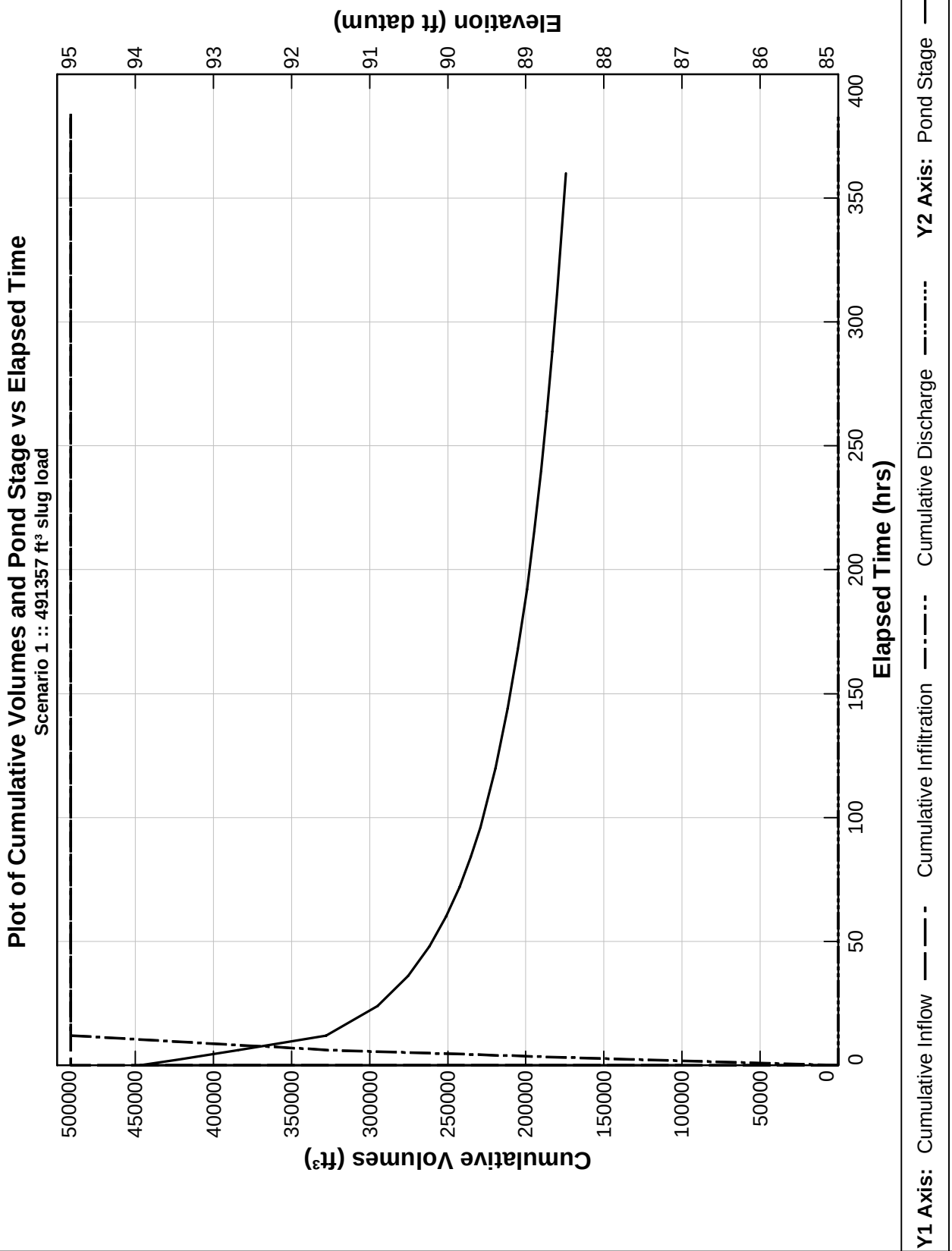
Detailed Results *:: Scenario 1 :: 491357 ft³ slug load*

Elapsed Time (hours)	Instantaneous Inflow Rate (ft³/s)	Outside Recharge (ft/day)	Stage Elevation (ft datum)	Infiltration Rate (ft³/s)	Combined Instantaneous Discharge Rate (ft³/s)	Cumulative Inflow Volume (ft³)	Cumulative Infiltration Volume (ft³)	Combined Cumulative Discharge (ft³)	Flow Type
0.000	81892.8400	0.00000	87.00000	0.00000	0	0.000	0.0	0	N.A.
0.002	81892.8400	0.00000	93.93593	15.59480	0	491357.000	93.6	0	U/P
2.400	0.0000	0.00000	93.43596	15.13738	0	491357.000	132808.3	0	U/P
6.000	0.0000	0.00000	92.68546	12.13938	0	491357.000	324440.7	0	U/P
12.000	0.0000	0.00000	91.55759	5.15174	0	491357.000	491357.0	0	U/S
24.000	0.0000	0.00000	90.89655	0.00000	0	491357.000	491357.0	0	S
36.000	0.0000	0.00000	90.50702	0.00000	0	491357.000	491357.0	0	S
48.000	0.0000	0.00000	90.23192	0.00000	0	491357.000	491357.0	0	S
60.000	0.0000	0.00000	90.02018	0.00000	0	491357.000	491357.0	0	S
72.000	0.0000	0.00000	89.84879	0.00000	0	491357.000	491357.0	0	S
84.000	0.0000	0.00000	89.70534	0.00000	0	491357.000	491357.0	0	S
96.000	0.0000	0.00000	89.58241	0.00000	0	491357.000	491357.0	0	S
120.000	0.0000	0.00000	89.38895	0.00000	0	491357.000	491357.0	0	S
144.000	0.0000	0.00000	89.23126	0.00000	0	491357.000	491357.0	0	S
168.000	0.0000	0.00000	89.09931	0.00000	0	491357.000	491357.0	0	S
192.000	0.0000	0.00000	88.98666	0.00000	0	491357.000	491357.0	0	S
216.000	0.0000	0.00000	88.88892	0.00000	0	491357.000	491357.0	0	S
240.000	0.0000	0.00000	88.80302	0.00000	0	491357.000	491357.0	0	S
264.000	0.0000	0.00000	88.72670	0.00000	0	491357.000	491357.0	0	S
288.000	0.0000	0.00000	88.65827	0.00000	0	491357.000	491357.0	0	S
312.000	0.0000	0.00000	88.59646	0.00000	0	491357.000	491357.0	0	S
336.000	0.0000	0.00000	88.54023	0.00000	0	491357.000	491357.0	0	S
360.000	0.0000	0.00000	88.48879	0.00000	0	491357.000	491357.0	0	S
384.000	0.0000	0.00000	88.44150	----	----	491357.000	491357.0	0	N.A.

Summary of Results *:: Scenario 1 :: 491357 ft³ slug load*

	Time (hours)	Stage (ft datum)	Rate (ft³/s)	Volume (ft³)
Stage				
Minimum	0.000	87.00		
Maximum	0.002	93.94		
Inflow				
Rate - Maximum - Positive	0.002		81892.8400	
Rate - Maximum - Negative	None		None	
Cumulative Volume - Maximum Positive	0.002			491357.0
Cumulative Volume - Maximum Negative	None			None
Cumulative Volume - End of Simulation	384.000			491357.0
Infiltration				
Rate - Maximum - Positive	0.002		15.5948	
Rate - Maximum - Negative	None		None	
Cumulative Volume - Maximum Positive	12.000			491357.0
Cumulative Volume - Maximum Negative	None			None
Cumulative Volume - End of Simulation	384.000			491357.0
Combined Discharge				
Rate - Maximum - Positive	None		None	
Rate - Maximum - Negative	None		None	
Cumulative Volume - Maximum Positive	None			None
Cumulative Volume - Maximum Negative	None			None
Cumulative Volume - End of Simulation	384.000			0.0
Discharge Structure 1 - inactive				
Rate - Maximum - Positive	disabled		disabled	
Rate - Maximum - Negative	disabled		disabled	
Cumulative Volume - Maximum Positive	disabled			disabled
Cumulative Volume - Maximum Negative	disabled			disabled
Cumulative Volume - End of Simulation	disabled			disabled
Discharge Structure 2 - inactive				
Rate - Maximum - Positive	disabled		disabled	
Rate - Maximum - Negative	disabled		disabled	
Cumulative Volume - Maximum Positive	disabled			disabled
Cumulative Volume - Maximum Negative	disabled			disabled
Cumulative Volume - End of Simulation	disabled			disabled
Discharge Structure 3 - inactive				
Rate - Maximum - Positive	disabled		disabled	
Rate - Maximum - Negative	disabled		disabled	
Cumulative Volume - Maximum Positive	disabled			disabled
Cumulative Volume - Maximum Negative	disabled			disabled
Cumulative Volume - End of Simulation	disabled			disabled
Pollution Abatement:				
36 Hour Stage and Infiltration Volume	36.000	90.51		491357.0
72 Hour Stage and Infiltration Volume	72.000	89.85		491357.0


Plot of Flow Rates and Pond Stage vs Elapsed Time
Scenario 1 :: 491357 ft³ slug load
Volumetric Rate (ft³/s)
Stage Elevation (ft datum)
Elapsed Time (hrs)
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
86
87
88
89
90
91
92
93
94
95
0
50
100
150
200
250
300
350
400
Y1 Axis: Inflow Rate Infiltration Rate Discharge Rate
Y2 Axis: Pond Stage


Plot of Cumulative Volumes and Pond Stage vs Elapsed Time
Scenario 1 :: 491357 ft³ slug load
Cumulative Volumes (ft³)
Elevation (ft datum)
Elapsed Time (hrs)
0
50000
100000
150000
200000
250000
300000
350000
400000
450000
500000
85
86
87
88
89
90
91
92
93
94
95
0
50
100
150
200
250
300
350
400
Y1 Axis: Cumulative Inflow
Cumulative Infiltration
Cumulative Discharge
Y2 Axis: Pond Stage