Slope Stability, Settlement, and Bearing Capacity Evaluation

Davidson County MSW Landfill – Phase 2 – Area 2
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management
Thomasville, North Carolina

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DAVIDSON COUNTY MSW LANDFILL - PHASE 2 - AREA 2

SLOPE STABILITY, SETTLEMENT, AND BEARING CAPACITY EVALUATION

TABLE OF CONTENTS

Page

1.0 OVERVIEW 1

2.0 SEISMIC CONSIDERATIONS 1
- 2.1 Regulatory Requirements/Guidance 1
- 2.2 Seismic Coefficients 1
- 2.3 Liquefaction Evaluation 2

3.0 SLOPE STABILITY 2
- 3.1 Required Factors of Safety 2
- 3.2 Deep-Seated Failure Surfaces 2
  - 3.2.1 Material Properties 3
  - 3.2.2 Results 4
- 3.3 Shallow Failure Surfaces 4
  - 3.3.1 Material Properties 4
  - 3.3.2 Results 5

4.0 FOUNDATION SETTLEMENT 6

5.0 BEARING CAPACITY 6

6.0 REFERENCES 7

TABLES
- Table 1 Material Properties Used in Slope Stability Analyses
- Table 2 Results Summary - Deep-Seated Failure Surfaces
- Table 3 Results Summary - Shallow Failure Surfaces

FIGURES
- Figure 1 USGS Seismic Hazard Map
- Figure 2 Capable Faults Map
- Figure 3 Site Amplification/Attenuation Relationships
- Figure 4 Location of Slope Stability Cross Section and Settlement Evaluation Points
- Figure 5 Shear Strength of Municipal Solid Waste

Table of Contents (Continued)

APPENDICES

Appendix A Deep-Seated Slope Stability Analyses
Appendix B Protective Cover Veneer Stability Evaluation
Appendix C Final Cover Veneer Stability Evaluation
Appendix D Foundation Settlement Evaluation
Appendix E Bearing Capacity Evaluation

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SLOPE STABILITY, SETTLEMENT, AND BEARING CAPACITY EVALUATION

1.0 OVERVIEW

The stability of the overall waste mass and perimeter berms (deep-seated failure surfaces) and the stability of the side slope liner/protective cover and final cover (shallow failure surfaces) are addressed herein in addition to evaluations of foundation settlement and bearing capacity.

2.0 SEISMIC CONSIDERATIONS

Although the project site lies just outside a seismic impact zone (a_{max} > 0.10 g according to USGS (Petersen et. al)) (see **Figure 1**), seismic (pseudo-static) slope stability analyses were performed and the potential for liquefaction was evaluated.

2.1 Regulatory Requirements/Guidance

On October 9, 1993, RCRA Subtitle D regulations (40 CFR Part 258) governing landfills receiving municipal solid waste (MSW) went into effect. These regulations require that:

- Section 258.13: landfills cannot be sited within 200-feet of a fault that has had displacement in the Holocene Epoch (past 11,000 years) unless it can be demonstrated that a lesser set back is safe.

- Section 258.14: landfills must be designed for seismic conditions if they are within a seismic impact zone defined as having a peak bedrock acceleration exceeding 0.10 g based on a 10% probability of being exceeded in a 250 year time period (equivalent of 2% probability of being exceeded in 50 years).

The EPA guidance for seismic design guidance for municipal solid waste landfills (EPA/600/R-95/051) states that, within the United States and east of the Rocky Mountains, only the Meers Fault in Oklahoma and the Reelfoot Fault in Tennessee (source of the 1811/1812 New Madrid earthquake sequence) (see **Figure 2** (Krinitsky et. al)) have had displacement evidenced at the ground surface. The project site thus satisfies the requirements of 258.13.

2.2 Seismic Coefficients

The peak bedrock acceleration at the project site is obtained from 2008 USGS information (Frankel et. al) (tabulated projected ground acceleration -- 2% probability of being exceeded in 50 years). This indicates that a peak bedrock acceleration of 0.10 g can be assigned to the site based on the site longitude (-81.1 degrees) and latitude (35.9 degrees).

The peak bedrock acceleration must be modified for site conditions to predict the peak ground surface acceleration at the site. The site amplification or attenuation of the peak bedrock acceleration can be evaluated using one-dimensional wave propagation analysis either specifically performed for the site or based on parametric studies. The site amplification or attenuation is estimated using the parametric relationships shown on **Figure 3** (Seed and Idriss). Site boring information indicates that much of the site is underlain by dense soils and partially weathered rock. The site amplification factor is taken from **Figure 3** and results in a ground surface acceleration of 0.10 g.

For the seismic evaluation of deep-seated failure surfaces, the pseudo-static seismic coefficient used in each analysis was taken as half of the ground surface acceleration value to account for the average acceleration predicted within the waste mass (EPA/600/R-95/051). For the seismic evaluation of shallow failure surfaces, the pseudo-static seismic coefficient was taken as equal to the full ground surface acceleration value.

2.3 Liquefaction Evaluation

The first step in any liquefaction evaluation is to assess whether the potential for liquefaction of cohesionless soils exists at a site. Because of the lack of loose cohesionless soils on-site, liquefaction is not a concern for this site.

3.0 SLOPE STABILITY

The stability of deep-seated and shallow failure surfaces was evaluated based on EPA guidance and standard industry practices.

3.1 Required Factors of Safety

The minimum acceptable factors of safety for long-term slope stability were selected to be 1.5 for static conditions and 1.0 for seismic conditions. For interim conditions, the minimum acceptable static factors of safety were selected to be 1.3 for static conditions and 1.0 for seismic conditions.

3.2 Deep-Seated Failure Surfaces

The stability of deep-seated failure surfaces was evaluated using the computer program STABL5M, a computer program developed by Purdue University, with the STEDWIN (v. 2.80) Windows interface program. Both block (translational along liner) and circular (rotational within waste mass and/or subgrade) failure surfaces were analyzed. For block failure surfaces, the factor of safety was determined using the modified Janbu Method. The modified Bishop Method was used to analyze circular failure surfaces.

Analyses were performed for the cross sections shown in **Figure 4** (Figure 4A - Base Grades; Figure 4B - Final Cover Grades) and **Appendix A**. These cross sections were chosen based on inspection as representative of worst case conditions.

3.2.1 Material Properties

A summary of material properties used in the evaluation of deep-seated failure surfaces is presented in **Table 1**. A discussion of these values is as follows:

Perimeter Berms/Subgrade:

The assumed material properties for the perimeter berms/subgrade were:

Unit Weight:	100 pcf (moist); 110 pcf (saturated)
Cohesion:	100 psf
Friction Angle (phi):	25 degrees

These properties are conservative as compared to typical soil strength properties (NAVFAC DM 7.02) considering actual subgrade conditions and the presence of relatively shallow rock in some areas.

Waste:

The assumed material properties for the MSW were:

Unit Weight:	70 pcf (moist); 90 pcf (saturated)
Cohesion (c):	500 psf
Friction Angle (phi):	30 degrees

The assumed unit weight is typical of landfills that do not recirculate leachate. The assumed shear strength envelope (cohesion and friction angle values) was based on EPA guidance and summarized strength properties for MSW waste by Kavazanjian et. al. (1995) and Eid et. al. (2000). These data came from published lab and field tests on MSW wastes and from values back figured from steep landfill slopes. Kavazanjian et. al. (1995) recommend a bilinear strength envelope for MSW materials as shown on **Figure 5**. This envelope represents a lower bound to the MSW strength data collected in that study. Also shown on **Figure 5** is the strength envelope recommended by Eid et. al and the strength envelope used in this evaluation. Note that the strength envelope used in this evaluation ranges between the Kavazanjian and Eid values for a normal stress up to approximately 260 kPa (± 6,260 psf or ± 90 feet of waste @ 70 pcf) and is more conservative than the two for greater waste thicknesses.

Liner System:

The assumed material properties for the liner system were:

Unit Weight:	100 pcf (moist and saturated)
Cohesion:	0 psf
Friction Angle (phi):	20 degrees

The assumed unit weight is not critical as the liner system is very thin relative to the cross sections analyzed. The assumed shear strength envelope for the liner system is considered to be conservative of the geosynthetic/soil and geosynthetic/geosynthetic interfaces involved.

Note that based on performing a parametric analysis of the worst case slope stability cross section, an interface shear strength envelope defined by c = 0 psf and phi = 9 degrees is the minimum required for liner system components to satisfy minimum slope stability factors of safety. This is much lower than would be anticipated using the specified materials.

The actual interface shear strength properties for the liner system interfaces should be confirmed prior to construction of the liner system. Based on this evaluation, RSG recommends the use of a textured geomembrane and reinforced GCL (if used) on this project to satisfy minimum slope stability factors of safety.

3.2.2 Results

Table 2 provides a summary of the results of the stability analyses for deep-seated failure surfaces. The results demonstrate that minimum factors of safety for both static and seismic conditions meet or exceed the minimum criteria (1.5 for final static conditions; 1.3 for interim static conditions; 1.0 for seismic conditions). These analyses are presented in **Appendix A**. In that the factors of safety for seismic conditions are at least 1.0, no deformation analyses were required.

3.3 Shallow Failure Surfaces

The stability of shallow translational (veneer) failure surfaces was evaluated using spreadsheet analyses. Translational failure surfaces along/through the side slope liner/protective cover and the final cover were analyzed.

3.3.1 Material Properties

A summary of material properties used in the evaluation of shallow failure surfaces is presented in **Table 1**. A discussion of these values is as follows:

Side Slope Liner/Protective Cover:

The assumed material properties for the side slope liner/protective cover were:

Unit Weight:	110 pcf
Cohesion:	0 psf
Friction Angle (phi):	26.6 degrees

The assumed shear strength envelope for the side slope liner/protective cover is

considered to be conservative of the geosynthetic/soil and geosynthetic/geosynthetic interfaces involved - especially considering the low (≤ 1,000 psf) that will be acting on this interface.

The actual interface shear strength properties for the side slope liner/protective cover interfaces should be confirmed prior to construction of the liner system. Based on this evaluation, RSG recommends the use of a textured geomembrane and reinforced GCL (if used) on this project to satisfy minimum slope stability factors of safety.

Final Cover System:

The assumed material properties for the final cover were:

Unit Weight:	110 pcf
Cohesion:	0 psf
Friction Angle (phi):	24 degrees

The assumed shear strength envelope for the final cover is considered to be conservative of the geosynthetic/soil and geosynthetic/geosynthetic interfaces involved - especially considering the low (≤ 1,000 psf) that will be acting on this interface.

Additionally, the analysis of the final cover system considered 6 inches of head acting on the final cover geomembrane. This is conservative for head acting on top of the geomembrane as the drainage geocomposite has been designed to limit the head to no more than the thickness of the geonet drainage core (< 1 inch). However, the assumed 6 inches of head also models the condition of excess gas pressure acting on the bottom of the geomembrane.

The actual interface shear strength properties for the final cover interfaces should be confirmed prior to construction of the final cover system. Based on this evaluation, RSG recommends the use of a textured geomembrane on this project to satisfy minimum slope stability factors of safety.

3.3.2 Results

Table 3 provides a summary of the results of the stability analyses for shallow failure surfaces. The results demonstrate that minimum factors of safety for both static and seismic conditions meet or exceed the minimum criteria (1.5 for final static conditions; 1.3 for interim static conditions; 1.0 for seismic conditions). These analyses are presented in **Appendix B** (Protective Cover Veneer) and **Appendix C** (Final Cover Veneer).

4.0 FOUNDATION SETTLEMENT

The anticipated total and differential settlements of the Phase 2 - Area 2 foundation were estimated under maximum Phase 2 - Area 2 loading. These values do not include subsidence of the waste itself, only settlement of the subgrade soils. The settlement analysis evaluated both elastic and consolidation settlement at various points in the landfill in predicting total and differential settlements.

Based upon site boring information, Phase 2 - Area 2 is underlain by varying thicknesses of medium stiff to hard silty clay (CL) and sandy clayey silt (SM) grading down to partially weathered rock (PWR).

Settlement calculations were performed for each of the points (1-5) shown on **Figure 4** to estimate the total and differential foundation settlements due to the weight of the planned waste and embankment loads. A section through these points includes the highest waste depths and is along the alignment of leachate collection piping). The resulting post-settlement slopes were evaluated to ensure that 1) positive drainage is maintained toward collection piping and/or sumps and 2) the maximum tensile strains in the liner system do not exceed allowable values.

The settlement calculations show that maximum total foundation settlement will be less than 6 inches and that positive slope will be maintained along leachate collection piping. Additionally, strains resulting from differential settlements are expected to be negligible meaning that no adverse impacts on the function of the leachate collection or liner systems are anticipated.

Foundation settlement calculations are provided in **Appendix D**.

5.0 BEARING CAPACITY

Both the bearing capacity of the subgrade materials beneath the landfill footprint and the bearing capacity of the leachate collection system under anticipated construction and operations equipment loads were evaluated. Based on the anticipated conditions, the overall landfill and the leachate collection system have adequate bearing capacity. The evaluation of the equipment loads also demonstrates the required separation between equipment and the underlying geomembrane.

Bearing capacity calculations are provided in **Appendix E**.

6.0 REFERENCES

Eid, H.T., Stark, T.D., Evans, W.D., and Sherry, P.E. (2000), "Municipal Solid Waste Slope Failure. I: Waste and Foundation Soil Properties," *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol. 126, No. 5, pp. 397-407.

Petersen, M.D., Frankel, A.D., et. al (2008), "Documentation for the 2008 Update of the United States National Seismic Hazard Maps," U.S. Geological Survey Open-File Report 2008-1128.

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Krinitzsky, E.L., Gould, J.P., and P.H. Edinger (1993), Fundamentals of Earthquake-Resistant Construction, John Wiley & Sons, New York.

Naval Facilities Engineering Command (1986), Foundations and Earth Structures (Design Manual 7.02), Naval Facilities Engineering Command, Alexandria, VA, p. 7.2-39.

Richardson, G.N., Kavazanjian, E., and N. Matasovic (1995), RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, EPA/600/R-95/051, U.S. Environmental Protection Agency, Washington, D.C.

Seed, H.B. and Idriss, I.M. (1982), "Ground Motions and Soil Liquefaction During Earthquakes," Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.

U.S. Army Corps of Engineers (2003), Engineering and Design - Slope Stability, Engineer Manual, EM 1110-2-1902, Dept. of the Army, Washington, D.C.

TABLE 1: MATERIAL PROPERTIES USED IN SLOPE STABILITY ANALYSES

Material	Unit Weight (pcf)	Shear Strength Properties[1]	
		Cohesion/ Adhesion (c) (psf)	Friction Angle (Φ) (degrees)
Perimeter Berms/Subgrade	100 (Moist) 110 (Saturated)	100	25
Waste (MSW)	75 (Moist) 90 (Saturated)	500	30
Liner: (Textured HDPE Interface)[2]	100	0	20
Side Slope Liner/Protective Cover[3]	110	0	26.6
Final Cover[3]	110	0	24.0

Notes:

1. Combinations of cohesion/adhesion and friction angle that are different than these values that produce the same shear strength could also be used here (shear strength (τ) = normal load x tan (Φ) + c).

2. A parametric evaluation of the worst case slope stability run (Cross Section A - Static) revealed that an interface shear strength envelope defined by at least c = 0 psf and phi = 9.0 degrees would be required to satisfy the minimum required FS values of 1.5 (static) and 1.0 (seismic).

3. The shear strength values given for the side slope liner/protective cover and final cover are the minimum required to satisfy the required factors of safety under low ($\leq$ 1,000 psf) normal loads.

TABLE 2: RESULTS SUMMARY - DEEP-SEATED FAILURE SURFACES

Cross Section Analyzed (Condition)	Failure Type	Method of Analysis	Factor of Safety[1]	
			Static (FS ≥ 1.5 - Final) (FS ≥ 1.3 - Interim)	Seismic[2] (FS ≥ 1.0)
A (Final)	Block Along Liner	Modified Janbu	2.32	1.89
	Circular	Modified Bishop	2.95	2.40

Notes:

1. See **Table 1** for material properties used in each run.
2. Seismic coefficient (a) = 0.5 x 0.10 g = 0.05 g.

TABLE 3: RESULTS SUMMARY - SHALLOW FAILURE SURFACES

Condition Analyzed (Condition)	Failure Type	Factor of Safety[1]	
		Static (FS ≥ 1.5)	Seismic[2] (FS ≥ 1.0)
Side Slope Liner/Protective Cover	Translational	1.51	1.12
Final Cover	Translational	1.53	1.06

Notes:

1. See **Table 1** for material properties used in each run.
2. Seismic coefficient (a) = 0.10 g.

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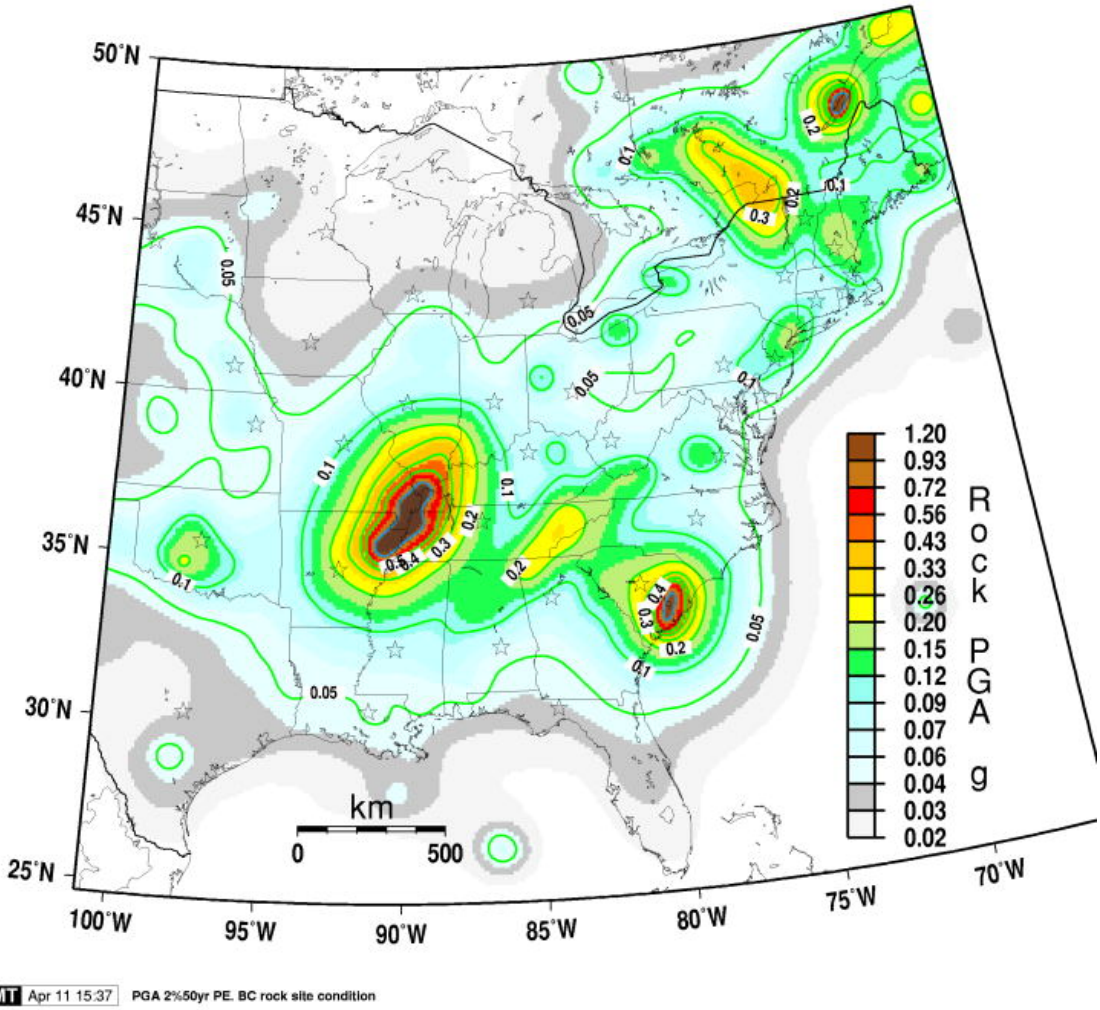
PGA with 2%/50 yr PE, 2008



USGS SEISMIC HAZARD MAP			RICHARDSON SMITH GARDNER & ASSOCIATES Engineering and Geological Services		
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NOT TO SCALE	OTHERS	PKS	MAY 2012	DAVDCO-10-5	1

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CAPABLE FAULTS (KRINITZKY et. al., 1993)			RICHARDSON SMITH GARDNER & ASSOCIATES Engineering and Geological Services		
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NOT TO SCALE	OTHERS	PKS	MAY 2012	DAVDCO-10-5	2

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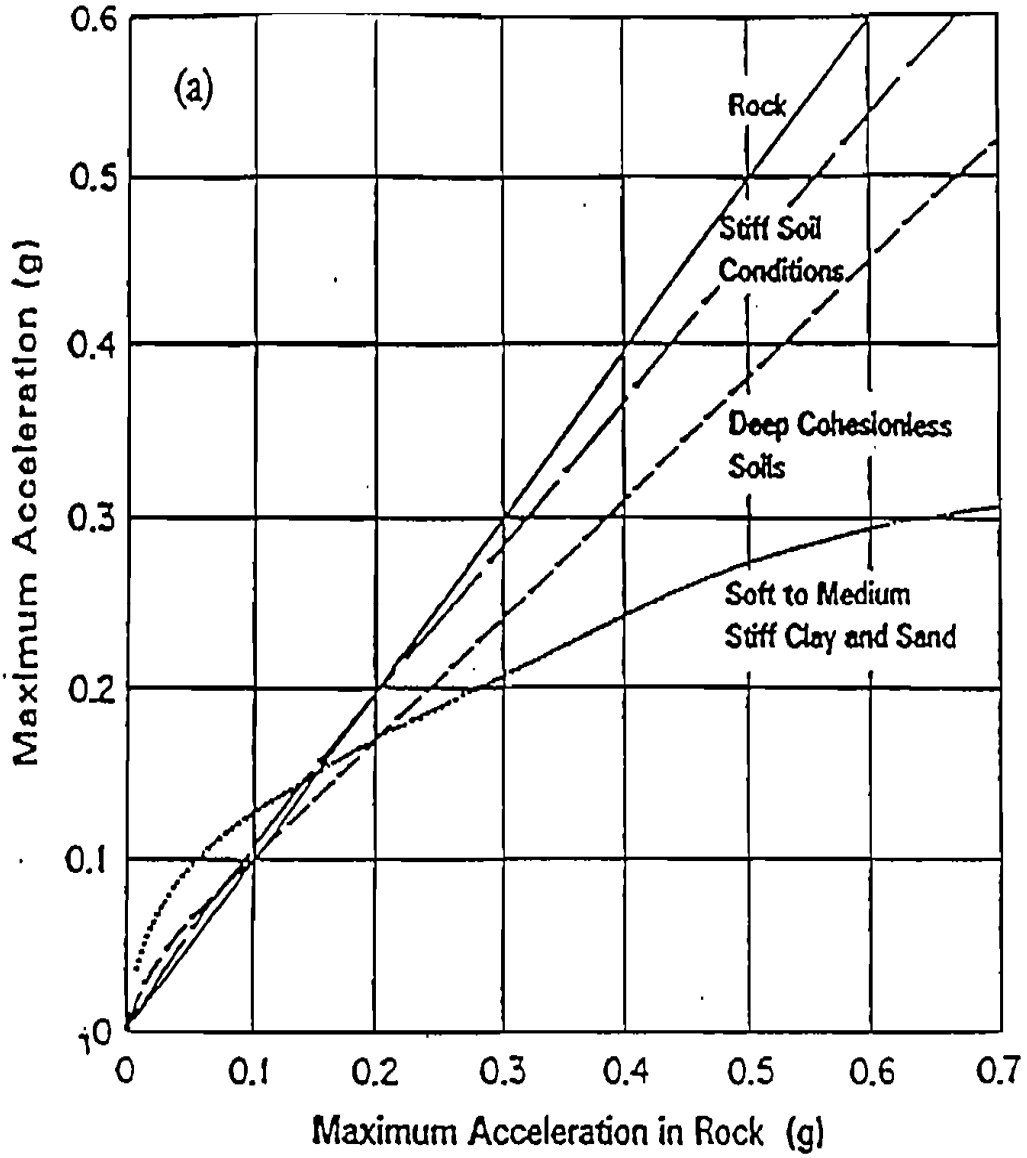

SITE AMPLIFICATION/ATTENUATION RELATIONSHIPS (SEED & IDRISS, 1982)			RICHARDSON SMITH GARDNER & ASSOCIATES Engineering and Geological Services		
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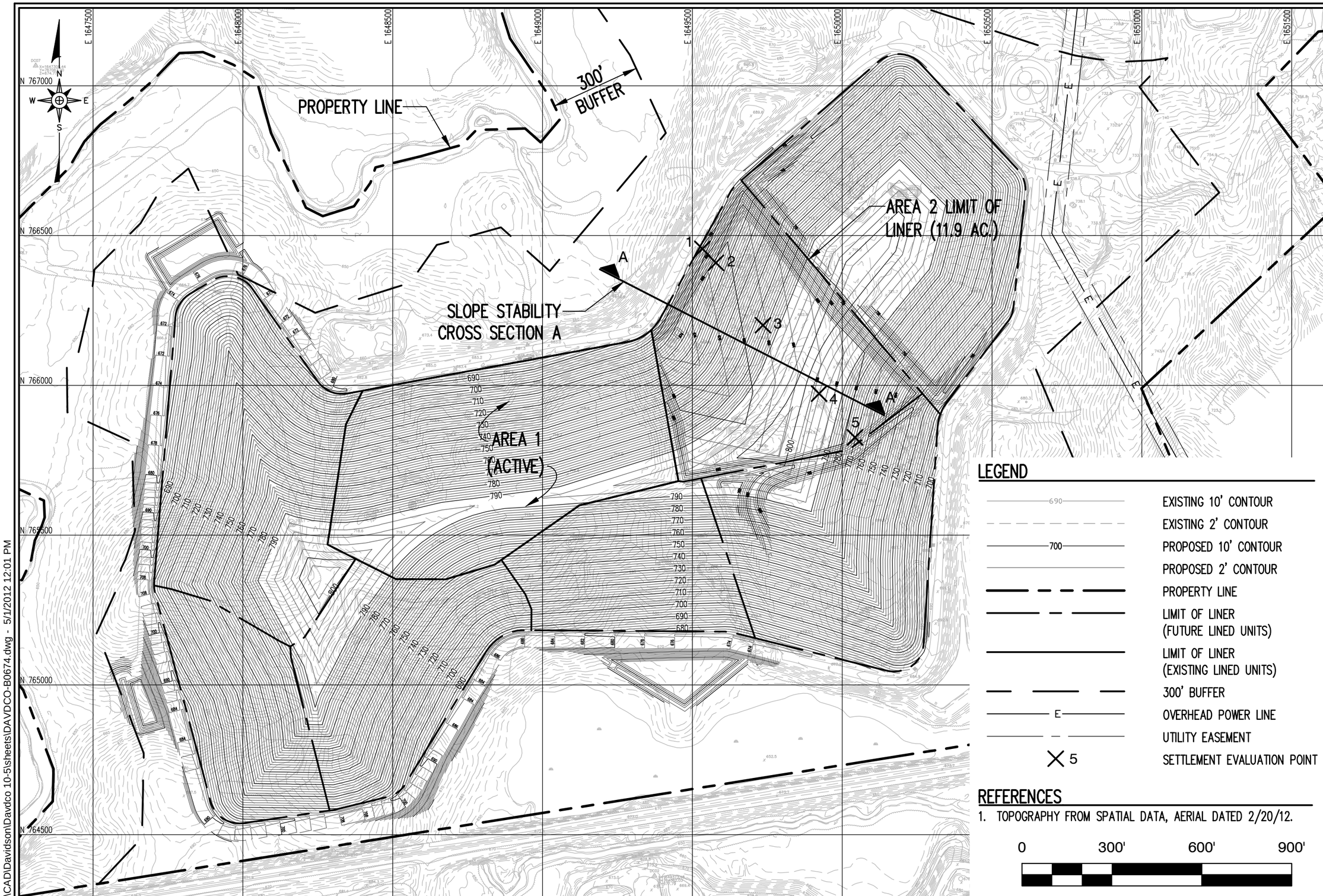

LEGEND

690	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
700	PROPOSED 10' CONTOUR
	PROPOSED 2' CONTOUR
	PROPERTY LINE
	LIMIT OF LINER (FUTURE LINED UNITS)
	LIMIT OF LINER (EXISTING LINED UNITS)
	300' BUFFER
E	OVERHEAD POWER LINE
	UTILITY EASEMENT
X 5	SETTLEMENT EVALUATION POINT

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.

0 300' 600' 900'

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FIGURE NO.	4
FILE NAME	DAVDCO-B0674
SCALE:	AS NOTED
PROJECT NO.	DAVDCO 10-5
CHECKED BY:	P.K.S.
DRAWN BY:	W.R.B.
DATE:	May. 2012

TITLE: LOCATION OF SLOPE STABILITY CROSS SECTION AND SETTLEMENT EVALUATION POINTS

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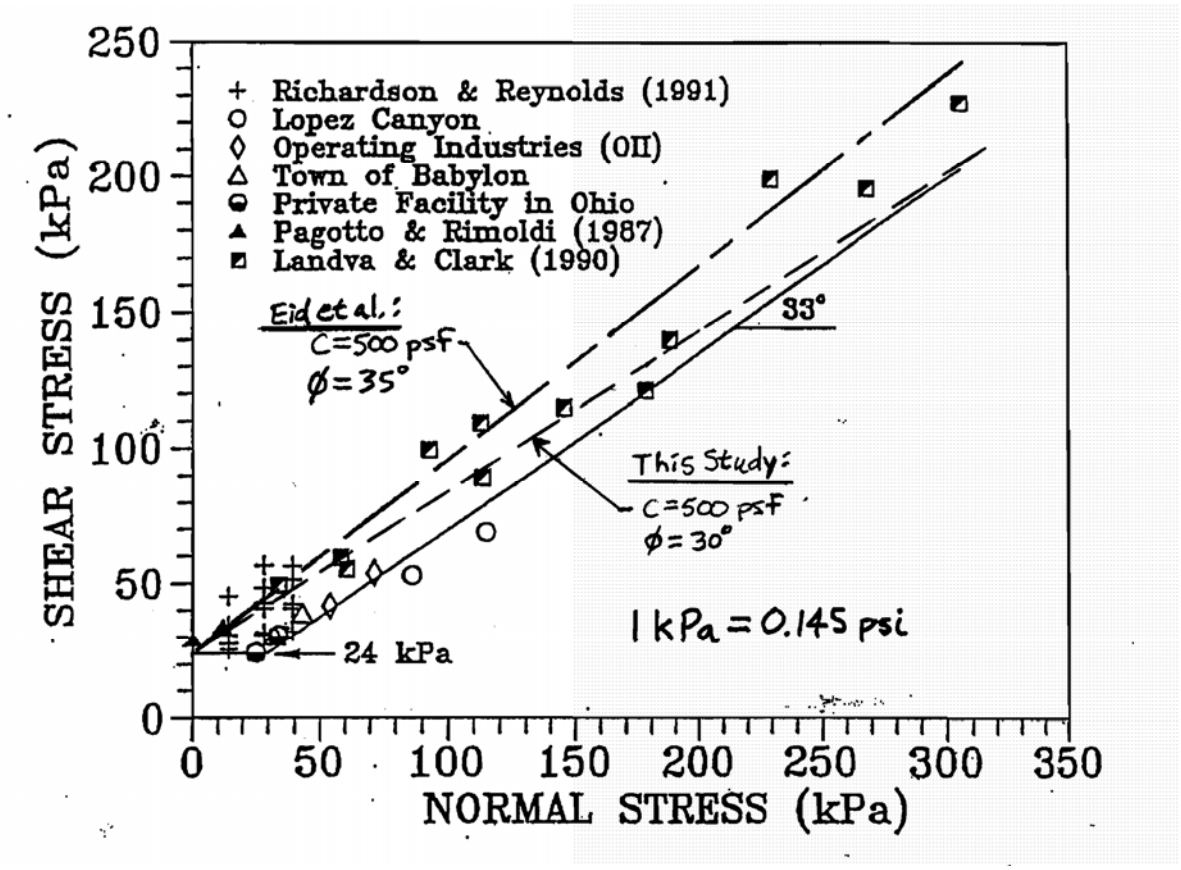

SHEAR STRENGTH OF MUNICIPAL SOLID WASTE			RICHARDSON SMITH GARDNER & ASSOCIATES Engineering and Geological Services		
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Appendix A

Deep-Seated Slope Stability
Analyses

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Davidson County MSWLF - Area 2 Section A - Block Liner Static

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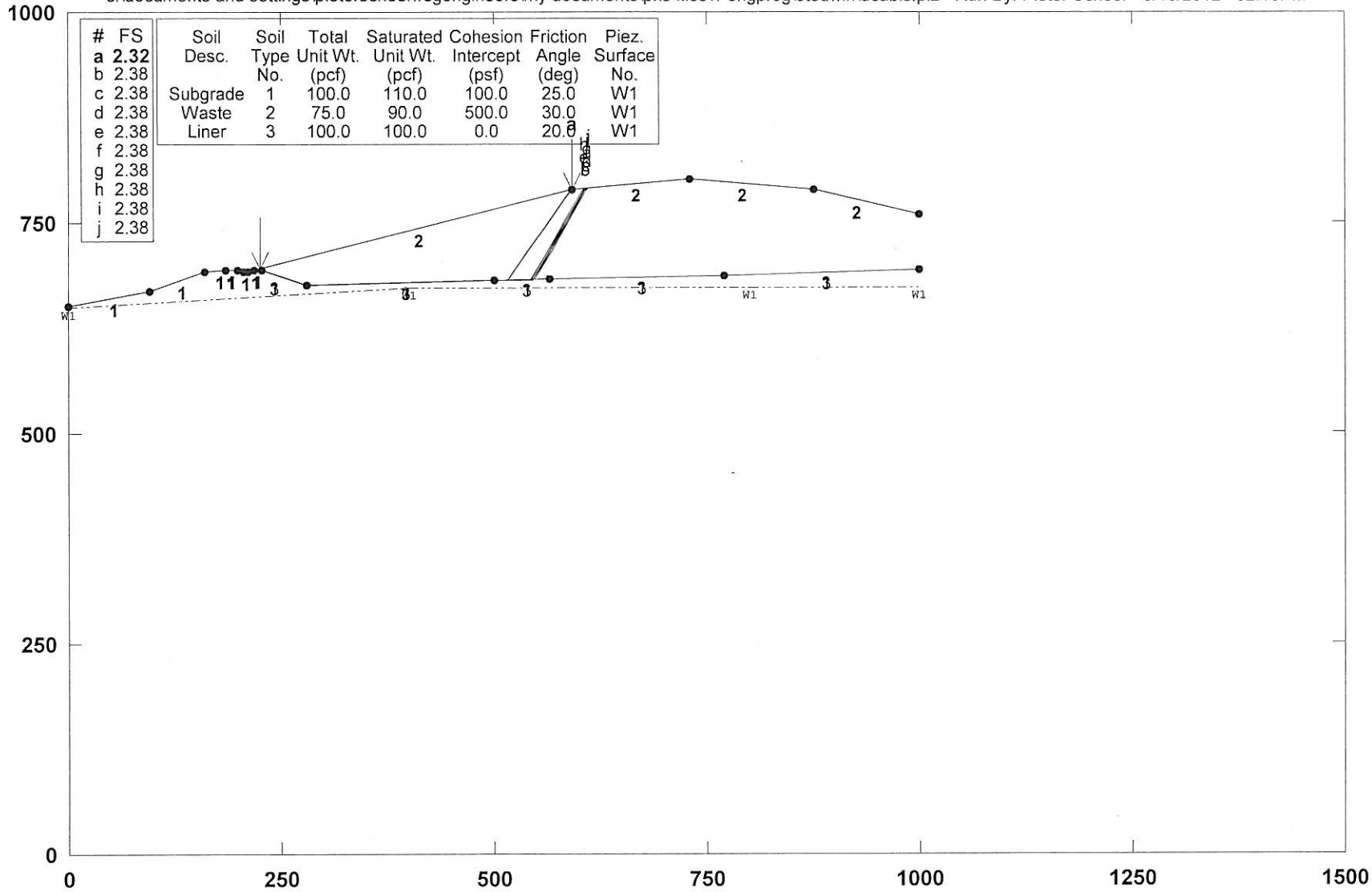

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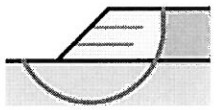
Safety Factors Are Calculated By The Modified Janbu Method

STED



91/16

EXAMPLE OUTPUT: BLOCK SURFACE

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/16/2012
Time of Run: 02:10PM
Run By: Pieter Scheer
Input Data Filename: C:DCABLS.
Output Filename: C:DCABLS.OUT
Unit: ENGLISH
Plotted Output Filename: C:DCABLS.PLT
PROBLEM DESCRIPTION Davidson County MSWLF - Area 2
Section A - Block Liner Static

BOUNDARY COORDINATES
11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	652.00	95.00	670.00	1
2	95.00	670.00	160.00	693.00	1
3	160.00	693.00	185.00	694.50	1
4	185.00	694.50	200.00	694.00	1
5	200.00	694.00	206.00	693.00	1
6	206.00	693.00	212.00	693.00	1
7	212.00	693.00	218.00	694.00	1
8	218.00	694.00	592.00	790.00	2
9	592.00	790.00	730.00	801.00	2
10	730.00	801.00	875.00	790.00	2
11	875.00	790.00	1000.00	760.00	2
12	218.00	694.00	228.00	694.00	1
13	228.00	694.00	280.00	677.00	3
14	280.00	677.00	500.00	681.50	3
15	500.00	681.50	565.00	683.50	3
16	565.00	683.50	770.00	687.50	3
17	770.00	687.50	1000.00	694.00	3
18	228.00	693.80	280.00	676.80	1
19	280.00	676.80	500.00	681.30	1
20	500.00	681.30	565.00	683.30	1
21	565.00	683.30	770.00	687.30	1
22	770.00	687.30	1000.00	693.80	1

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	110.0	100.0	25.0	.00	.0	1
2	75.0	90.0	500.0	30.0	.00	.0	1
3	100.0	100.0	.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	650.00
2	400.00	674.00
3	800.00	674.00
4	1000.00	673.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
The Active And Passive Portions Of The Sliding Surfaces Are Generated According To The Rankine Theory.
100 Trial Surfaces Have Been Generated.
4 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 40.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)

1	228.00	693.90	228.00	693.90	.00
2	280.00	676.90	280.00	676.90	.00
3	500.00	681.40	500.00	681.40	.00
4	500.01	681.40	565.00	683.40	.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	515.98	681.89
7	516.06	681.99
8	539.00	714.76
9	561.94	747.53
10	584.88	780.29
11	591.61	789.90

*** 2.321 ***

Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.0	287.8	.0	.0	.0	.0	.0	.0	.0
2	.1	28.0	.0	.0	.0	.0	.0	.0	.0
3	52.0	69708.5	.0	.0	.0	.0	.0	.0	.0
4	220.0	974044.8	.0	.0	.0	.0	.0	.0	.0
5	16.0	104083.4	.0	.0	.0	.0	.0	.0	.0
6	.1	476.4	.0	.0	.0	.0	.0	.0	.0
7	22.9	129181.5	.0	.0	.0	.0	.0	.0	.0
8	22.9	82933.7	.0	.0	.0	.0	.0	.0	.0
9	22.9	36685.5	.0	.0	.0	.0	.0	.0	.0
10	6.7	1988.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	545.69	682.81
7	545.76	682.91
8	565.76	717.55
9	585.76	752.19
10	605.76	786.83
11	608.34	791.30

*** 2.377 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	544.54	682.77
7	544.62	682.87
8	564.62	717.51
9	584.62	752.15
10	604.62	786.80
11	607.16	791.21

*** 2.377 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	546.45	682.83
7	546.52	682.93
8	566.52	717.57
9	586.52	752.21
10	606.52	786.85
11	609.12	791.36

*** 2.377 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	544.16	682.76
7	544.23	682.86
8	564.23	717.50
9	584.23	752.14
10	604.23	786.78
11	606.77	791.18

*** 2.377 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	547.08	682.85
7	547.15	682.95
8	567.15	717.59
9	587.15	752.23
10	607.15	786.87
11	609.78	791.42

*** 2.377 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	547.21	682.85
7	547.28	682.95
8	567.28	717.60
9	587.28	752.24
10	607.28	786.88
11	609.91	791.43

*** 2.377 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90

4	280.00	676.90
5	500.00	681.40
6	543.40	682.74
7	543.47	682.84
8	563.47	717.48
9	583.47	752.12
10	603.47	786.76
11	605.99	791.11

*** 2.377 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	547.84	682.87
7	547.92	682.97
8	567.92	717.62
9	587.92	752.26
10	607.92	786.90
11	610.56	791.48

*** 2.377 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.82	695.75
2	227.86	694.00
3	228.00	693.90
4	280.00	676.90
5	500.00	681.40
6	548.35	682.89
7	548.42	682.99
8	568.42	717.63
9	588.42	752.27
10	608.42	786.91
11	611.08	791.52

*** 2.377 ***

Davidson County MSWLF - Area 2 Section A - Block Liner Dynamic

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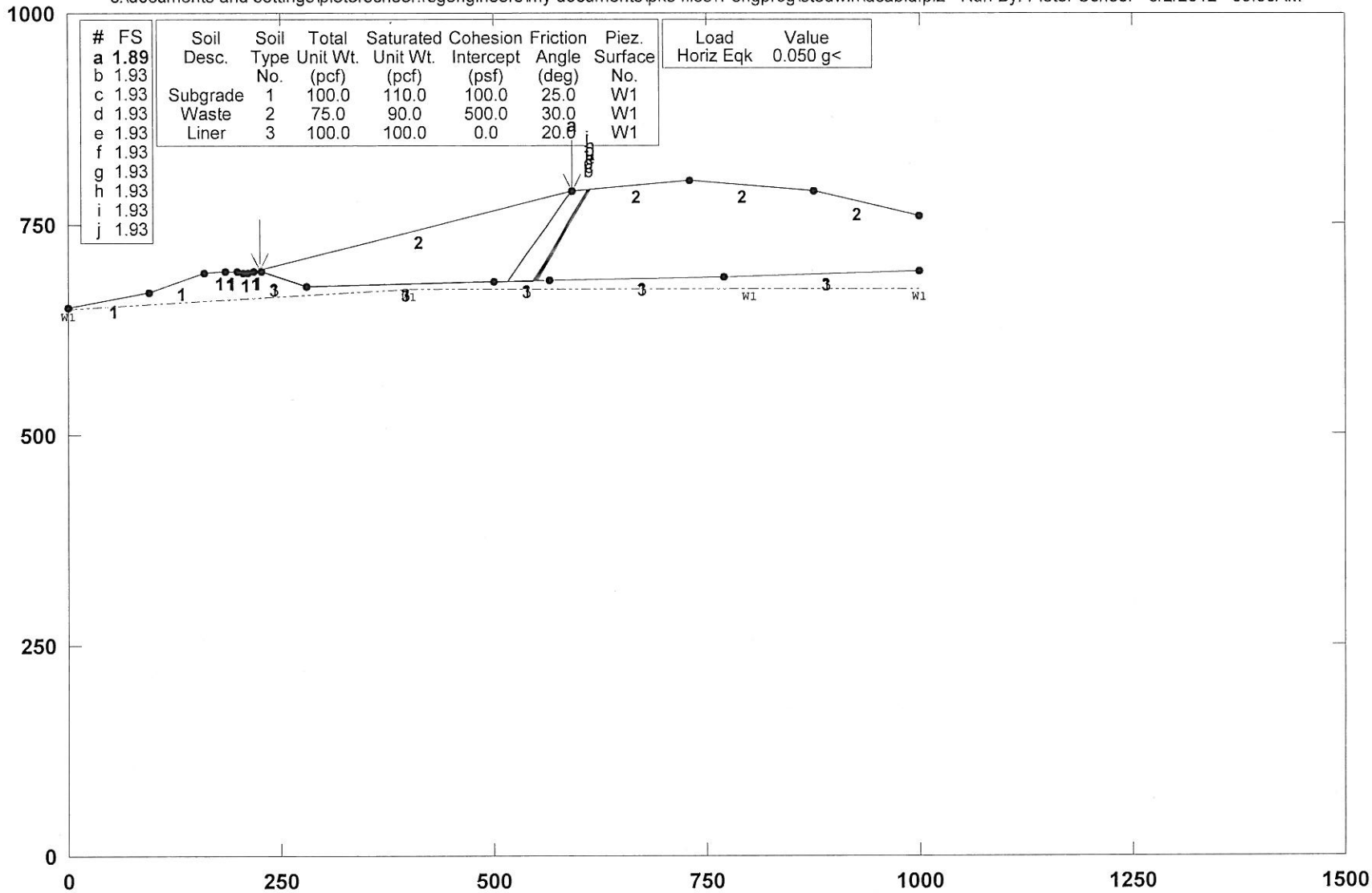

PCSTABL5M/si FSmin=1.89

Safety Factors Are Calculated By The Modified Janbu Method

STED

6/16

Davidson County MSWLF - Area 2 Section A - Circular Global Static

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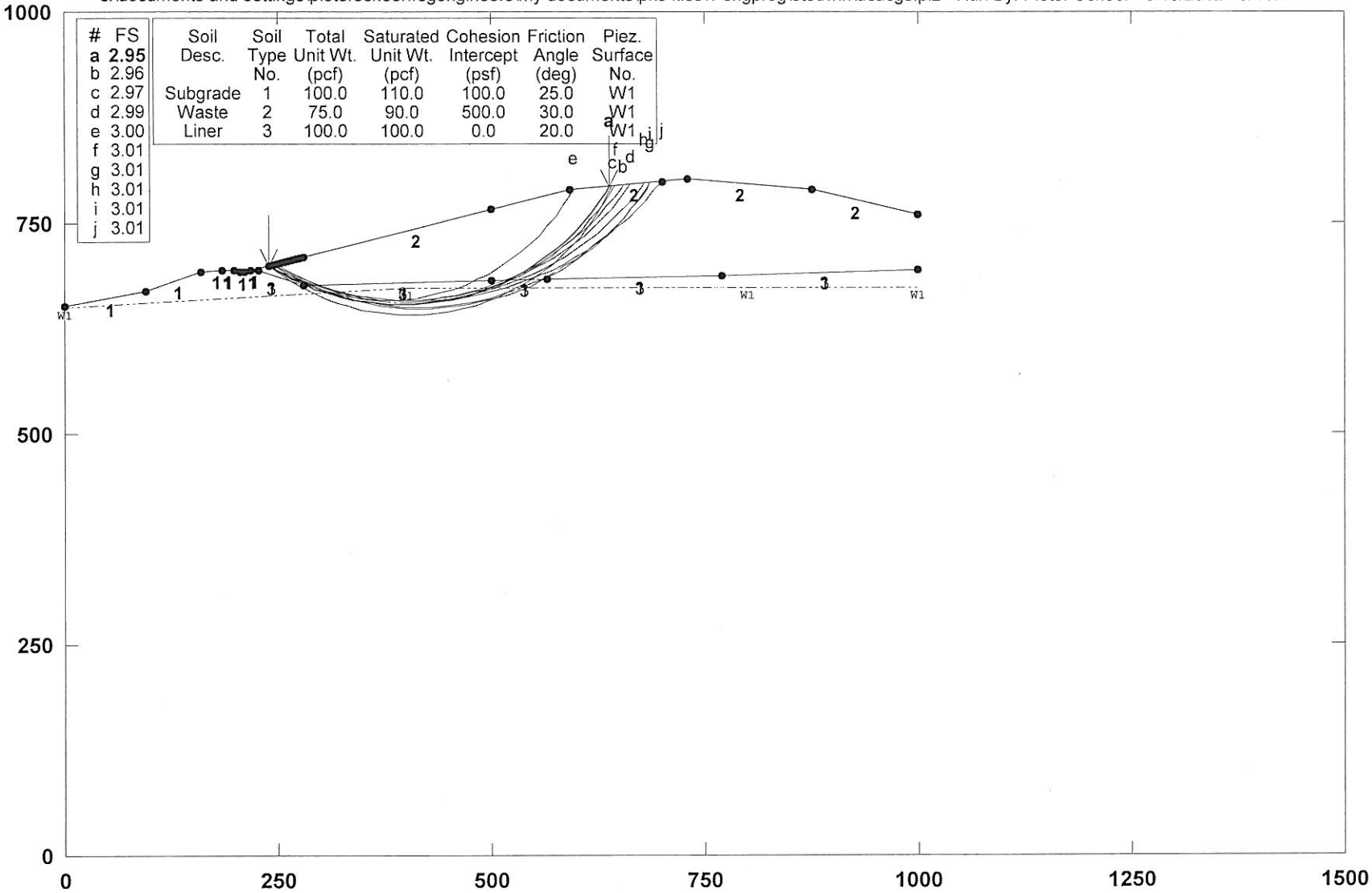

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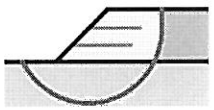
Safety Factors Are Calculated By The Modified Bishop Method

STED



7/16

8/16

EXAMPLE OUTPUT: CIRCULAR SURFACE

```
                    ** PCSTABL5M **
                          by
                   Purdue University
             --Slope Stability Analysis--
          Simplified Janbu, Simplified Bishop
             or Spencer`s Method of Slices
Run Date:                    3/16/2012
Time of Run:                 02:47PM
Run By:                      Pieter Scheer
Input Data Filename:         C:dcacgs.
Output Filename:             C:dcacgs.OUT
Unit:                        ENGLISH
Plotted Output Filename:     C:dcacgs.PLT
PROBLEM DESCRIPTION   Davidson County MSWLF - Area 2
                      Section A - Circular Global Static
BOUNDARY COORDINATES
   11 Top   Boundaries
   22 Total Boundaries
Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1          .00      652.00      95.00     670.00        1
    2        95.00      670.00     160.00     693.00        1
    3       160.00      693.00     185.00     694.50        1
    4       185.00      694.50     200.00     694.00        1
    5       200.00      694.00     206.00     693.00        1
    6       206.00      693.00     212.00     693.00        1
    7       212.00      693.00     218.00     694.00        1
    8       218.00      694.00     592.00     790.00        2
    9       592.00      790.00     730.00     801.00        2
   10       730.00      801.00     875.00     790.00        2
   11       875.00      790.00    1000.00     760.00        2
   12       218.00      694.00     228.00     694.00        1
   13       228.00      694.00     280.00     677.00        3
   14       280.00      677.00     500.00     681.50        3
   15       500.00      681.50     565.00     683.50        3
   16       565.00      683.50     770.00     687.50        3
   17       770.00      687.50    1000.00     694.00        3
   18       228.00      693.80     280.00     676.80        1
   19       280.00      676.80     500.00     681.30        1
   20       500.00      681.30     565.00     683.30        1
   21       565.00      683.30     770.00     687.30        1
   22       770.00      687.30    1000.00     693.80        1
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
  1   100.0    110.0     100.0     25.0     .00        .0      1
  2    75.0     90.0     500.0     30.0     .00        .0      1
  3   100.0    100.0        .0     20.0     .00        .0      1
1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water =  62.40
Piezometric Surface No.  1 Specified by  4 Coordinate Points
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1          .00      650.00
    2        400.00      674.00
    3        800.00      674.00
    4       1000.00      673.00
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
 50 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between  X = 240.00 ft.
                            and   X = 280.00 ft.
Each Surface Terminates Between   X = 500.00 ft.
                            and   X = 700.00 ft.
```

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =640.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	240.00	699.65
2	252.75	691.74
3	265.90	684.52
4	279.41	678.01
5	293.25	672.23
6	307.38	667.20
7	321.76	662.92
8	336.34	659.42
9	351.09	656.69
10	365.97	654.75
11	380.93	653.61
12	395.92	653.27
13	410.91	653.72
14	425.86	654.97
15	440.72	657.01
16	455.45	659.85
17	470.01	663.46
18	484.36	667.84
19	498.45	672.97
20	512.25	678.85
21	525.72	685.46
22	538.81	692.77
23	551.50	700.77
24	563.75	709.43
25	575.52	718.74
26	586.77	728.65
27	597.49	739.15
28	607.63	750.20
29	617.16	761.78
30	626.07	773.85
31	634.32	786.38
32	638.61	793.72

Circle Center At X = 394.9 ; Y = 935.0 and Radius, 281.7
*** 2.946 ***
Individual data on the 40 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.7	5343.6	.0	.0	.0	.0	.0	.0	.0
2	13.1	16248.0	.0	.0	.0	.0	.0	.0	.0
3	13.5	27124.5	.0	.0	.0	.0	.0	.0	.0
4	2.3	5716.5	.0	.0	.0	.0	.0	.0	.0
5	.5	1147.8	.0	.0	.0	.0	.0	.0	.0
6	11.0	31663.8	.0	.0	.0	.0	.0	.0	.0
7	11.1	39168.1	.0	.0	.0	.0	.0	.0	.0
8	3.0	11695.5	.0	123.0	.0	.0	.0	.0	.0
9	14.4	63028.3	.0	3563.5	.0	.0	.0	.0	.0
10	14.6	74478.5	.0	8011.0	.0	.0	.0	.0	.0
11	14.8	84784.8	.0	11744.0	.0	.0	.0	.0	.0
12	14.9	93796.8	.0	14751.9	.0	.0	.0	.0	.0
13	15.0	101388.0	.0	17026.3	.0	.0	.0	.0	.0
14	15.0	107455.9	.0	18560.7	.0	.0	.0	.0	.0
15	4.1	30066.5	.0	5222.5	.0	.0	.0	.0	.0
16	10.9	81825.6	.0	13930.5	.0	.0	.0	.0	.0
17	14.9	114582.2	.0	18396.4	.0	.0	.0	.0	.0
18	14.9	115595.0	.0	16854.9	.0	.0	.0	.0	.0

19	14.7	114943.3	.0	14573.5	.0	.0	.0	.0	.0
20	14.6	112660.3	.0	11558.5	.0	.0	.0	.0	.0
21	14.3	108806.6	.0	7818.7	.0	.0	.0	.0	.0
22	14.1	103468.5	.0	3364.5	.0	.0	.0	.0	.0
23	1.5	11118.2	.0	73.1	.0	.0	.0	.0	.0
24	.9	6136.6	.0	10.7	.0	.0	.0	.0	.0
25	11.4	79798.3	.0	.0	.0	.0	.0	.0	.0
26	6.1	41680.6	.0	.0	.0	.0	.0	.0	.0
27	.4	2911.3	.0	.0	.0	.0	.0	.0	.0
28	6.9	45653.3	.0	.0	.0	.0	.0	.0	.0
29	13.1	84034.1	.0	.0	.0	.0	.0	.0	.0
30	12.7	77282.9	.0	.0	.0	.0	.0	.0	.0
31	12.2	69869.5	.0	.0	.0	.0	.0	.0	.0
32	11.8	61933.9	.0	.0	.0	.0	.0	.0	.0
33	11.3	53624.9	.0	.0	.0	.0	.0	.0	.0
34	5.2	22782.4	.0	.0	.0	.0	.0	.0	.0
35	5.5	22118.7	.0	.0	.0	.0	.0	.0	.0
36	10.1	35104.8	.0	.0	.0	.0	.0	.0	.0
37	9.5	25486.0	.0	.0	.0	.0	.0	.0	.0
38	8.9	16396.2	.0	.0	.0	.0	.0	.0	.0
39	8.3	8003.1	.0	.0	.0	.0	.0	.0	.0
40	4.3	1126.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	240.00	699.65
2	253.19	692.51
3	266.71	686.01
4	280.52	680.16
5	294.60	674.98
6	308.91	670.48
7	323.42	666.68
8	338.09	663.57
9	352.90	661.16
10	367.80	659.47
11	382.77	658.50
12	397.77	658.24
13	412.76	658.70
14	427.72	659.88
15	442.60	661.78
16	457.37	664.38
17	472.00	667.69
18	486.46	671.70
19	500.70	676.39
20	514.71	681.76
21	528.44	687.79
22	541.87	694.48
23	554.96	701.80
24	567.69	709.74
25	580.02	718.28
26	591.93	727.40
27	603.39	737.08
28	614.37	747.30
29	624.85	758.03
30	634.80	769.25
31	644.21	780.93
32	653.04	793.06
33	654.30	794.97

Circle Center At X = 395.6 ; Y = 971.4 and Radius, 313.1

*** 2.955 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	240.00	699.65
2	251.88	690.50
3	264.28	682.04
4	277.14	674.32

5	290.42	667.35
6	304.08	661.16
7	318.08	655.76
8	332.36	651.19
9	346.89	647.44
10	361.60	644.54
11	376.46	642.49
12	391.41	641.29
13	406.41	640.97
14	421.40	641.51
15	436.34	642.91
16	451.16	645.17
17	465.84	648.28
18	480.31	652.23
19	494.53	657.01
20	508.44	662.60
21	522.02	668.99
22	535.20	676.15
23	547.95	684.05
24	560.22	692.68
25	571.97	702.00
26	583.17	711.98
27	593.77	722.59
28	603.75	733.79
29	613.06	745.55
30	621.68	757.83
31	629.57	770.58
32	636.72	783.77
33	641.49	793.95

Circle Center At X = 404.6 ; Y = 901.1 and Radius, 260.1

*** 2.972 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	244.44	700.79
2	257.66	693.69
3	271.19	687.22
4	285.02	681.40
5	299.10	676.23
6	313.41	671.74
7	327.91	667.92
8	342.58	664.78
9	357.38	662.34
10	372.28	660.60
11	387.25	659.57
12	402.24	659.23
13	417.24	659.61
14	432.20	660.69
15	447.09	662.47
16	461.89	664.95
17	476.55	668.12
18	491.04	671.98
19	505.34	676.52
20	519.41	681.73
21	533.21	687.59
22	546.73	694.09
23	559.93	701.23
24	572.77	708.97
25	585.24	717.31
26	597.30	726.23
27	608.92	735.71
28	620.09	745.73
29	630.78	756.25
30	640.95	767.27
31	650.60	778.76
32	659.70	790.69
33	663.14	795.67

Circle Center At X = 401.8 ; Y = 977.9 and Radius, 318.7
*** 2.993 ***
Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	240.00	699.65
2	252.78	691.79
3	266.00	684.71
4	279.63	678.45
5	293.61	673.02
6	307.90	668.44
7	322.43	664.73
8	337.16	661.90
9	352.04	659.97
10	367.00	658.94
11	382.00	658.82
12	396.98	659.60
13	411.89	661.28
14	426.67	663.86
15	441.26	667.32
16	455.62	671.66
17	469.69	676.85
18	483.42	682.89
19	496.77	689.74
20	509.67	697.39
21	522.09	705.80
22	533.98	714.94
23	545.30	724.79
24	556.00	735.29
25	566.05	746.43
26	575.41	758.15
27	584.05	770.42
28	591.93	783.18
29	595.75	790.30

Circle Center At X = 376.6 ; Y = 907.3 and Radius, 248.6
*** 3.002 ***
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	248.89	701.93
2	261.61	693.98
3	274.74	686.73
4	288.24	680.19
5	302.07	674.38
6	316.19	669.33
7	330.57	665.04
8	345.15	661.53
9	359.90	658.81
10	374.78	656.88
11	389.74	655.76
12	404.73	655.43
13	419.73	655.92
14	434.67	657.20
15	449.52	659.29
16	464.24	662.17
17	478.79	665.84
18	493.12	670.29
19	507.18	675.49
20	520.95	681.44
21	534.38	688.13
22	547.43	695.52
23	560.07	703.61
24	572.25	712.36
25	583.94	721.75
26	595.12	731.76
27	605.74	742.35
28	615.78	753.50

29	625.20	765.17
30	633.99	777.32
31	642.11	789.94
32	644.53	794.19

Circle Center At X = 403.2 ; Y = 934.7 and Radius, 279.2

*** 3.007 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	244.44	700.79
2	257.28	693.03
3	270.47	685.88
4	283.98	679.36
5	297.78	673.48
6	311.83	668.24
7	326.12	663.67
8	340.61	659.77
9	355.26	656.56
10	370.04	654.03
11	384.93	652.20
12	399.89	651.06
13	414.88	650.63
14	429.88	650.89
15	444.85	651.86
16	459.75	653.52
17	474.57	655.89
18	489.25	658.94
19	503.78	662.67
20	518.12	667.08
21	532.23	672.15
22	546.10	677.88
23	559.68	684.25
24	572.94	691.25
25	585.87	698.86
26	598.43	707.07
27	610.58	715.85
28	622.32	725.20
29	633.60	735.08
30	644.41	745.48
31	654.73	756.37
32	664.52	767.73
33	673.77	779.54
34	682.45	791.77
35	686.14	797.50

Circle Center At X = 416.7 ; Y = 971.4 and Radius, 320.8

*** 3.008 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	244.44	700.79
2	257.71	693.78
3	271.27	687.37
4	285.11	681.58
5	299.19	676.41
6	313.48	671.87
7	327.97	667.98
8	342.62	664.74
9	357.39	662.16
10	372.27	660.24
11	387.22	658.99
12	402.21	658.41
13	417.21	658.50
14	432.19	659.26
15	447.12	660.69
16	461.97	662.79
17	476.72	665.55
18	491.32	668.97

19	505.76	673.03
20	520.00	677.74
21	534.02	683.08
22	547.78	689.04
23	561.27	695.61
24	574.44	702.78
25	587.29	710.53
26	599.77	718.84
27	611.87	727.71
28	623.56	737.11
29	634.82	747.02
30	645.62	757.43
31	655.95	768.30
32	665.78	779.63
33	675.10	791.39
34	679.10	796.94

Circle Center At X = 407.7 ; Y = 993.5 and Radius, 335.1
*** 3.009 ***
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	244.44	700.79
2	257.16	692.83
3	270.24	685.49
4	283.66	678.78
5	297.37	672.71
6	311.36	667.30
7	325.60	662.56
8	340.04	658.51
9	354.66	655.15
10	369.42	652.48
11	384.29	650.52
12	399.24	649.27
13	414.23	648.73
14	429.23	648.91
15	444.20	649.79
16	459.11	651.39
17	473.94	653.70
18	488.63	656.71
19	503.17	660.41
20	517.51	664.80
21	531.63	669.87
22	545.49	675.60
23	559.06	681.99
24	572.32	689.01
25	585.22	696.65
26	597.75	704.90
27	609.87	713.74
28	621.56	723.14
29	632.78	733.09
30	643.52	743.56
31	653.76	754.53
32	663.45	765.98
33	672.60	777.87
34	681.16	790.18
35	685.74	797.47

Circle Center At X = 418.1 ; Y = 964.1 and Radius, 315.4
*** 3.009 ***
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	240.00	699.65
2	253.41	692.92
3	267.08	686.75
4	280.99	681.14
5	295.12	676.11
6	309.45	671.66

7	323.94	667.81
8	338.59	664.55
9	353.35	661.90
10	368.21	659.86
11	383.14	658.43
12	398.12	657.61
13	413.12	657.41
14	428.11	657.82
15	443.08	658.85
16	457.99	660.50
17	472.82	662.75
18	487.54	665.61
19	502.14	669.07
20	516.58	673.13
21	530.84	677.78
22	544.90	683.01
23	558.73	688.82
24	572.31	695.18
25	585.62	702.10
26	598.63	709.56
27	611.33	717.55
28	623.69	726.05
29	635.69	735.05
30	647.30	744.54
31	658.52	754.50
32	669.32	764.90
33	679.69	775.75
34	689.60	787.01
35	698.93	798.52

Circle Center At X = 410.5 ; Y = 1022.7 and Radius, 365.3

*** 3.011 ***

Davidson County MSWLF - Area 2 Section A - Circular Global Dynamic

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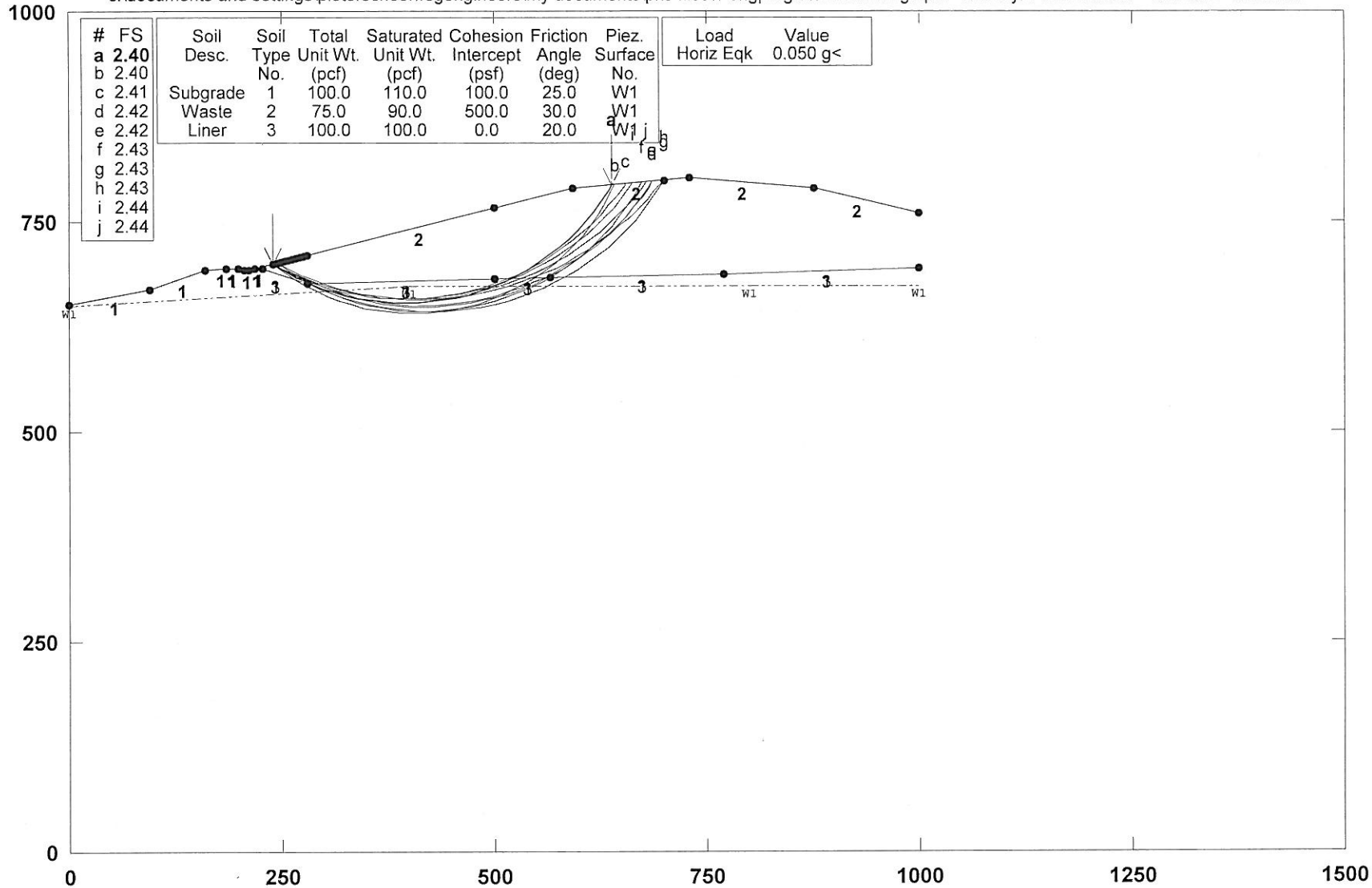

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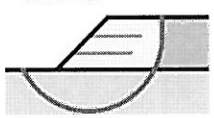
Safety Factors Are Calculated By The Modified Bishop Method

STED



16/16

Appendix B

Protective Cover Veneer
Stability Evaluation

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Objective To determine the interface shear strength requirements for the liner/leachate collection system/protective cover veneer to satisfy the required factor(s) of safety against sliding.

Reference Matasovic, N. (1991), "Selection of Method for Seismic Slope Stability Analysis," Proc. 2nd International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, St. Louis, Vol. 2, pp.1057-1062.

Requirements FS_{min}(Static) = 1.5
FS_{min}(Seismic) = 1.0 (If Applicable)

Analysis 1. Treat the protective cover as an infinite slope and use the following equation:

$$FS = \frac{\dfrac{c}{\gamma_c z_c \cos^2\beta} + \tan\phi\left[1 - \dfrac{\gamma_w\left(z_c - d_w\right)}{\gamma_c z_c}\right] - k_s\left(\tan\beta\right)\left(\tan\phi\right)}{k_s + \tan\beta}$$ (Matasovic, 1991)

where:

FS	=	factor of safety against shallow veneer failure
k_s	=	seismic coefficient (= 0 for static conditions) (= peak ground acceleration for seismic conditions)
γ_c	=	unit weight of protective cover material(s) (pcf)
γ_w	=	unit weight of water (62.4 pcf) (pcf)
c	=	cohesion/adhesion along assumed failure surface (psf)
ϕ	=	interface friction angle along assumed failure surface (degrees)
z_c	=	depth of protective cover (depth to failure surface) (ft)
d_w	=	depth to seepage surface (assumed parallel to slope) (ft) (= z if slope is dry)
β	=	slope angle of protective cover (degrees).

2. Determine minimum interface shear strength as follows:

$$\tau = \sigma \tan\phi + c$$

where:

τ	=	interface shear strength (lbs)
σ	=	normal load (psf)
ϕ	=	interface friction angle (min. value from analysis or greater)
c	=	cohesion/adhesion (min. value from analysis or greater)

STABILITY PROCVR.WPD

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Raleigh, NC 27603 Fax: 919-828-3899

SHEET:	2/2
JOB #:	DAVDCO-10-5
DATE:	3/2/12
BY:	PKS
CHKD BY:	LAQ

Davidson County MSW Landfill - Phase 2
Protective Cover Veneer Stability Evaluation

Input Parameters:

	Side Slope Angle (β):	18.4	degrees	(3H:1V Slopes)
Protective Cover:	Thickness (z_c):	2	ft	
	Unit Weight (γ_c):	110	pcf	
	Cohesion (c):	0	psf	
	Depth to Seepage (d_w):	2	ft	(= z if Slope is Dry)
	Seismic Coefficient (k_s):	0	Static Conditions	
		0.10	Seismic Conditions	(= Peak Ground Acceleration For The Site)

Required Factors of Safety:

Static:	1.5
Dynamic:	1.0

Static Conditions:

Interface Friction Angle (ϕ) (degrees)	Resisting Force	Driving Force	FS	Comment
24	0.45	0.33	1.34	**NO GOOD**
25	0.47	0.33	1.40	**NO GOOD**
26	0.49	0.33	1.47	**NO GOOD**
26.6	0.50	0.33	1.51	**OK**
27	0.51	0.33	1.53	**OK**
28	0.53	0.33	1.60	**OK**

Seismic Conditions:

Interface Friction Angle (ϕ) (degrees)	Resisting Force	Driving Force	FS	Comment
24	0.43	0.43	0.99	**NO GOOD**
25	0.45	0.43	1.04	**OK**
26	0.47	0.43	1.09	**OK**
26.6	0.48	0.43	1.12	**OK**
27	0.49	0.43	1.14	**OK**
28	0.51	0.43	1.19	**OK**

Minimum Interface Shear Strength Requirements:

Cohesion (c) (From Above) =	0	psf	
Interface Friction Angle (ϕ) =	26.6	degrees	(Use Min. Value From Above or Greater)

Normal Load (psf)	Interface Shear Strength (psf)
100	50
200	100
500	250

Appendix C

Final Cover Veneer
Stability Evaluation

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PROJECT Davidson County MSWLF - Phase 2 - Area 2

SUBJECT Final Cover Veneer Stability Evaluation

JOB NO. DAVDCO-10-5
DATE 3/2/12
COMPUTED BY PKS
CHECKED BY LAQ

Objective To determine the interface shear strength requirements for the final cover system veneer to satisfy the required factor(s) of safety against sliding.

Reference Matasovic, N. (1991), "Selection of Method for Seismic Slope Stability Analysis," Proc. 2nd International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, St. Louis, Vol. 2, pp.1057-1062.

Requirements FS_{min}(Static) = 1.5
FS_{min}(Seismic) = 1.0 (If Applicable)

Analysis 1. Treat the final cover as an infinite slope and use the following equation:

$$FS = \frac{\dfrac{c}{\gamma_c z_c \cos^2\beta} + \tan\phi\left[1 - \dfrac{\gamma_w\left(z_c - d_w\right)}{\gamma_c z_c}\right] - k_s\left(\tan\beta\right)\left(\tan\phi\right)}{k_s + \tan\beta}$$ (Matasovic, 1991)

where:

FS	=	factor of safety against shallow veneer failure
k_s	=	seismic coefficient (= 0 for static conditions) (= peak ground acceleration for seismic conditions)
γ_c	=	unit weight of final cover material(s) (pcf)
γ_w	=	unit weight of water (62.4 pcf) (pcf)
c	=	cohesion/adhesion along assumed failure surface (psf)
ϕ	=	interface friction angle along assumed failure surface (degrees)
z_c	=	depth of final cover (depth to failure surface) (ft)
d_w	=	depth to seepage surface (assumed parallel to slope) (ft) (= z if slope is dry)
β	=	slope angle of final cover (degrees)\

$$u = \gamma_w\left(z_c - d_w\right)$$

*Note: Based on an allowable LFG pressure of 6 inch-w.c. (= 31.2 psf), the use of a depth to seepage of 1.5 feet or less (for evaluation of interfaces above the geomembrane) will satisfy the evaluation for LFG pressure against the bottom of the geomembrane as well.

2. Determine minimum interface shear strength as follows:

$$\tau = \sigma \tan\phi + c$$

where:

τ	=	interface shear strength (lbs)
σ	=	normal load (psf)
ϕ	=	interface friction angle (min. value from analysis or greater)
c	=	cohesion/adhesion (min. value from analysis or greater)

STABILITY FCS.WPD

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SHEET:	2/2
JOB #:	DAVDCO-10-5
DATE:	3/2/12
BY:	PKS
CHKD BY:	LAQ

Davidson County MSW Landfill - Phase 2
Final Cover Veneer Stability Evaluation

Input Parameters:

	Side Slope Angle (β):	14.0	degrees	(4H:1V Slopes)
Final Cover:	Thickness (z_c):	2	ft	
	Unit Weight (γ_c):	110	pcf	
	Cohesion (c):	0	psf	
	Depth to Seepage (d_w):	1.5	ft	(= z if Slope is Dry)
	Seismic Coefficient (k_s):	0	Static Conditions	
		0.10	Seismic Conditions	(= Peak Ground Acceleration For The Site)

Required Factors of Safety:

Static:	1.5
Dynamic:	1.0

Static Conditions:

Interface Friction Angle (ϕ) (degrees)	Resisting Force	Driving Force	FS	Comment
23	0.36	0.25	1.46	**NO GOOD**
23	0.36	0.25	1.46	**NO GOOD**
24	0.38	0.25	1.53	**OK**
25	0.40	0.25	1.61	**OK**
26	0.42	0.25	1.68	**OK**
27	0.44	0.25	1.75	**OK**

Seismic Conditions:

Interface Friction Angle (ϕ) (degrees)	Resisting Force	Driving Force	FS	Comment
23	0.35	0.35	1.01	**OK**
24	0.37	0.35	1.06	**OK**
25	0.39	0.35	1.11	**OK**
26	0.41	0.35	1.16	**OK**
27	0.42	0.35	1.22	**OK**
28	0.44	0.35	1.27	**OK**

Minimum Interface Shear Strength Requirements:

Cohesion (c) (From Above) =	0	psf	
Interface Friction Angle (ϕ) =	24	degrees	(Use Min. Value From Above or Greater)

Normal Load (psf)	Interface Shear Strength (psf)
100	45
200	89
500	223

Appendix D

Foundation Settlement
Evaluation

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Objective To estimate the total and differential foundation settlements due to the weight of the planned waste and embankment loads. The resulting post-settlement slopes are evaluated to ensure that 1) positive drainage is maintained toward collection piping and/or sumps and 2) the maximum tensile strains in the liner system do not exceed allowable values.

References

Holtz, R.D., & Kovacs, W.D. (1981), An Introduction To Geotechnical Engineering, Prentice-Hall, Englewood Cliffs, NJ, Chapters 8 and 9.

Ohio EPA - Geotechnical Resource Group (2004), "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities", Ohio EPA, Columbus, Ohio, Chapter 6.

Quian, X., Koerner, R.M., & Gray, D.H. (2001), Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, Upper Saddle River, N.J., pp. 310, 469-473.

Assumptions

1. Vertical stresses acting on the liner are assumed to be one-dimensional (1-D).
2. Assumptions for soil properties are listed in the attached spreadsheet.

Analysis The following approach is used to perform the evaluation:

1. Identify the critical cross section(s) to be evaluated (maximum waste fill, minimum liner slopes, etc.).
2. Select points along each cross section to perform calculations (points of grade breaks in final cover and/or liner system).
3. For each calculation point, determine the subsurface profile beneath the liner system and separate into distinct layers (thickness and material properties) (Include structural fill where applicable).
4. For each calculation point, determine the stresses acting on the midpoint of each layer both before and after liner construction.
5. For each calculation point, determine the stress change at the liner. Take into account the stress decrease due to excavation (where applicable) and the stress increase due to waste loads.
6. Calculate elastic settlements for each granular soil layer using the equations below.
7. Calculate consolidation (primary and secondary) settlements for each clay/silt soil layer using the equations below.
8. Calculate total settlements at each calculation point and resulting post-settlement slopes and liner strain between each point. Verify that slopes meet or exceed the minimum allowable slope. Verify that tensile strains do not exceed allowable values.

SETTLEMENT 1D.WPD

Calculations

- Elastic Settlement Equation:

$$S_e = \frac{\Delta p}{M_S} H$$

where:
S_e = elastic settlement (ft)
Δp = net stress change acting on middle of soil layer (psf)
Ms = constrained modulus of soil (psf)

$$M_S = \frac{E_S(1-\upsilon_S)}{(1+\upsilon_S)(1-2\upsilon_S)}$$

Es = elastic modulus of soil (psf)
v_s = Poisson's ratio of soil
H = initial thickness of soil layer (ft).

- Primary Consolidation Settlement Equations:

$for\ p'_O + \Delta p \geq p'_{mp}$

$$S_C = H\left(C_{r\varepsilon} \log \frac{p'_{mp}}{p'_o} + C_{c\varepsilon} \log \frac{p'_o + \Delta p}{p'_{mp}} \right)$$

$for\ p'_O + \Delta p < p'_{mp}$

$$S_C = H\left(C_{r\varepsilon} \log \frac{p'_o + \Delta p}{p'_o} \right)$$

where:
S_C = primary consolidation settlement (ft)
H = initial thickness of soil layer (ft)
p'_{mp} = maximum past consolidation pressure (psf)
p'_o = effective vertical stress in middle of soil layer afer excavation, but before loading (psf)
Δp = net stress change acting on middle of soil layer (psf).
$C_{r\varepsilon}$ = modified recompression index

$$C_{r\varepsilon} = \frac{C_r}{1+e_o}$$

$C_{c\varepsilon}$ = modified primary compression index

$$C_{c\varepsilon} = \frac{C_c}{1 + e_o}$$

C_r = recompression index
C_c = primary compression index
e_O = initial void ratio

- Secondary Consolidation Settlement Equation:

$$S_s = C_{s\varepsilon} H \log \frac{t_s}{t_{pf}}$$

where:
S_s = secondary consolidation settlement (ft)
$C_{s\varepsilon}$ = modified secondary compression index
H = initial thickness of soil layer (ft)
t_s = time over which secondary settlement is to be calculated (typ. this is a max. of 100 years plus the max. time to complete primary consolidation)
t_{pf} = time to complete primary consolidation

$$t_{pf} = \frac{T_V * H_t^2}{C_V}$$

T_V = dimensionless time factor associated with the time it takes for primary consolidation settlement to be completed

$$For U < 60\%: \; T_V = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$$

$$For U \geq 60\%: \; T_V = 1.781 - 0.933 \log(100 - U\%)$$

H_t = maximum length of drainage in the consolidating layer (= H for single-drained; = 0.5H for double-drained)
C_V = coefficient of consolidation (ft^2/year)
U = percent of primary consolidation (%) (typ. max. is 99.999; results in T_V = 4.58).

- Total Settlement Equation:

$$S_{Total} = S_e + S_c + S_s$$

where:
S_{Total} = total settlement (ft)
Se = elastic settlement (ft)
S_C = primary consolidation settlement (ft)
S_s = secondary consolidation settlement (ft).

- Liner Strain Equation:

$$E_T = \frac{L_f - L_o}{L_o} \text{x}100$$

where:

E_T = total strain (%) ("+" = tension; "-" = compression)

L_o = original distance separating two adjacent calculation points (ft)

L_f = final distance separating two adjacent calculation points after settlement is complete (ft).

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SHEET: 5/10
JOB #: DAVDCO-10-5
DATE: 3/16/12
BY: PKS
CHKD BY: LAQ

Davidson County MSW Landfill - Phase 2 - Area 2
Settlement Analysis - Points 1-5

Soils Information: (Note: When elastic or consolidation settlement is not applicable to a particular layer, enter "NA" for requested parameters.)

Soil Layer	Description	Dry Unit Wt. (pcf)	Natural Moisture Content (%)	Wet Unit Wt. (pcf)	Elastic Settlement Parameters			Consolidation Settlement Parameters			
					E_s (psf)	ν_s	M_s (psf)	OCR	$C_{c\varepsilon}$	$C_{r\varepsilon}$	$C_{s\varepsilon}$
1	Structural Fill	105.0	15.0	120.8	NA	NA	NA	NA	NA	NA	NA
2	Silty Clay & Clayey Silt (Med. To V. Hard)*	108.7	18.1	128.4	NA	NA	NA	2	0.10	0.020	0.002
3	Partially Weathered Rock (PWR)	120.0	10.0	132.0	2,160,000	0.30	2,907,692	NA	NA	NA	NA
4											
5											
6											
7											
8											
9											
10											

Waste Information:

Average Unit Weight, γ_{Waste} (pcf) = 70

Assumptions:

Subsurface Soil Parameters:

*Silty Clay & Clayey Silt Parameters are Based on Shelby Tube Sample Collected from PZ-12.

Dry Unit Weight (pcf): 108.7 (from PZ-12)
Natural moisture content (%), w_n: 18.1 (from PZ-12)
OCR: 2.0 (based on consolidation test and overburden, OCR of 3 could be estimated; thus, 2 is conservative)
Modified primary compression index (dimensionless), $C_{c\varepsilon}$: 0.1 (from consolidation test)
Modified recompression Index (dimensionless), $C_{r\varepsilon}$: 0.02 (from consolidation test)
Modified secondary compression index (dim'less), $C_{s\varepsilon}$: 0.002 (assume as w_n x 0.0001, w_n = 18%)

PWR Parameters:

E_s (PWR): 15,000 Assumed
Poisson's Ratio (PWR): 0.3 Assumed

SHEET:	6/10
JOB #:	DAVDCO-10-5
DATE:	3/16/12
BY:	PKS
CHKD BY:	LAQ

Settlement Points - Location Information:

	Top Berm	Toe	B-35									
	Point											
Parameter	1	2	3	4	5	6	7	8	9	10	11	12
Position:	0	65	325	625	815							
Original Ground Surface Elevation (ft) =	695.0	698.0	700.0	700.0	700.0							
Avg. Unit Wt. of Soil Excavated (pcf) =	110.0	110.0	110.0	110.0	110.0							
Top of Landfill Elevation (ft) =	702.0	720.0	777.0	796.0	772.0							
Top of Liner Elevation (ft) =	700.0	680.5	683.0	688.0	692.5							
Top of Groundwater Elevation (ft) =	663.0	667.0	676.0	675.0	673.0							
Layer 1: Thickness (ft) =	20.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	690.0	680.5	683.0	688.0	692.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	604	1,925	1,870	1,320	825							
p'_{mp} at Mid Point (psf) =	NA	NA	NA	NA	NA							
(After Liner Construct.) p'_o at Mid Point (psf) =	1,208	0	0	0	0							
Layer 2: Thickness (ft) =	10.0	10.0	55.0	10.0	10.0							
Elevation of Mid Point (ft) =	675.0	675.5	655.5	683.0	687.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	2,453	2,567	4,121	1,962	1,467							
p'_{mp} at Mid Point (psf) =	4,906	5,134	8,242	3,924	2,934							
(After Liner Construct.) p'_o at Mid Point (psf) =	3,057	642	2,251	642	642							
Layer 3: Thickness (ft) =	36.0	36.0	10.0	6.0	10.0							
Elevation of Mid Point (ft) =	652.0	652.5	623.0	675.0	677.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	4,785	4,680	6,283	3,000	2,769							
p'_{mp} at Mid Point (psf) =	NA	NA	NA	NA	NA							
(After Liner Construct.) p'_o at Mid Point (psf) =	5,388	2,755	4,413	1,680	1,944							
Layer 4: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							
Layer 5: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							
Layer 6: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							
Layer 7: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							
Layer 8: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							
Layer 9: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							
Layer 10: Thickness (ft) =	0.0	0.0	0.0	0.0	0.0							
Elevation of Mid Point (ft) =	634.0	634.5	618.0	672.0	672.5							
(Before Liner Construct.) p'_o at Mid Point (psf) =	6,037	5,933	6,631	3,209	3,398							
p'_{mp} at Mid Point (psf) =	0	0	0	0	0							
(After Liner Construct.) p'_o at Mid Point (psf) =	6,641	4,008	4,761	1,889	2,573							

SHEET:	7/10
JOB #:	DAVDCO-10-5
DATE:	3/16/12
BY:	PKS
CHKD BY:	LAQ

Stress Change, Δp, at Liner:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Stress Decrease From Excavation (psf) =	0	1,925	1,870	1,320	825							
Stress Increase From Waste Load (psf) =	140	2,765	6,580	7,560	5,565							
Net Stress Increase/Decrease, Δ_p (psf) =	140	840	4,710	6,240	4,740							

Elastic Settlement:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Elastic Settlement (ft):												
Layer 1: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 2: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 3: S_e =	**0.00**	**0.01**	**0.02**	**0.01**	**0.02**							
Layer 4: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 5: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 6: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 7: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 8: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 9: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 10: S_e =	**NA**	**NA**	**NA**	**NA**	**NA**							
Total Elastic Settlement (ft) =	**0.00**	**0.01**	**0.02**	**0.01**	**0.02**							

Elastic Settlement Equation:

$$Se = \frac{\Delta p}{M_S} H$$

Primary Consolidation Settlement:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Primary Consolidation Settlement (ft):												
Layer 1: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 2: S_c =	**0.00**	**0.00**	**0.00**	**0.40**	**0.40**							
	R	R	R	C	C							
Layer 3: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 4: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 5: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 6: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 7: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 8: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 9: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Layer 10: S_c =	**NA**	**NA**	**NA**	**NA**	**NA**							
	---	---	---	---	---							
Total Primary Consol. Settlement (ft) =	**0.00**	**0.00**	**0.00**	**0.40**	**0.40**							

Primary Consolidation Settlement Equations:

For primary recompression and compression (designated C):

$$S_C = H\left(C_{r\varepsilon}\log\frac{p'_{mp}}{p'_o} + C_{c\varepsilon}\log\frac{p'_o+\Delta p}{p'_{mp}}\right)$$

For primary recompression only (designated R):

$$S_C = H\left(C_{r\varepsilon}\log\frac{p'_o+\Delta p}{p'_o}\right)$$

SHEET:	8/10
JOB #:	DAVDCO-10-5
DATE:	3/16/12
BY:	PKS
CHKD BY:	LAQ

Secondary Consolidation Settlement:

Assumed % Primary Consolidation (U) = 99.999 **(Max. = 99.999)**
T_v (dimensionless) = 4.58
$t_s = t_{pf}$ + "X" (years) = 100

Parameter		Point 1	2	3	4	5	6	7	8	9	10	11	12
Secondary Consolidation Settlement (ft):													
Layer 1:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	20.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.000	0.000	0.000	0.000	0.000							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 2:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	10.0	10.0	55.0	10.0	10.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	2.5	2.5	75.9	2.5	2.5							
	S_s =	**0.03**	**0.03**	**0.04**	**0.03**	**0.03**							
Layer 3:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	36.0	36.0	10.0	6.0	10.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	32.5	32.5	2.5	0.9	2.5							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 4:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 5:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 6:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 7:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 8:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.050	0.050	0.050	0.050	0.050							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 9:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.000	0.000	0.000	0.000	0.000							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Layer 10:	Drainage* =	1	1	1	1	1							
	H_t (ft) =	0.0	0.0	0.0	0.0	0.0							
	C_v (in^2/min) =	0.000	0.000	0.000	0.000	0.000							
	t_{pf} (years) =	0.0	0.0	0.0	0.0	0.0							
	S_s =	**NA**	**NA**	**NA**	**NA**	**NA**							
Total Sec. Consol. Settlement (ft) =		**0.03**	**0.03**	**0.04**	**0.03**	**0.03**							

* Single-Drained = 1; Double-Drained = 2

Secondary Consolidation Settlement Equation:

$$S_s = C_{s\varepsilon} H \log \frac{t_s}{t_{pf}}$$

SHEET:	9/10
JOB #:	DAVDCO-10-5
DATE:	3/16/12
BY:	PKS
CHKD BY:	LAQ

Total Settlement:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Total Settlement (ft):												
Layer 1: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 2: S_{Total} =	**0.03**	**0.03**	**0.04**	**0.43**	**0.43**							
Layer 3: S_{Total} =	**0.00**	**0.01**	**0.02**	**0.01**	**0.02**							
Layer 4: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 5: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 6: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 7: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 8: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 9: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Layer 10: S_{Total} =	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**							
Total Settlement (ft) =	**0.03**	**0.04**	**0.06**	**0.45**	**0.44**							

Total Settlement Equation:

$$S_{Total} = S_e + S_c + S_s$$

Liner Slopes & Liner Strain:

Min. Post-Settlement Liner Slope (%) = 0.5 **(Min. Along Drainage Path)**
Max. Liner Strain (%) = 0.5 **(Assumed Max. Tensile Strain in Compacted Clay Liner)**

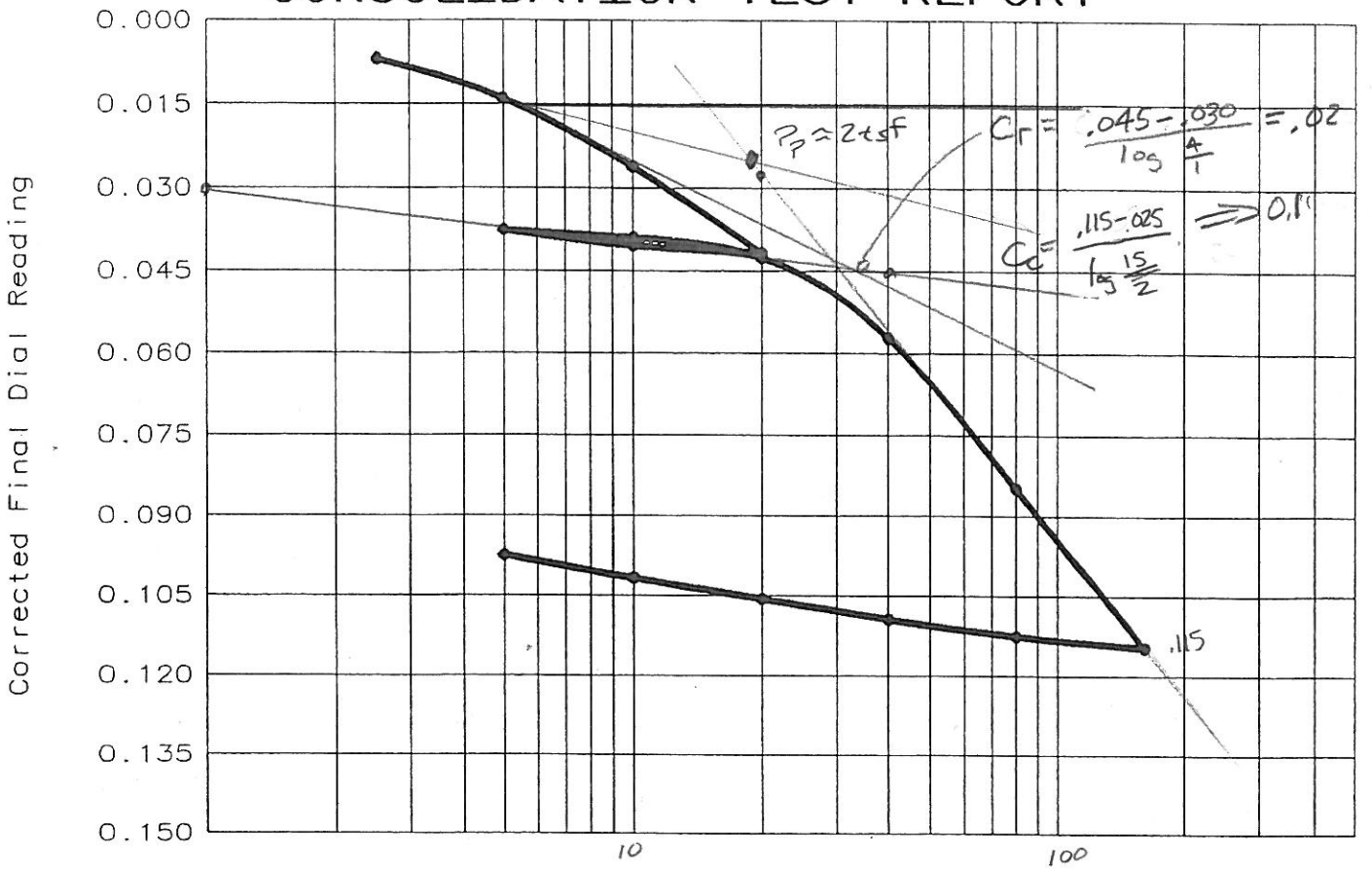
Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Position:	0	65	325	625	815							
Before Settlement:												
Top of Liner Elevation (ft) =	700.0	680.5	683.0	688.0	692.5							
Slope of Liner (%) (+ up;- down)=	-----	-30.0	1.0	1.7	2.4							
Length Along Liner (L_o) Bet. Points (ft) =	-----	67.862	260.012	300.042	190.053							
After Settlement:												
Top of Liner Elevation (ft) =	700.0	680.5	682.9	687.6	692.1							
Slope of Liner (%) (+ up; - down)=	**-----**	**-30.0**	**1.0**	**1.5**	**2.4**							
Slope Change (%) (+ steeper; - flatter)=	-----	0.0	0.0	-0.1	0.0							
Length Along Liner (L_f) Bet. Points (ft) =	-----	67.865	260.012	300.035	190.053							
Liner Strain (E_T) (%) (+ tension; - comp.)=	**-----**	**0.00**	**0.00**	**0.00**	**0.00**							
Comments:												
Liner Slope:	**-----**	**O.K.**	**O.K.**	**O.K.**	**O.K.**							
Liner Strain:	**-----**	**O.K.**	**O.K.**	**O.K.**	**O.K.**							

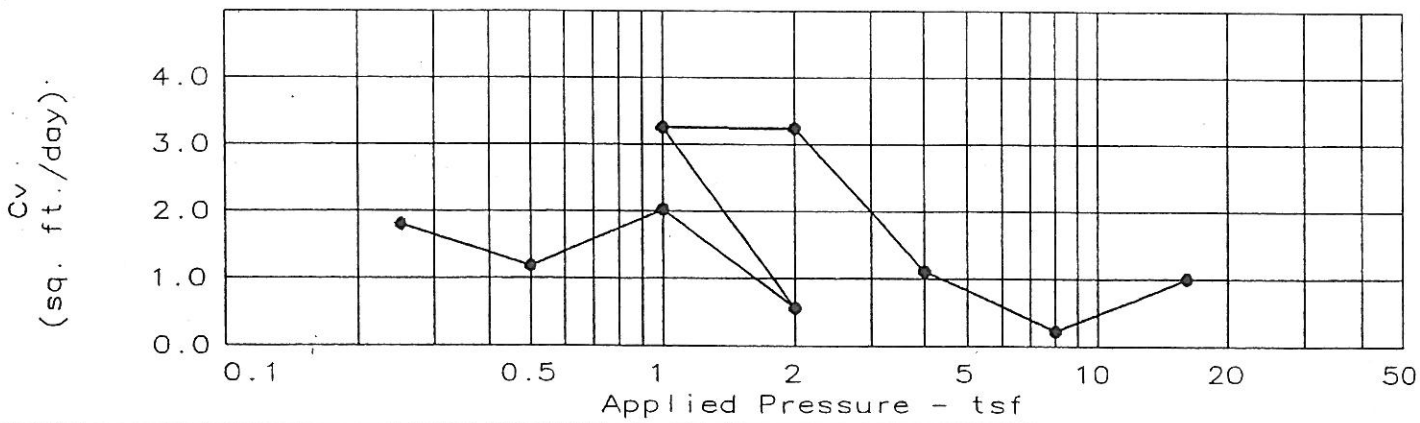
Liner Strain Equation:

$$E_T = \frac{L_f - L_o}{L_o} \text{x} 100$$

Slope is acceptable for Points 3 and 4 as slope between Points 2 through 4 is a cross slope (i.e. > 2% slope exists in different direction)

CONSOLIDATION TEST REPORT





Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Initial void ratio
91.8 %	18.1 %	108.7	29	NP	2.650	0.5226

TEST RESULTS	MATERIAL DESCRIPTION
	Gray silty sand Class: SM
Project No.: 00-793D Project: Davidson County Landfill Location: PZ-12 @ 5.0-7.0 ft. Date: 12-20-00	Remarks: Tested by R.M. Checked by JMR
CONSOLIDATION TEST REPORT ENGINEERING TECTONICS	Undisturbed sample Fig. No. 15

Appendix E

Bearing Capacity
Evaluation

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PROJECT Davidson County MSWLF - Phase 2 - Area 2

SUBJECT Bearing Capacity Analysis

JOB NO. DAVDCO-10-5
DATE 3/2/12
COMPUTED BY PKS
CHECKED BY LAQ

Objective To evaluate the bearing capacity of the subgrade materials beneath the landfill footprint and the bearing capacity of the leachate collection system (LCS) and the protective cover under anticipated construction and operations equipment loads. The evaluation of the equipment loads also demonstrates the required separation between equipment and the underlying geomembrane(s).

Reference Naval Facilities Engineering Command (NAVFAC) (1986), Foundations & Earth Structures - Design Manual 7.02 Alexandria, VA, Change 1, September 1986, p. 7.2-131.

Analysis Use bearing capacity equations as presented in NAVFAC DM 7.02 (see attached).

Requirements FS_{min} (Overall) = 3.0; FS_{min} (LCS/Protective Cover) = 2.0.

Assumptions

1. General shear failure mode controls.
2. For the overall bearing capacity of the landfill, the landfill footprint is simplified as a rectangle.
3. For the evaluation of equipment loads, the stress is distributed at depth based on 2V:1H (2:1 approximation).
4. Tracked equipment are modeled as rectangular loads; wheeled equipment are modeled as circular loads.

BEARING CAPACITY.WPD

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

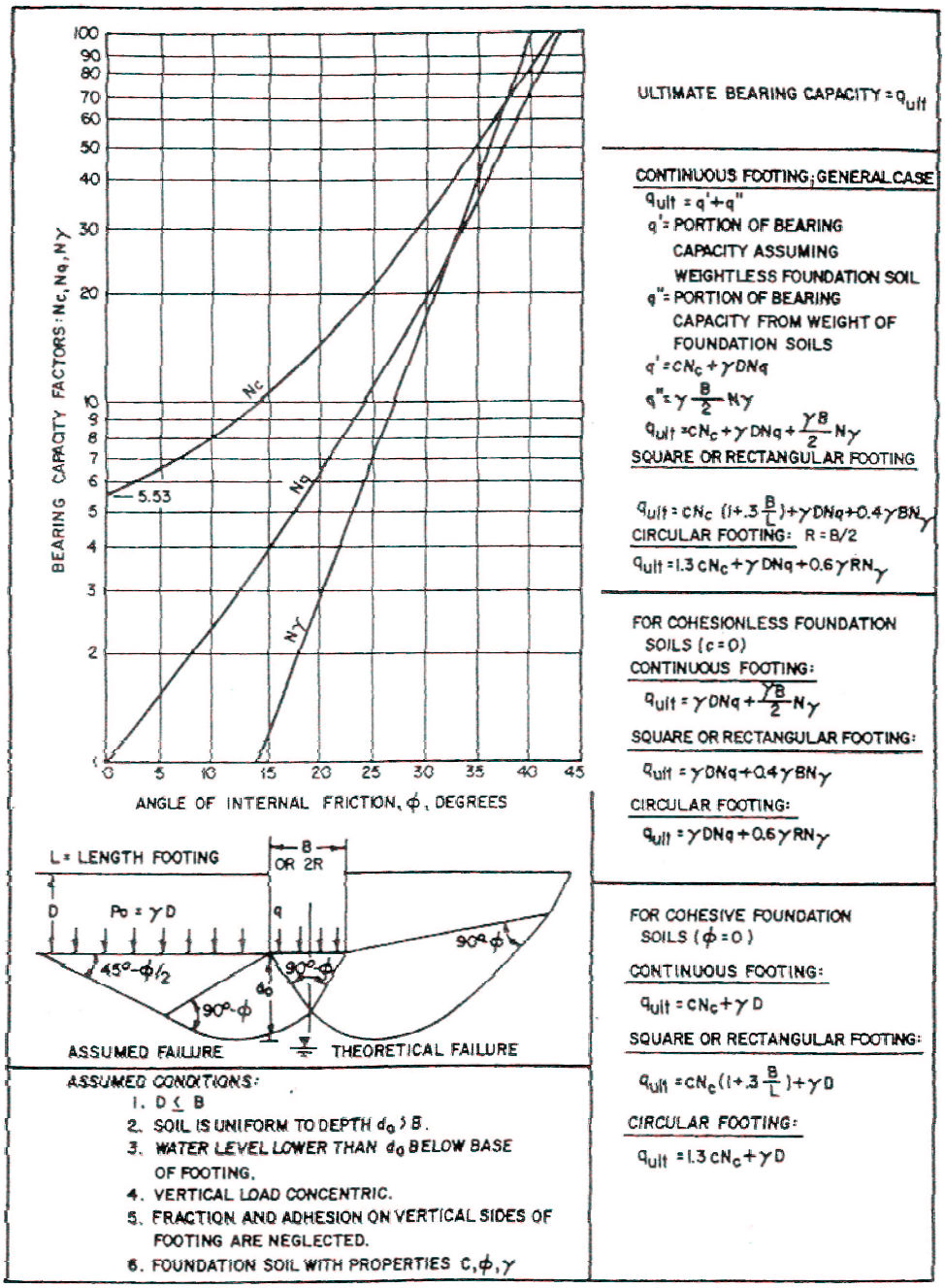


FIGURE 1
Ultimate Bearing Capacity of Shallow Footings With Concentric Loads
7.2-131

NAVFAC DM7.2

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET:	3/4
JOB #:	DAVDCO-10-5
DATE:	3/2/12
BY:	PKS
CHKD BY:	LAQ

Davidson County MSW Landfill - Phase 2
Overall Bearing Capacity Analysis

Subsurface Bearing Soil & Load Information:

Soil Parameters:

Friction Angle (ϕ) =	25	Degrees
Cohesion (c) =	100	psf
Unit Weight (γ) =	100	pcf
Eff. Unit Weight (γ_{eff})=	37.6	pcf

Soil Bearing Capacity Factors:

N_c =	21
N_q =	11
N_g =	7

Load Information:

Depth of Footing (D_f) =	5	ft	(Depth of Landfill Base Below Outside Ground Surface - Typ. Min.)
Foundation Width (B) =	1,000	ft	
Foundation Length (L) =	2,500	ft	
Waste Unit Weight (γ) =	75	pcf	
Waste Thickness =	125	ft	(> Avg. Thickness)

Bearing Capacity:

Soil Surcharge (γ x D_f) =	500	psf	
Ultimate Bearing Cap. (q_{ult}) =	109,700	psf	
Allowable Bearing Cap. (q_{allow}) =	36,567	psf	(Ultimate Bearing Capacity/3)
Applied Load =	9,375	psf	
Bearing Capacity FS =	**11.7**		**OK - GREATER THAN 3**

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET:	4/4
JOB #:	DAVDCO-10-5
DATE:	3/2/12
BY:	PKS
CHKD BY:	LAQ

Davidson County MSW Landfill - Phase 2
Equipment Contact Stress & Bearing Capacity Analysis - Leachate Collection System/Protective Cover

Bearing Soil & Load Information (USER INPUT):

Soil Parameters:

Friction Angle (ϕ) =	30	Degrees
Cohesion (c) =	0	psf
Unit Weight (γ) =	110	pcf

Soil Bearing Capacity Factors:

N_c =	32
N_q =	20
N_g =	16

Equipment Contact Stress & Bearing Capacity:

LGP Dozer:

Max. Contact Stress =	6	psi	
Typ. Track Width =	34	in	CAT D6N LGP DS
Typ. Track Length =	122	in	

Depth (ft)	Contact Area (in^2)	Contact Stress (psi)	qult (psi)	FS		Comment
0	4,148	6.0	13.9	2.3		OK
0.5	5,120	4.9	21.5	4.4		OK
0.75	5,633	4.4	25.3	5.7		OK
1	6,164	4.0	29.1	7.2		OK
1.5	7,280	3.4	36.8	10.8		OK
2	8,468	2.9	44.4	15.1		OK

Non-LGP Dozer:

Max. Contact Stress =	12	psi	
Typ. Track Width =	22	in	CAT D7R Series II
Typ. Track Length =	112	in	

Depth (ft)	Contact Area (in^2)	Contact Stress (psi)	qult (psi)	FS		Comment
0	2,464	12.0	9.0	0.7	Expect Rutting	- More Separation Reqd.
0.5	3,304	8.9	16.6	1.9		- More Separation Reqd.
0.75	3,751	7.9	20.4	2.6		OK
1	4,216	7.0	24.2	3.5		OK
1.5	5,200	5.7	31.9	5.6		OK
2	6,256	4.7	39.5	8.4		OK

Truck (H_{20}):

Max. Contact Stress =	90	psi
Typ. Contact Diameter =	9	in

Depth (ft)	Contact Area (in^2)	Contact Stress (psi)	qult (psi)	FS		Comment
0	64	90.0	2.8	0.0	Expect Rutting	- More Separation Reqd.
0.5	177	32.4	10.4	0.3	Expect Rutting	- More Separation Reqd.
0.75	254	22.5	14.2	0.6	Expect Rutting	- More Separation Reqd.
1	346	16.5	18.0	1.1		- More Separation Reqd.
1.5	573	10.0	25.7	2.6		OK
2	855	6.7	33.3	5.0		OK
2.5	1,195	4.8	40.9	8.5		OK
3	1,590	3.6	48.6	13.5		OK

Truck (Off-Road):

Max. Contact Stress =	60	psi
Typ. Contact Diameter =	30	in

Depth (ft)	Contact Area (in^2)	Contact Stress (psi)	qult (psi)	FS		Comment
0	707	60.0	9.2	0.2	Expect Rutting	- More Separation Reqd.
0.5	1,018	41.7	16.8	0.4	Expect Rutting	- More Separation Reqd.
0.75	1,195	35.5	20.6	0.6	Expect Rutting	- More Separation Reqd.
1	1,385	30.6	24.4	0.8	Expect Rutting	- More Separation Reqd.
1.5	1,810	23.4	32.1	1.4		- More Separation Reqd.
2	2,290	18.5	39.7	2.1		OK
2.5	2,827	15.0	47.4	3.2		OK
3	3,421	12.4	55.0	4.4		OK

Waste Compactor:

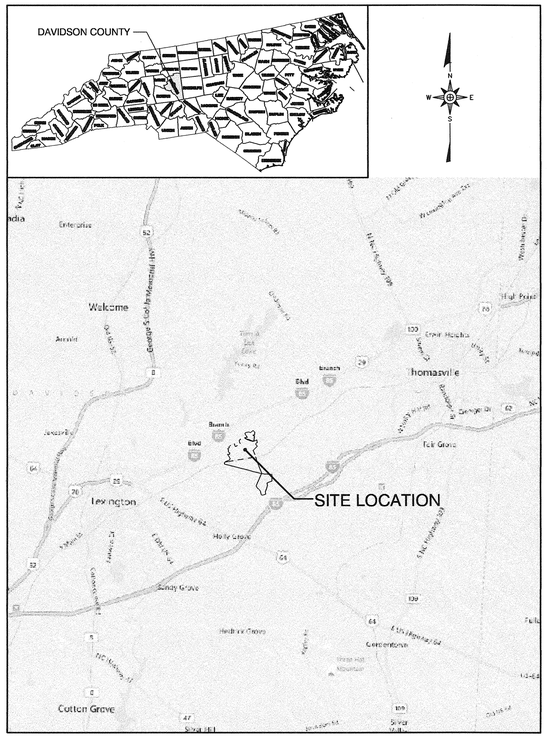
Max. Contact Stress =	70	psi	
Typ. Drum Contact Width =	12	in	Typ. Drum - Large Compactor
Typ. Drum Length =	48	in	

Depth (ft)	Contact Area (in^2)	Contact Stress (psi)	qult (psi)	FS		Comment
0	576	70.0	4.9	0.1	Expect Rutting	- More Separation Reqd.
0.5	972	41.5	12.5	0.3	Expect Rutting	- More Separation Reqd.
0.75	1,197	33.7	16.3	0.5	Expect Rutting	- More Separation Reqd.
1	1,440	28.0	20.2	0.7	Expect Rutting	- More Separation Reqd.
1.5	1,980	20.4	27.8	1.4		- More Separation Reqd.
2	2,592	15.6	35.4	2.3		OK
2.5	3,276	12.3	43.1	3.5		OK
3	4,032	10.0	50.7	5.1		OK

DAVIDSON COUNTY INTEGRATED SOLID WASTE MANAGEMENT
LEXINGTON, NORTH CAROLINA

DAVIDSON COUNTY MSW LANDFILL
PHASE 2 - AREA 2
PERMIT TO CONSTRUCT DRAWINGS

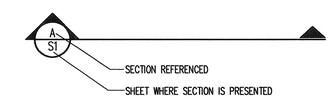
MAY 2012



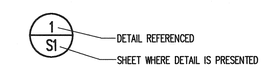
SITE LOCATION MAP
NOT TO SCALE

SHEET NO.	DRAWING NO.	DRAWING TITLE
1	--	TITLE – COVER SHEET
2	S1	EXISTING CONDITIONS
3	S2	SITE DEVELOPMENT PLAN – BASE GRADES
4	S3	SITE DEVELOPMENT PLAN – FINAL COVER GRADES
5	S4	AREA 2 – SUBGRADE GRADING PLAN
6	S5	AREA 2 – COMPOSITE LINER GRADING PLAN
7	S6	AREA 2 – PROTECTIVE COVER GRADING PLAN
8	S7	LEACHATE MANAGEMENT SYSTEM PLAN
9	L1	LINER AND BERM DETAILS (SHEET 1 OF 2)
10	L2	LINER AND BERM DETAILS (SHEET 2 OF 2)
11	LM1	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 3)
12	LM2	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 3)
13	LM3	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 3 OF 3)
14	R1	ROADWAY DETAILS
15	EC1	EROSION AND SEDIMENTATION CONTROL PLAN – AREA 2 CONSTRUCTION
16	EC2	EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 1 OF 2)
17	EC3	EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 2)
18	LR1	LEACHATE RECIRCULATION DETAILS (SHEET 1 OF 2)
19	LR2	LEACHATE RECIRULATION DETAILS (SHEET 2 OF 2)
20	FC1	AREAS 1 & 2 – FINAL COVER GRADING AND DRAINAGE PLAN
21	FC2	FINAL COVER DETAILS (SHEET 1 OF 2)
22	FC3	FINAL COVER DETAILS (SHEET 2 OF 2)
23	LFG1	LANDFILL GAS MANAGEMENT DETAILS
24	X1	ENGINEERING CROSS SECTIONS
25	P1	PHASING PLAN (SHEET 1 OF 2)
26	P2	PHASING PLAN (SHEET 2 OF 2)

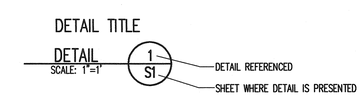
STANDARD SECTION LOCATION (SHEET AND DETAIL)



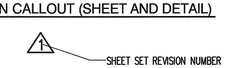
STANDARD DETAIL CALLOUT

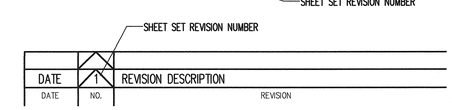


STANDARD DETAIL TITLE AND CALLOUT



STANDARD REVISION CALLOUT (SHEET AND DETAIL)





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NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHRODT
5/31/12

PERMIT ISSUE
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FILE NAME
DAVDCO-D0581

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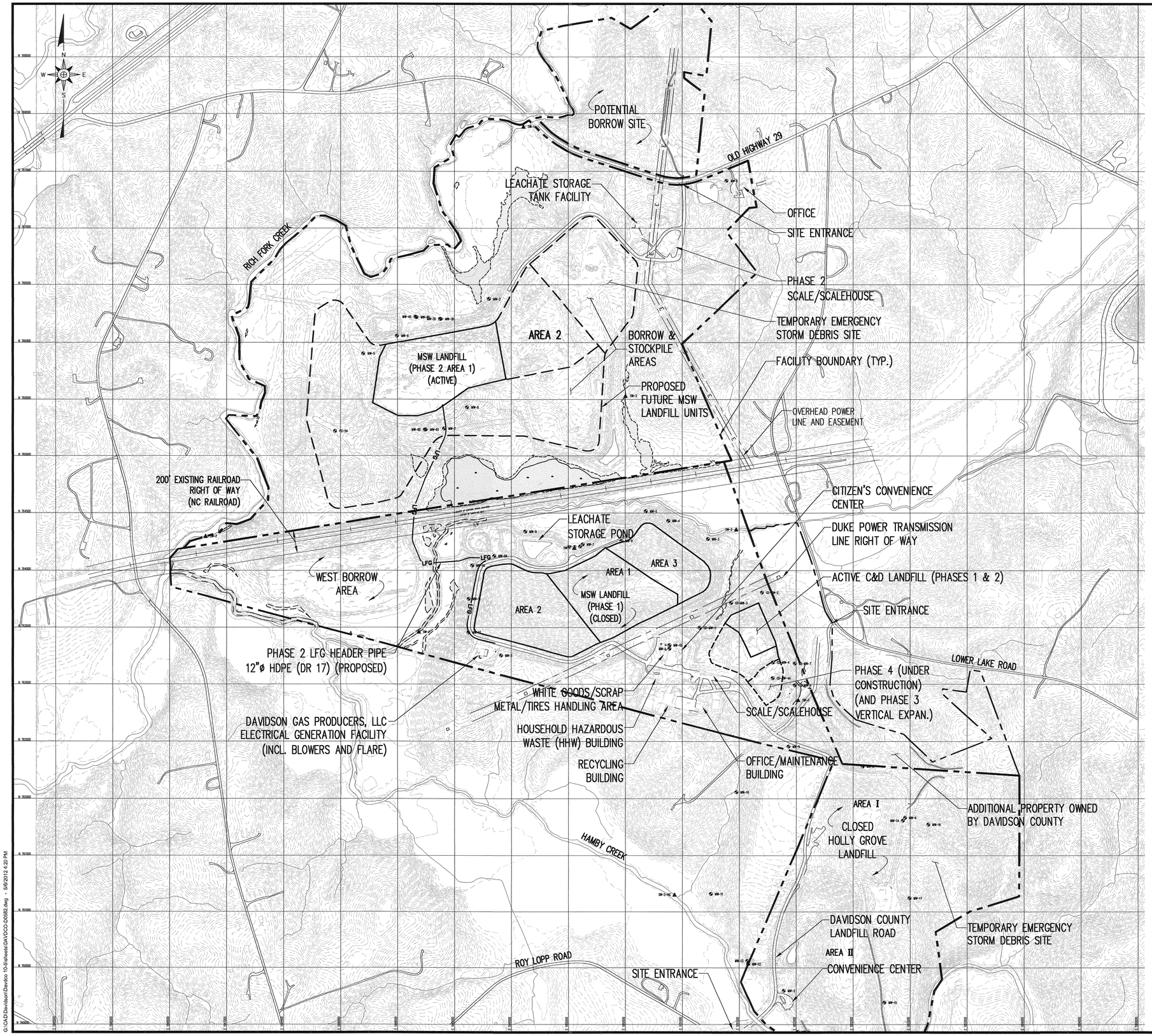

LEGEND

- EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- FACILITY BOUNDARY (PROPERTY LINE)
- LIMIT OF LINER (EXISTING LINED UNITS)
- LIMIT OF LINER (FUTURE LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)
- EXISTING OVERHEAD POWER LINE AND EASEMENT
- MW-8D EXISTING MONITORING WELL
- SW-3 EXISTING SURFACE WATER SAMPLING POINT

REFERENCES

1. OVERALL TOPOGRAPHY PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004. TOPOGRAPHY IN ACTIVE C&D AND MSW AREAS FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 400' 800' 1200'

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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SEAL

SEAL: PROFESSIONAL SEAL 021666 ENGINEER PETER K. WEIGL NORTH CAROLINA 2/13/12

PROJECT TITLE: DAVIDSON COUNTY MSW LANDFILL PHASE 2 AREA 2 PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE: EXISTING CONDITIONS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: PKW	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0582	
SHEET NO. 2	DRAWING NO. S1

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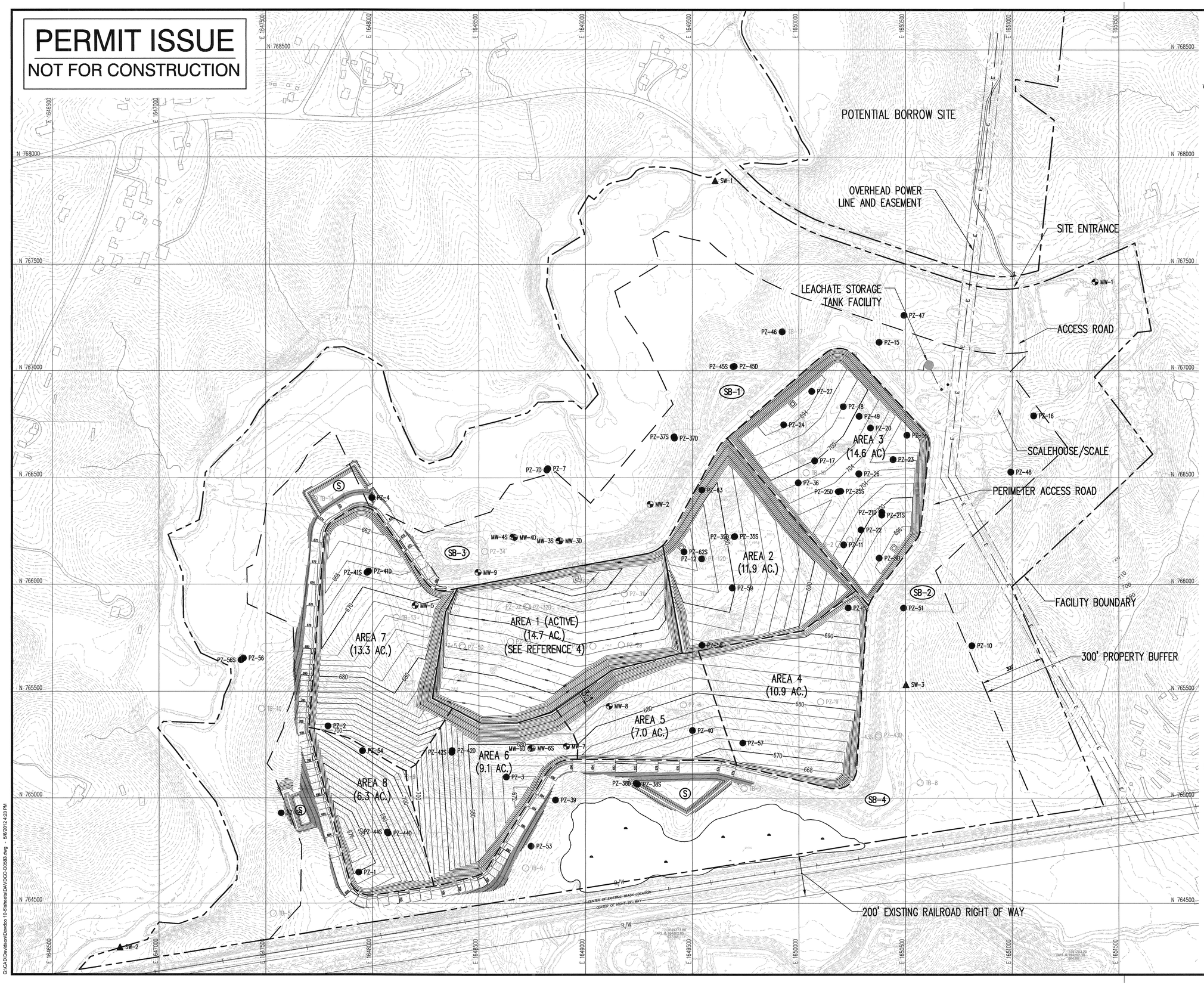
PERMIT ISSUE
NOT FOR CONSTRUCTION



LEGEND

660	EXISTING CONTOURS
660	PROPOSED CONTOURS
	FACILITY BOUNDARY (PROPERTY LINE)
	300' BUFFER
	LIMIT OF LINER (EXISTING LINED UNITS)
	LIMIT OF LINER (FUTURE LINED UNITS)
E	OVERHEAD POWER LINE AND EASEMENT
MW-4	EXISTING MONITORING WELL
SW-3	EXISTING SURFACE WATER SAMPLING POINT
PZ-22	PIEZOMETER
TB-16 B-1	ABANDONED BORING
PZ-29	ABANDONED PIEZOMETER
SB-4	EXISTING SEDIMENT BASIN
S	PLANNED SEDIMENT BASIN

REFERENCES

1. OVERALL TOPOGRAPHY PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004. TOPOGRAPHY IN ACTIVE C&D AND MSW AREAS FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.
4. BASE GRADES SHOWN FOR AREA 1 REPRESENT AS-BUILT SUBGRADE. FIELD WORK FOR SURVEY COMPLETED DURING THE MONTHS OF AUGUST – DECEMBER 2007, JANUARY–MAY 2008 BY BATEMAN CIVIL SURVEY COMPANY P.C., HOLLY SPRINGS, NC.

0 200' 400' 600'

REVISION	DATE	NO.

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
SITE DEVELOPMENT PLAN
BASE GRADES

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY: LQ	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0583	
SHEET NO. 3	DRAWING NO. S2

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POTENTIAL BORROW SITE

OVERHEAD POWER LINE AND EASEMENT

SITE ENTRANCE

LEACHATE STORAGE TANK FACILITY

ACCESS ROAD

SCALEHOUSE/SCALE

PERIMETER ACCESS ROAD

FACILITY BOUNDARY

300' PROPERTY BUFFER

300'

200' EXISTING RAILROAD RIGHT OF WAY

AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8

SB-1
SB-2
SB-3
SB-4

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- FACILITY BOUNDARY (PROPERTY LINE)
- 300' BUFFER
- LIMIT OF LINER (EXISTING LINED UNITS)
- LIMIT OF LINER (FUTURE LINED UNITS)
- OVERHEAD POWER LINE AND EASEMENT
- SB-4 EXISTING SEDIMENT BASIN
- S PLANNED SEDIMENT BASIN

REFERENCES

1. OVERALL TOPOGRAPHY PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004. TOPOGRAPHY IN ACTIVE C&D AND MSW AREAS FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 200' 400' 600'

DATE	NO.	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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www.rsgengineers.com

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
SITE DEVELOPMENT PLAN
FINAL COVER GRADES

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0584	
SHEET NO. 4	DRAWING NO. S3

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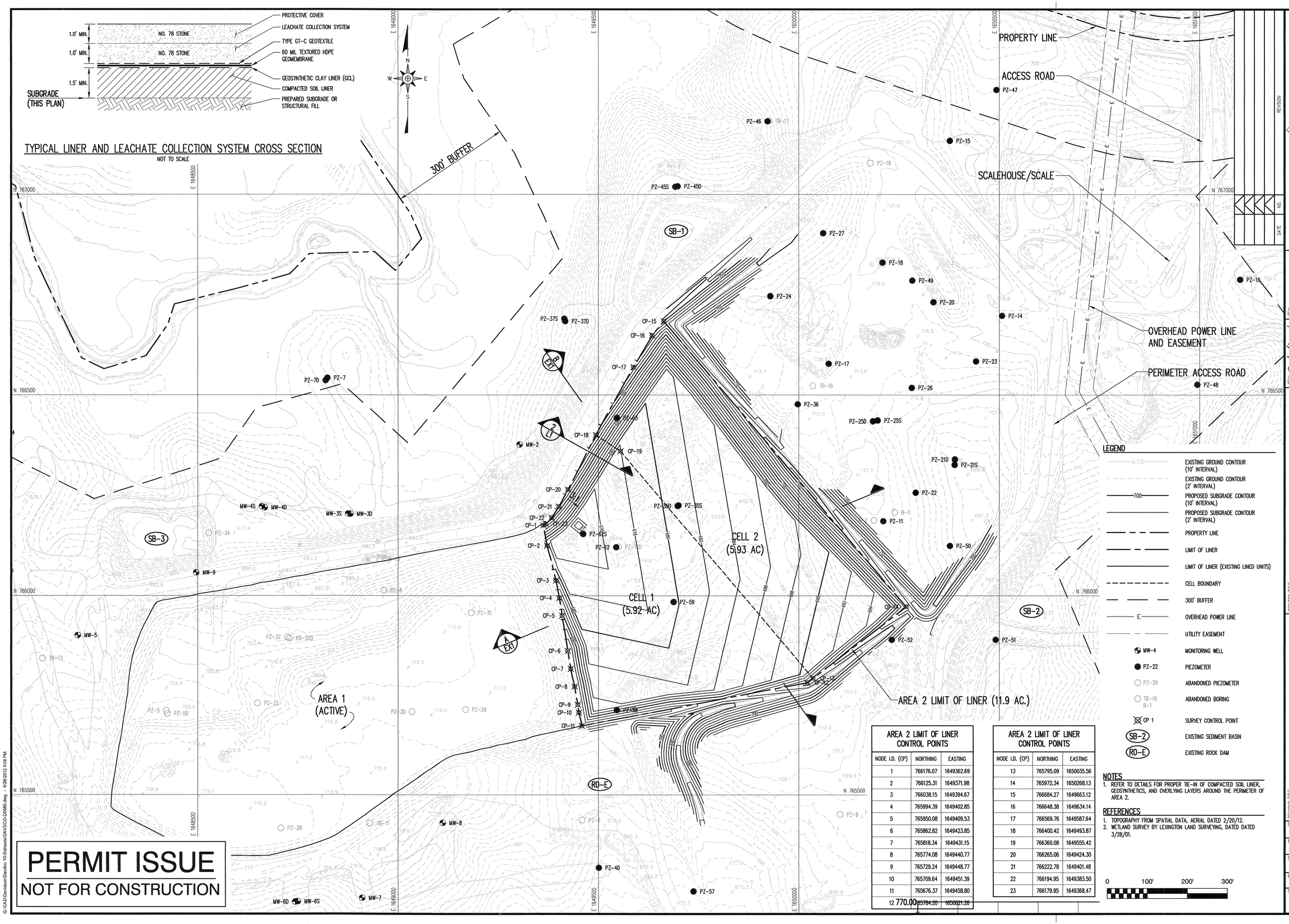

AREA 2 LIMIT OF LINER CONTROL POINTS		
NODE I.D. (CP)	NORTHING	EASTING
1	766176.07	1649362.69
2	766125.31	1649371.98
3	766038.15	1649394.67
4	765994.39	1649402.85
5	765950.08	1649409.53
6	765862.82	1649423.85
7	765818.34	1649431.15
8	765774.08	1649440.77
9	765729.24	1649448.77
10	765709.64	1649451.39
11	765676.37	1649458.80
12	765784.20	1650021.26
13	765795.09	1650035.56
14	765972.34	1650268.13
15	766684.27	1649663.12
16	766648.38	1649634.14
17	766569.76	1649587.64
18	766400.42	1649493.87
19	766360.08	1649555.42
20	766265.06	1649424.30
21	766222.78	1649401.48
22	766194.95	1649383.50
23	766179.95	1649368.47

NOTES

1. REFER TO DETAILS FOR PROPER TIE-IN OF COMPACTED SOIL LINER, GEOSYNTHETICS, AND OVERLYING LAYERS AROUND THE PERIMETER OF AREA 2.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.

PERMIT ISSUE
NOT FOR CONSTRUCTION

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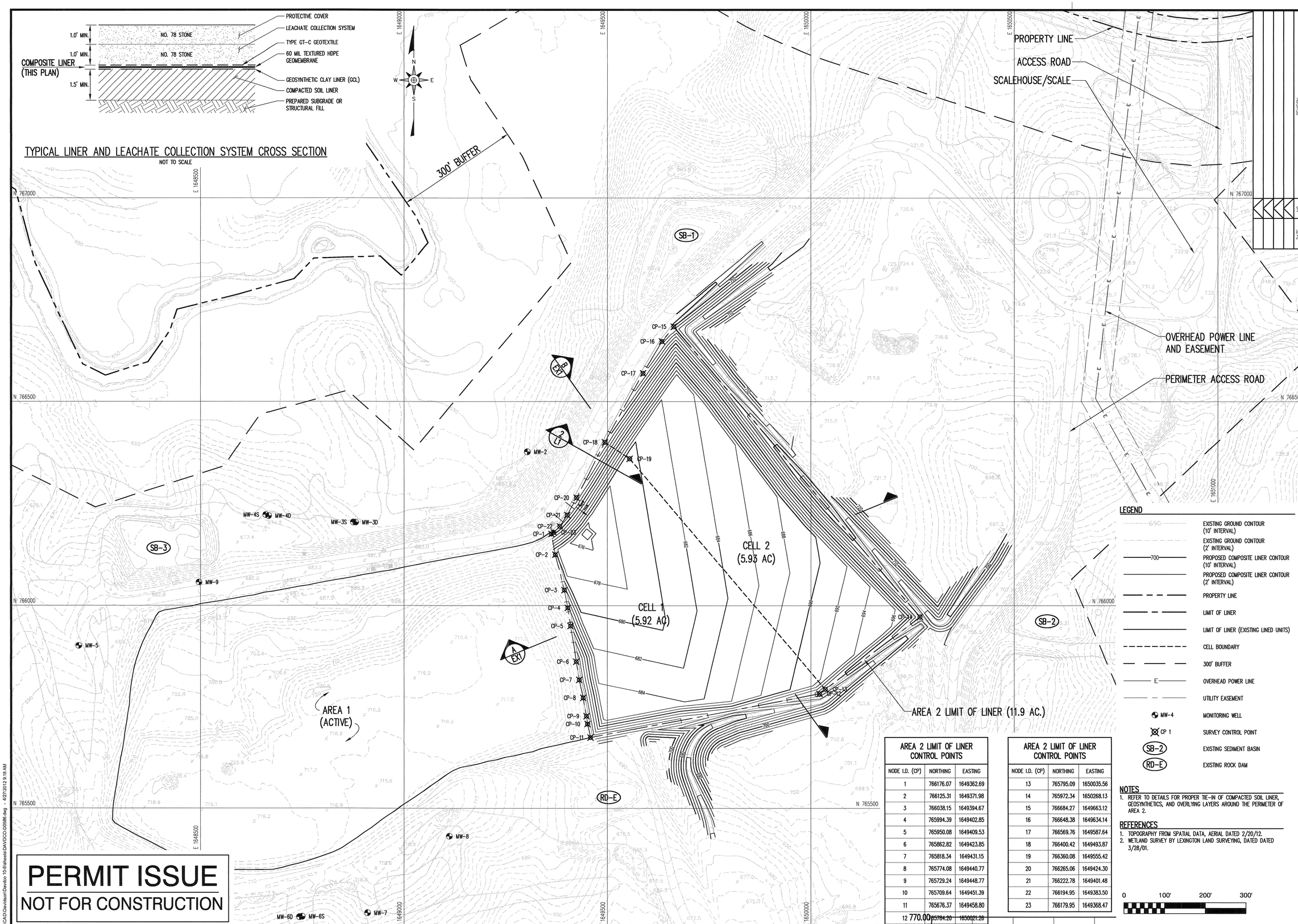
NO.	DATE	REVISION

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
AREA 2
SUBGRADE GRADING PLAN

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0585	
SHEET NO. 5	DRAWING NO. S4



AREA 2 LIMIT OF LINER CONTROL POINTS		
NODE I.D. (CP)	NORTHING	EASTING
1	766176.07	1649362.69
2	766125.31	1649371.98
3	766038.15	1649394.67
4	765994.39	1649402.85
5	765950.08	1649409.53
6	765862.82	1649423.85
7	765818.34	1649431.15
8	765774.08	1649440.77
9	765729.24	1649448.77
10	765709.64	1649451.39
11	765676.37	1649458.80
12	765784.20	1650021.28

AREA 2 LIMIT OF LINER CONTROL POINTS		
NODE I.D. (CP)	NORTHING	EASTING
13	765795.09	1650035.56
14	765972.34	1650268.13
15	766684.27	1649663.12
16	766648.38	1649634.14
17	766569.76	1649587.64
18	766400.42	1649493.87
19	766360.08	1649555.42
20	766265.06	1649424.30
21	766222.78	1649401.48
22	766194.95	1649383.50
23	766179.95	1649368.47

NOTES

1. REFER TO DETAILS FOR PROPER TIE-IN OF COMPACTED SOIL LINER, GEOSYNTHETICS, AND OVERLYING LAYERS AROUND THE PERIMETER OF AREA 2.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.

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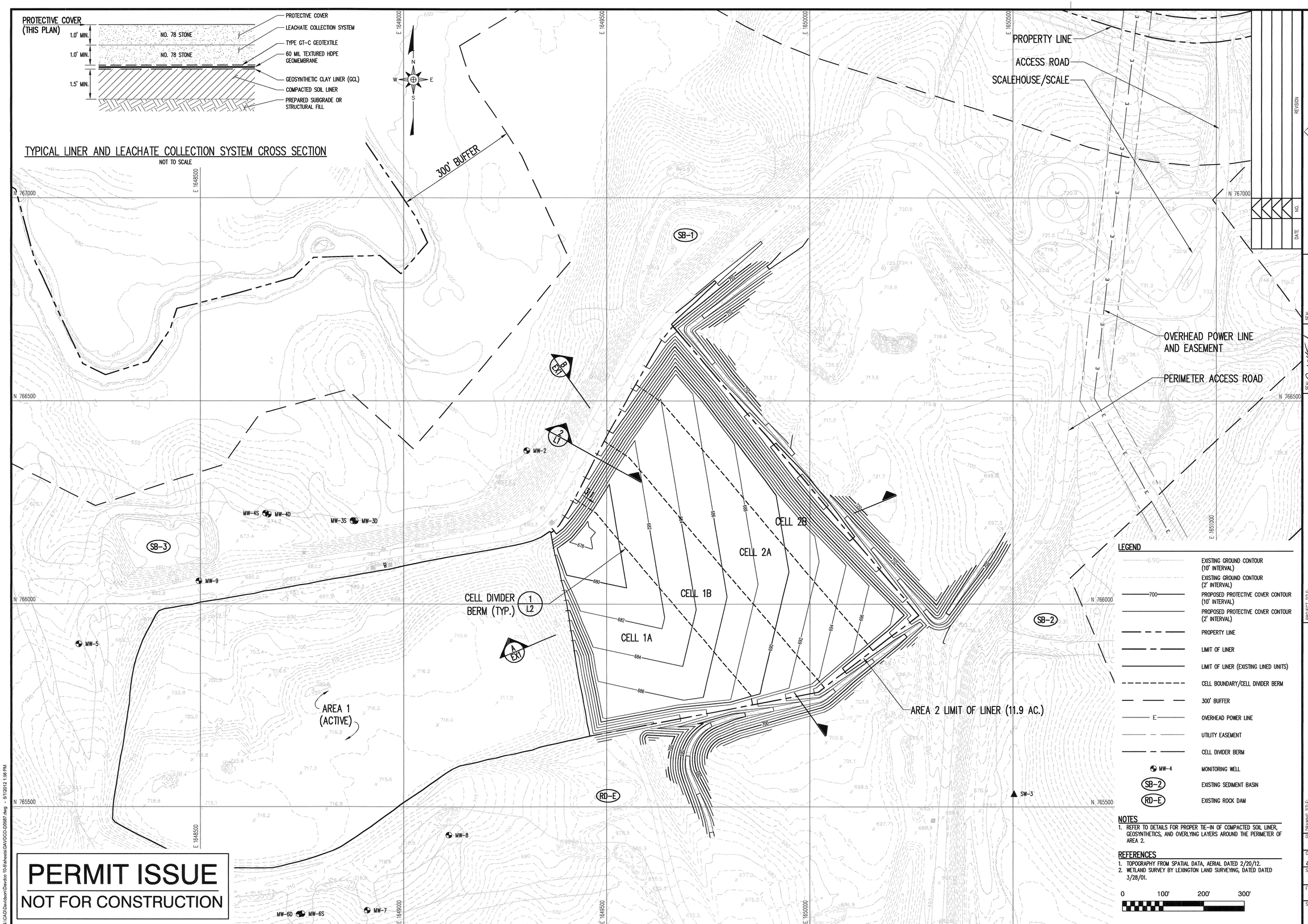
NO.	DATE	REVISION

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
AREA 2
COMPOSITE LINER
GRADING PLAN

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0586	
SHEET NO. 6	DRAWING NO. S5



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fax: 919-828-3899
www.rsgengineers.com

REVISION | NO. | DATE

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
AREA 2
PROTECTIVE COVER
GRADING PLAN

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME DAVDCO-D0587	
SHEET NO. 7	DRAWING NO. S6

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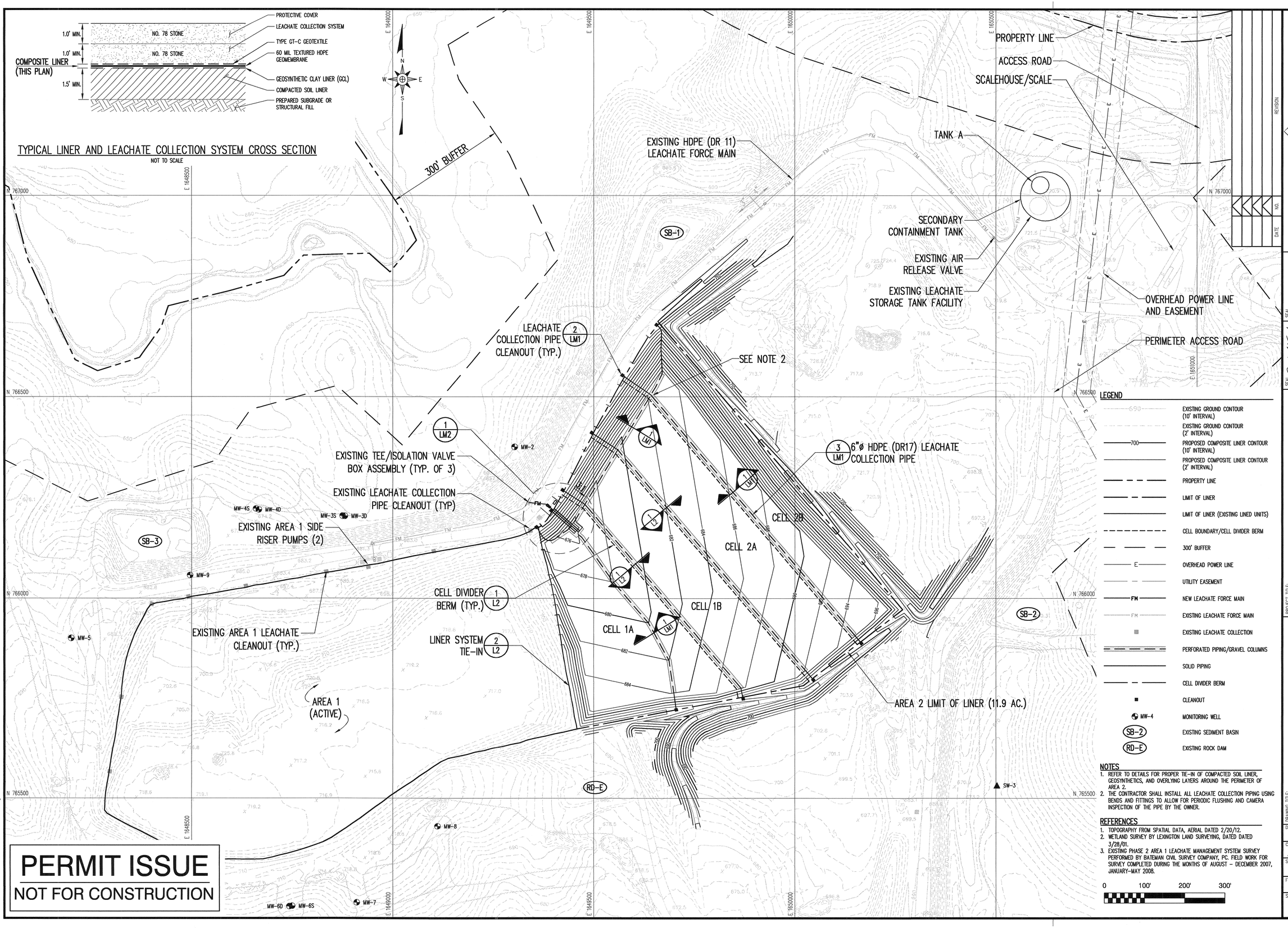
TYPICAL LINER AND LEACHATE COLLECTION SYSTEM CROSS SECTION

NOT TO SCALE



LEGEND

- EXISTING GROUND CONTOUR (10' INTERVAL)
- EXISTING GROUND CONTOUR (2' INTERVAL)
- PROPOSED COMPOSITE LINER CONTOUR (10' INTERVAL)
- PROPOSED COMPOSITE LINER CONTOUR (2' INTERVAL)
- PROPERTY LINE
- LIMIT OF LINER
- LIMIT OF LINER (EXISTING LINED UNITS)
- CELL BOUNDARY/CELL DIVIDER BERM
- 300' BUFFER
- OVERHEAD POWER LINE
- UTILITY EASEMENT
- NEW LEACHATE FORCE MAIN
- EXISTING LEACHATE FORCE MAIN
- EXISTING LEACHATE COLLECTION
- PERFORATED PIPING/GRAVEL COLUMNS
- SOLID PIPING
- CELL DIVIDER BERM
- CLEANOUT
- MW-4 MONITORING WELL
- SB-2 EXISTING SEDIMENT BASIN
- RD-E EXISTING ROCK DAM

NOTES

1. REFER TO DETAILS FOR PROPER TIE-IN OF COMPACTED SOIL LINER, GEOSYNTHETICS, AND OVERLYING LAYERS AROUND THE PERIMETER OF AREA 2.
2. THE CONTRACTOR SHALL INSTALL ALL LEACHATE COLLECTION PIPING USING BENDS AND FITTINGS TO ALLOW FOR PERIODIC FLUSHING AND CAMERA INSPECTION OF THE PIPE BY THE OWNER.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. EXISTING PHASE 2 AREA 1 LEACHATE MANAGEMENT SYSTEM SURVEY PERFORMED BY BATEMAN CIVIL SURVEY COMPANY, P.C. FIELD WORK FOR SURVEY COMPLETED DURING THE MONTHS OF AUGUST – DECEMBER 2007, JANUARY–MAY 2008.

0 100' 200' 300'

PERMIT ISSUE

NOT FOR CONSTRUCTION

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www.rsgengineers.com

NO.	DATE	REVISION

SEAL

PROJECT TITLE: DAVIDSON COUNTY MSW LANDFILL PHASE 2 AREA 2 PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE: LEACHATE MANAGEMENT SYSTEM PLAN

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0588	
SHEET NO. 8	DRAWING NO. S7

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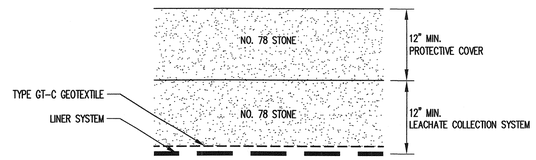
PERMIT ISSUE
NOT FOR CONSTRUCTION



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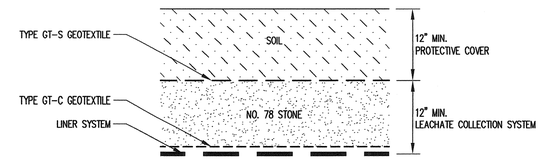
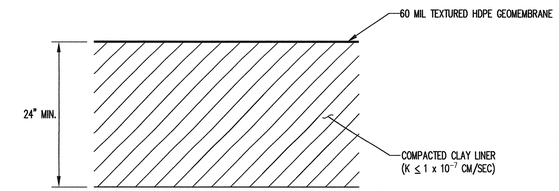
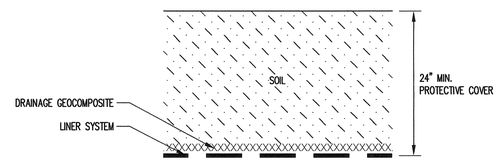


TYPE 2

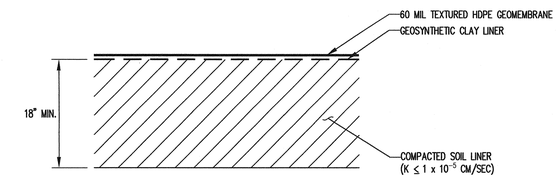


STANDARD LINER

NOTES:
1. THE ALTERNATIVE LINER SYSTEM IS ASSUMED IN THE PROJECT DETAILS.



TYPE 3

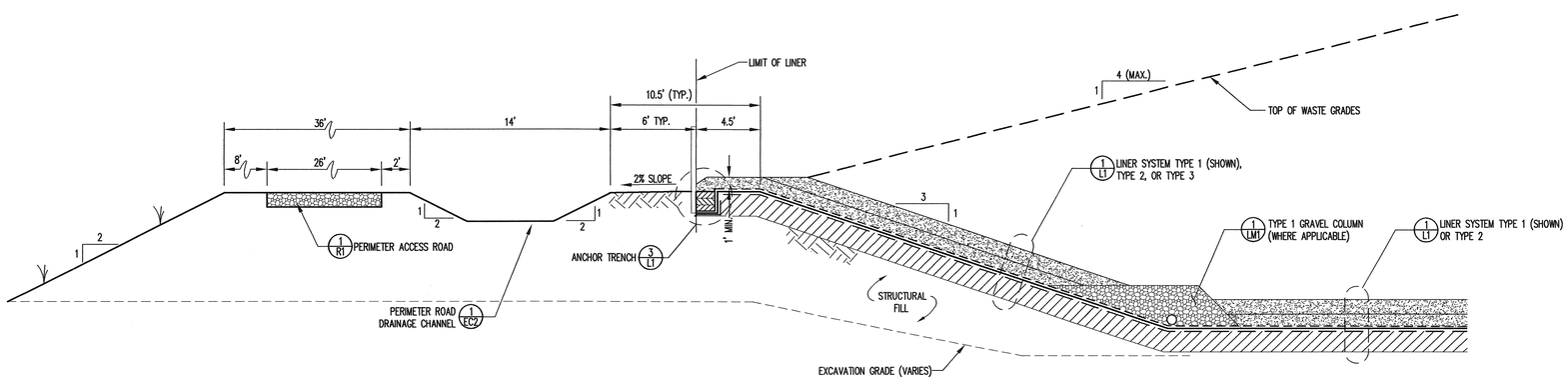


ALTERNATIVE LINER
(SEE NOTE 1)

LINER SYSTEM

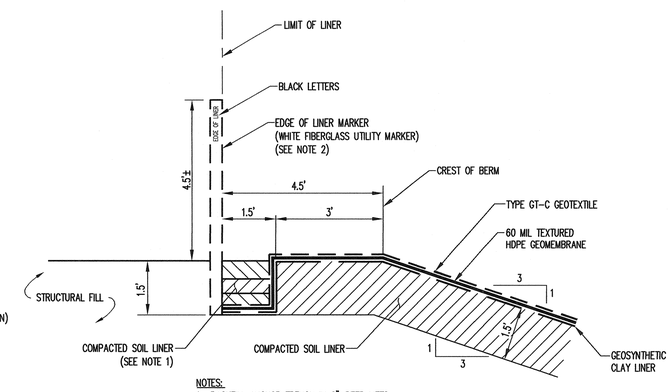
TYPICAL LINER AND LEACHATE COLLECTION SYSTEM CROSS SECTIONS

DETAIL 1/L1
NOT TO SCALE



PERIMETER BERM CROSS SECTION (TYP.)

DETAIL 2/L1
NOT TO SCALE



NOTES:
1. BACKFILL ANCHOR TRENCH IN 6"-DEEP LIFTS.
2. PLACE EDGE OF LINER MARKERS EVERY 100' ON-CENTER AND AT BREAK POINTS.
3. SOME LAYERS NOT SHOW FOR CLARITY.

ANCHOR TRENCH

DETAIL 3/L1
NOT TO SCALE

NO.	DATE	REVISION

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
LINER AND BERM DETAILS
(SHEET 1 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME DAVDCO-D0589	
SHEET NO. 9	DRAWING NO. L1

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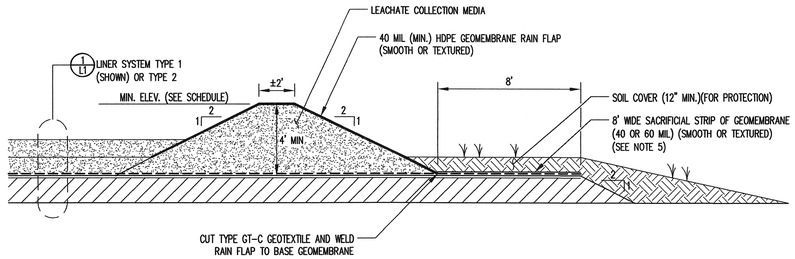
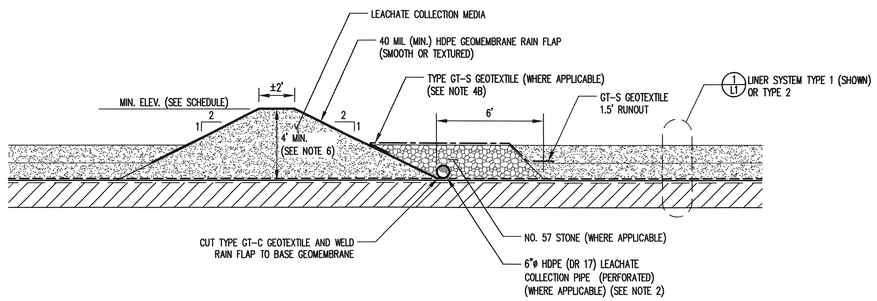
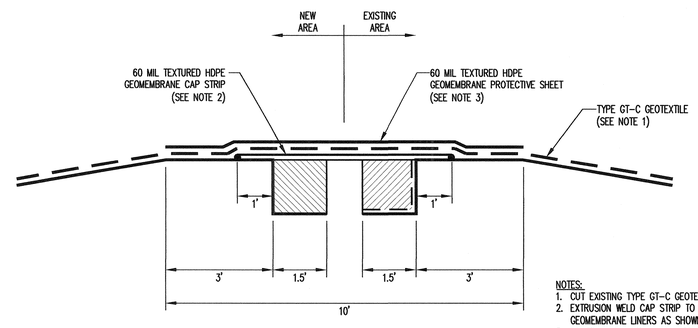


CELL 1 TEMPORARY TERMINATION



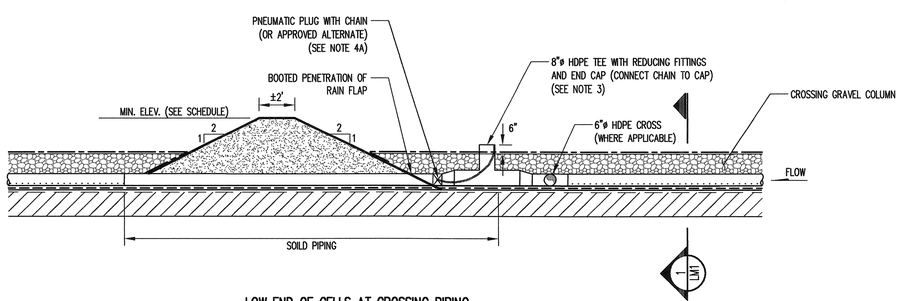
TYPICAL



LINER SYSTEM TIE-IN (SEE NOTE 5)

DETAIL 2/L2
NOT TO SCALE

NOTES:
1. CUT EXISTING TYPE GT-C GEOTEXTILE AT TOP OF ANCHOR TRENCH.
2. EXTRUSION WELD CAP STRIP TO BOTH EXISTING AND NEW HDPE GEOMEMBRANE LINERS AS SHOWN. VACUUM BOX TEST ALL WELDS.
3. PROTECTIVE SHEET IS NOT ATTACHED TO GEOMEMBRANE LINERS.
4. SOME LAYERS NOT SHOWN FOR CLARITY.
5. THIS DETAIL IS FOR TIE-INS AROUND THE PERIMETER OF AREA 2. SEE DETAIL 1/L2 FOR CELL 1 TEMPORARY TERMINATION (IF USED).



LOW END OF CELLS AT CROSSING PIPING

CELL DIVIDER BERM SCHEDULE	
BERM	MIN. ELEV.
CELL 1A–1B	684.0
CELL 1B–2A	686.0
CELL 2A–2B	690.0

CELL DIVIDER BERM

DETAIL 1/L2
NOT TO SCALE

NOTES:
1. SEE DETAIL 3/LM1 FOR PIPE PERFORATIONS.
2. SHIFT 6" HDPE PIPE OVER AS REQUIRED TO CONNECT WITH HDPE CROSS AT LOW END OF EACH CELL.
3. CONTRACTOR SHALL VERIFY FIT OF SELECTED PLUG PRIOR TO INSTALLATION. A WYE FITTING IS ALLOWABLE IF REQUIRED FOR OPERATION OF PLUG.
4. OPERATIONS:
   A. PLUG AND CHAIN SHALL BE REMOVED WHEN ACTIVATING A CELL.
   B. THE EXPOSED TYPE GT-S GEOTEXTILE SHALL BE REMOVED PRIOR TO THE PLACEMENT OF WASTE OVER THAT PORTION OF THE GRAVEL COLUMN.
5. WHEN EXTENDING LINER SYSTEM, EXPOSE AND REMOVE SACRIFICIAL GEOMEMBRANE BEFORE MAKING LINER CONNECTIONS.
6. TYPICAL BERM HEIGHT MAY BE REDUCED TO 3' MIN. WHERE STONE IS USED AS PROTECTIVE COVER. NOTE THAT THIS DOES NOT APPLY TO BERM USED ALONG TEMPORARY TERMINATION. ALSO THIS DOES NOT EFFECT MIN. ELEVATIONS REQUIRED AT LOW END OF CELLS.

PERMIT ISSUE
NOT FOR CONSTRUCTION

NO.	DATE	REVISION

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
LINER AND BERM DETAILS
(SHEET 2 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0590	
SHEET NO. 10	DRAWING NO. L2

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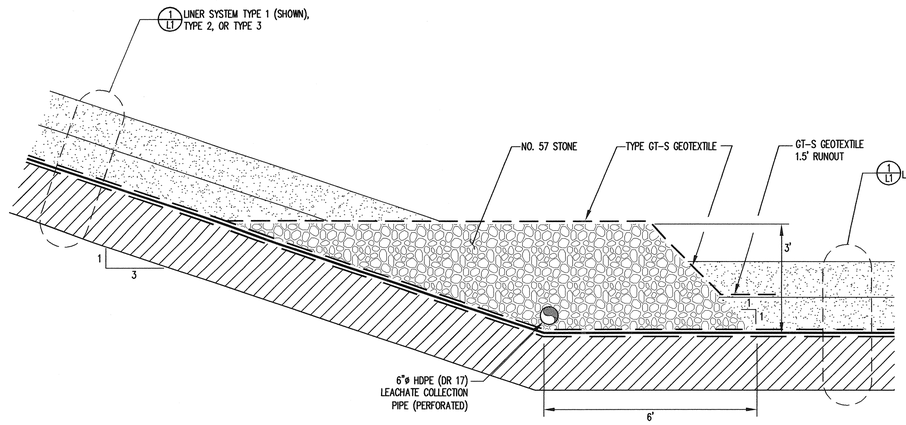
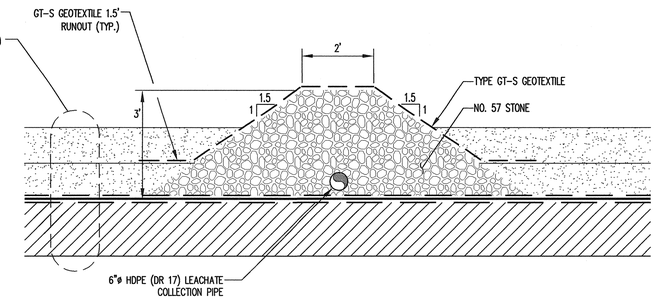


TYPE 1

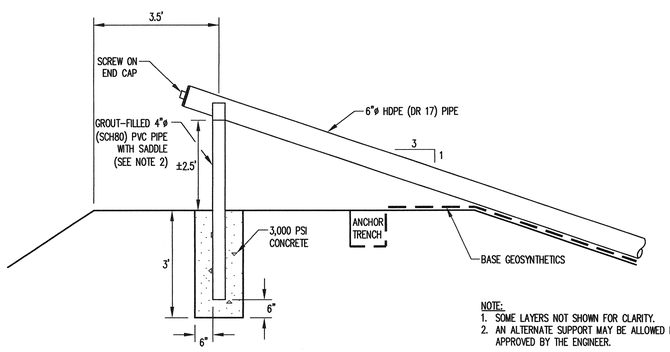


TYPE 2

NOTES:
1. SEE DETAIL 3/LM1 FOR PIPE PERFORATIONS.
2. OPERATIONS:
THE EXPOSED TYPE GT-S GEOTEXTILE SHALL BE REMOVED PRIOR TO THE PLACEMENT OF WASTE OVER THAT PORTION OF THE GRAVEL COLUMN.

GRAVEL COLUMN CROSS SECTIONS

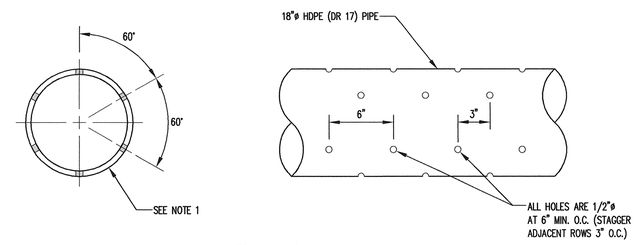
DETAIL 1/LM1
NOT TO SCALE



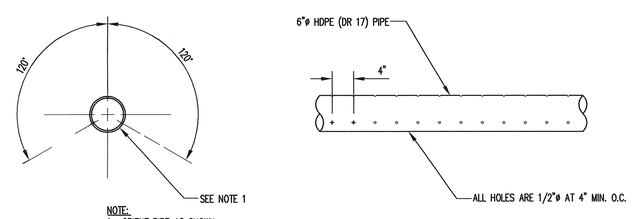
NOTE:
1. SOME LAYERS NOT SHOWN FOR CLARITY.
2. AN ALTERNATE SUPPORT MAY BE ALLOWED IF APPROVED BY THE ENGINEER.

LEACHATE COLLECTION CLEANOUT

DETAIL 2/LM1
NOT TO SCALE



SIDE RISERS

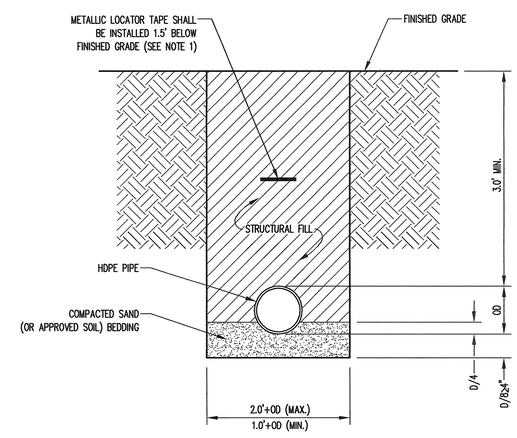


NOTE:
1. ORIENT PIPE AS SHOWN.

LEACHATE COLLECTION PIPING

HDPE PIPE PERFORATIONS

DETAIL 3/LM1
NOT TO SCALE



NOTE:
1. ALTERNATIVELY USE ANOTHER APPROVED LOCATOR DEVICE.

HDPE PIPE BEDDING

DETAIL 4/LM1
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

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NO.	DATE	REVISION

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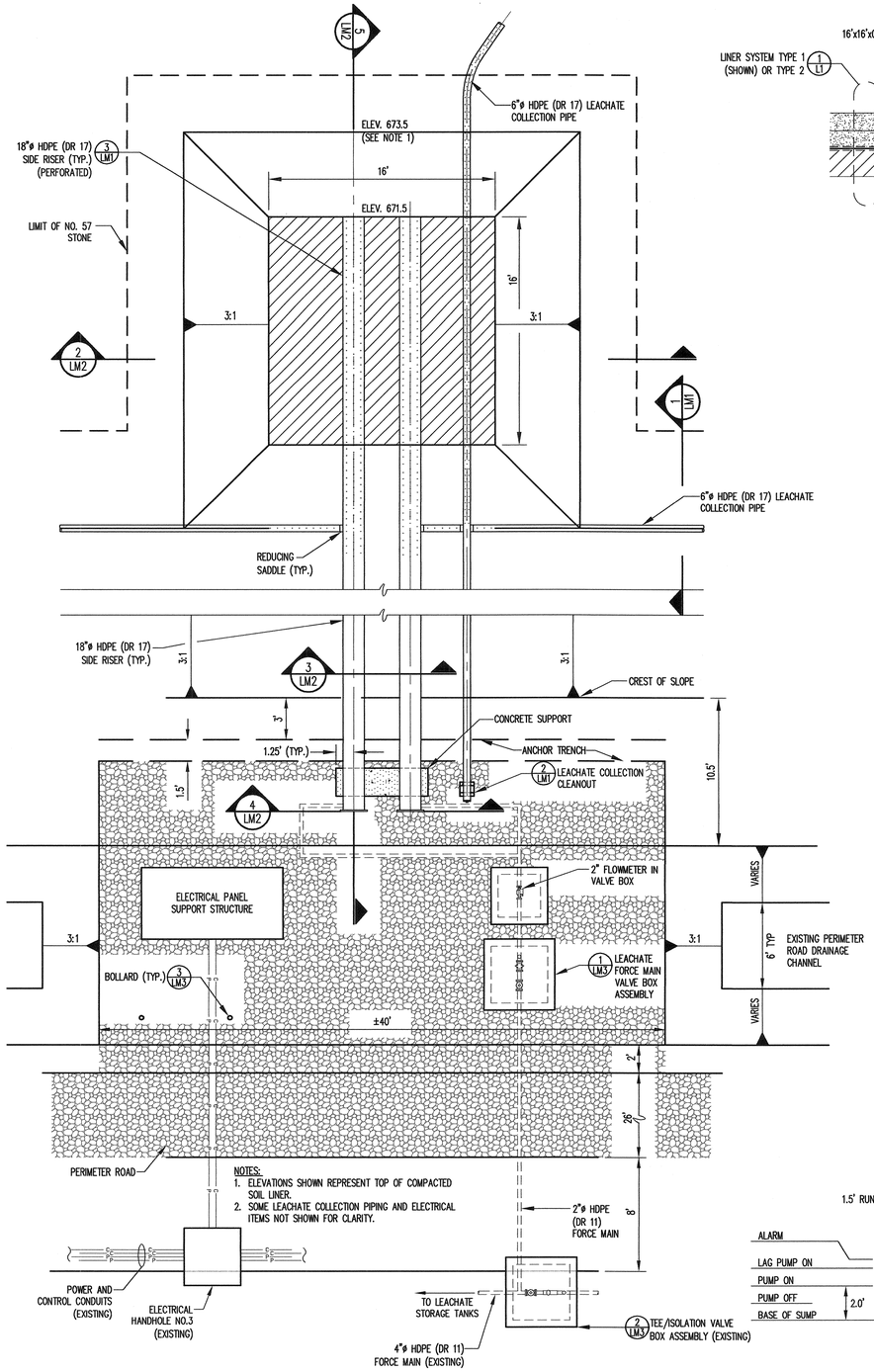
SEAL

SEAL 021668 PROFESSIONAL ENGINEER NORTH CAROLINA PETER R. SMITH 5/21/12

PROJECT TITLE: DAVIDSON COUNTY MSW LANDFILL PHASE 2 AREA 2 PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE: LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 3)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: PRS	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0591	
SHEET NO. 11	DRAWING NO. LM1

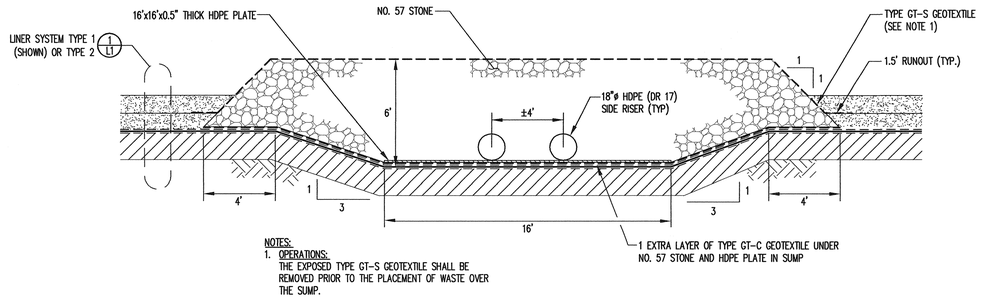


NOTES:
1. ELEVATIONS SHOWN REPRESENT TOP OF COMPACTED SOIL LINER.
2. SOME LEACHATE COLLECTION PIPING AND ELECTRICAL ITEMS NOT SHOWN FOR CLARITY.

LEACHATE SUMP– PLAN VIEW

DETAIL 1 LM2
NOT TO SCALE

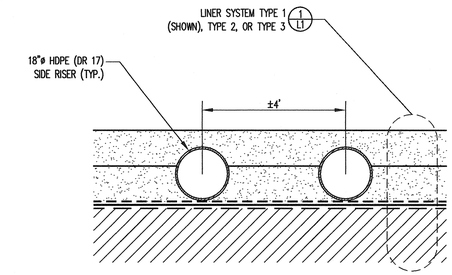
SUMP SCHEDULE						
LANDFILL UNIT	BASE OF SUMP (EL.)	PUMP OFF (EL.)	PUMP ON (EL.)	LAG PUMP ON (EL.)	ALARM (EL.)
AREA 2	673.5'	674.5'	675.5'	676.5'	677.0'



NOTES:
1. OPERATIONS:
THE EXPOSED TYPE GT-S GEOTEXTILE SHALL BE REMOVED PRIOR TO THE PLACEMENT OF WASTE OVER THE SUMP.

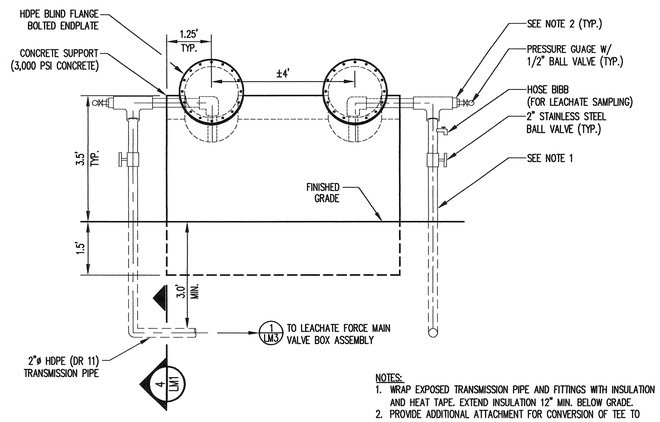
LEACHATE SUMP – TYPICAL CROSS SECTION

DETAIL 2 LM2
NOT TO SCALE



LEACHATE SUMP – TYPICAL CROSS SECTION ON SLOPE

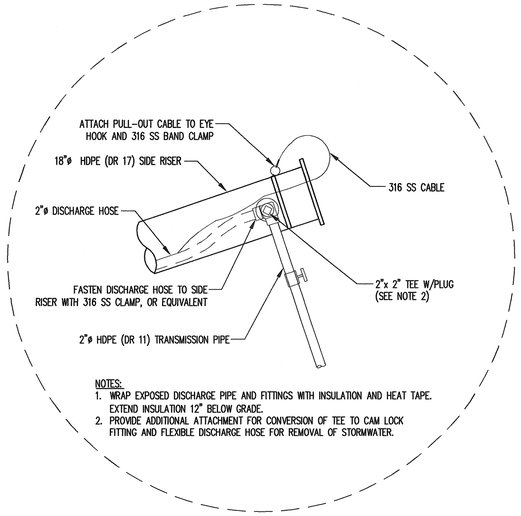
DETAIL 3 LM2
NOT TO SCALE



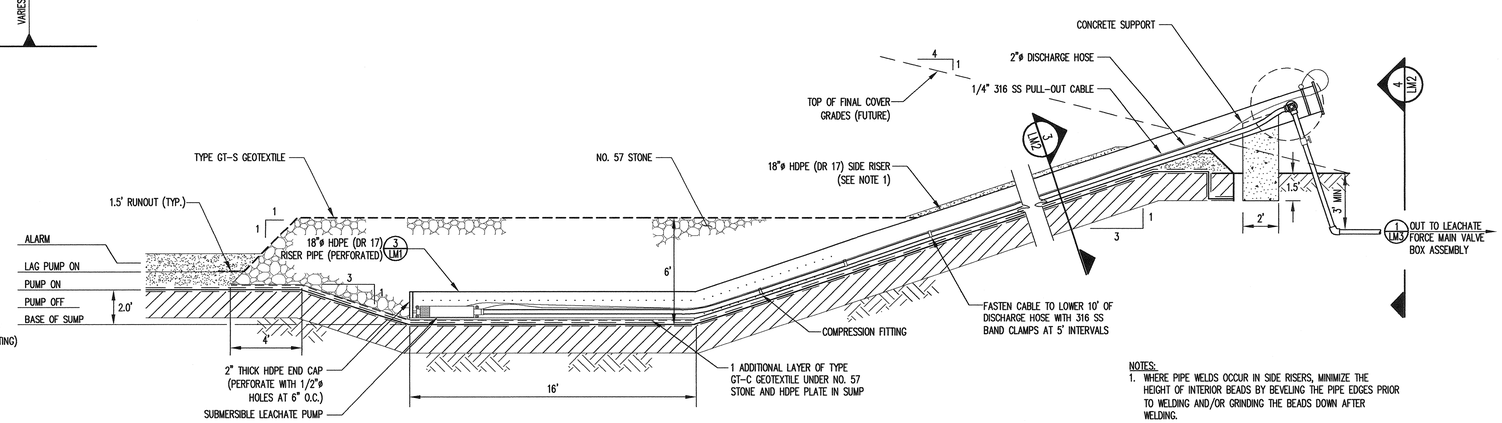
NOTES:
1. WRAP EXPOSED TRANSMISSION PIPE AND FITTINGS WITH INSULATION AND HEAT TAPE. EXTEND INSULATION 12" MIN. BELOW GRADE.
2. PROVIDE ADDITIONAL ATTACHMENT FOR CONVERSION OF TEE TO CAM LOCK FITTING AND FLEXIBLE DISCHARGE HOSE FOR REMOVAL OF STORMWATER.

SIDE RISER – FRONT VIEW

DETAIL 4 LM2
NOT TO SCALE



NOTES:
1. WRAP EXPOSED DISCHARGE PIPE AND FITTINGS WITH INSULATION AND HEAT TAPE. EXTEND INSULATION 12" BELOW GRADE.
2. PROVIDE ADDITIONAL ATTACHMENT FOR CONVERSION OF TEE TO CAM LOCK FITTING AND FLEXIBLE DISCHARGE HOSE FOR REMOVAL OF STORMWATER.



NOTES:
1. WHERE PIPE WELDS OCCUR IN SIDE RISERS, MINIMIZE THE HEIGHT OF INTERIOR BEADS BY BEVELING THE PIPE EDGES PRIOR TO WELDING AND/OR GRINDING THE BEADS DOWN AFTER WELDING.

LEACHATE SUMP – SECTION THROUGH SIDE RIDER

DETAIL 5 LM2
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

REVISION | NO. | DATE

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SEAL

PROJECT TITLE: DAVIDSON COUNTY MSW LANDFILL PHASE 2 AREA 2 PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE: LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 3)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0592	
SHEET NO. 12	DRAWING NO. LM2

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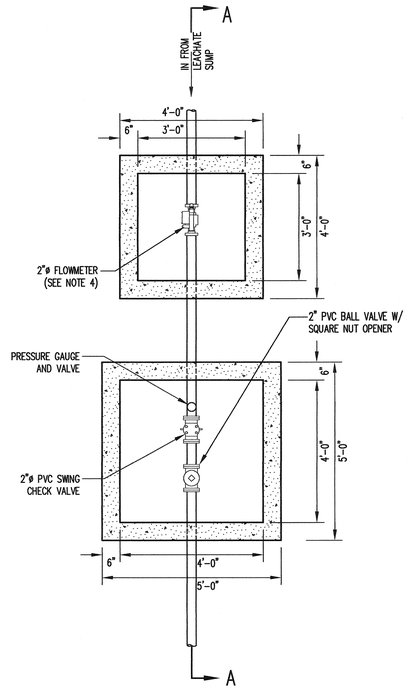
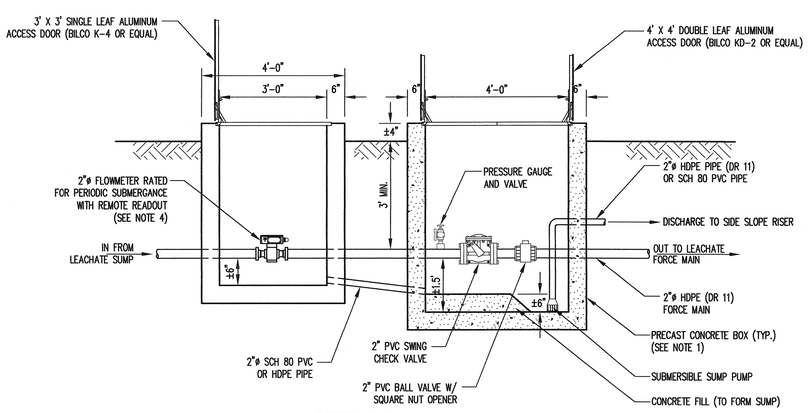


PLAN VIEW

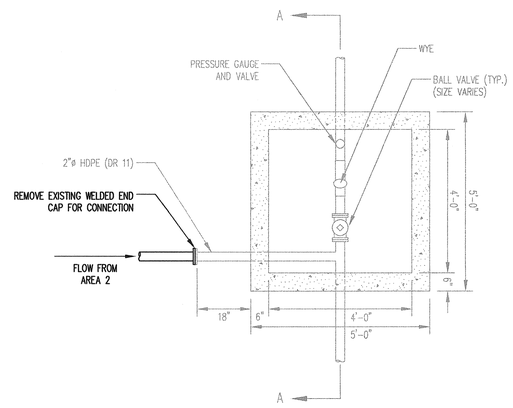


SECTION A-A

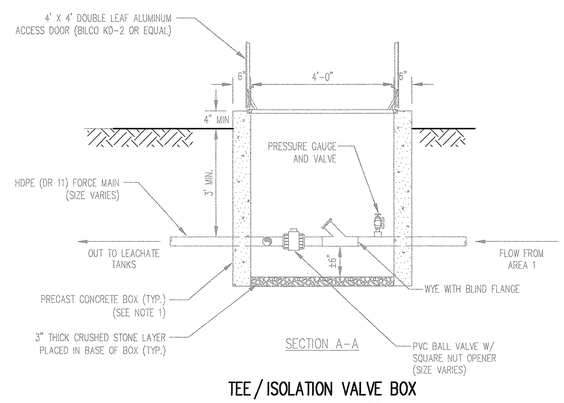
LEACHATE FORCEMAIN VALVE BOX ASSEMBLY

DETAIL 1 / LM3
NOT TO SCALE

NOTES:
1. PRECAST CONCRETE BOXES AND COVERS SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
   A. CONCRETE: COMPRESSIVE STRENGTH 4,000 PSI
   B. REINFORCING: ASTM A-615, GRADE 60
   C. MEETS H-20 LOADING.
2. CONTRACTOR SHALL PROVIDE CONCRETE THRUST BLOCKING AND VALVE SUPPORTS AS REQUIRED.
3. CONTRACTOR SHALL VERIFY THAT THE SELECTED BOX IS ADEQUATELY SIZED TO FIT THE PROPOSED VALVES AND FITTINGS.
4. FLOWMETER SHALL BE INSTALLED IN PIPE WITH MINIMUM OF 5 PIPE DIAMETERS UNOBSTRUCTED PIPE DOWNSTREAM OF METER AND 10 PIPE DIAMETERS UPSTREAM OF METER.



PLAN VIEW

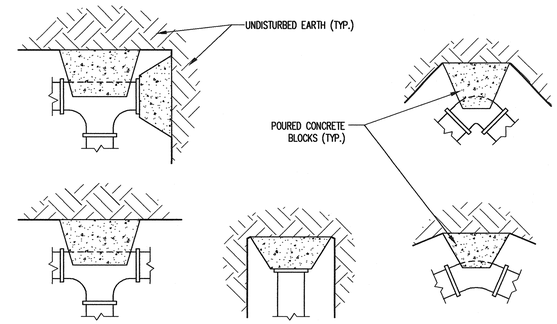


SECTION A-A

TEE / ISOLATION VALVE BOX

DETAIL 2 / LM3
NOT TO SCALE

NOTES:
1. PRECAST CONCRETE BOXES AND COVERS SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
   A. CONCRETE: COMPRESSIVE STRENGTH 4,000 PSI
   B. REINFORCING: ASTM A-615, GRADE 60
   C. MEETS H-20 LOADING.
2. CONTRACTOR SHALL PROVIDE CONCRETE THRUST BLOCKING AND VALVE SUPPORTS AS REQUIRED.
3. CONTRACTOR SHALL VERIFY THAT THE SELECTED BOX IS ADEQUATELY SIZED TO FIT THE PROPOSED VALVES AND FITTINGS.
4. PLACE UP TO FOUR (4) BOLLARDS AROUND COMPLETED STRUCTURE AS DIRECTED BY THE OWNER AND ENGINEER.



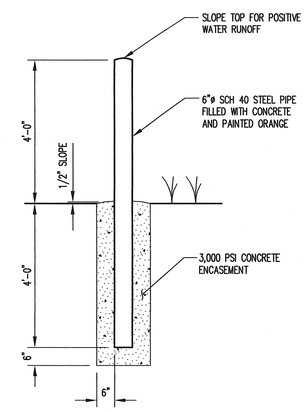
NOTES:
1. THESE DETAILS ARE FOR BOTH VERTICALLY AND HORIZONTALLY LAID PIPE.
2. POURED IN PLACE CONCRETE SHALL BE CLASS B.
3. LEAVE JOINTS CLEAR OF CONCRETE FOR EASY ACCESS.
4. POLYETHYLENE SHALL BE WRAPPED AROUND FITTINGS WHERE CONCRETE BLOCKING WILL EVENTUALLY BE REMOVED.
5. THE CRITICAL CONDITION OF UNDISTURBED EARTH IS ANTICIPATED TO BE SILTY SAND.
6. FITTING FACTORS: 90° – 1.41
   PLUG – 1.00
   45° – 0.77
   22 1/2° – 0.39
   11 1/4° – 0.20

REQUIRED AREA OF BLOCK FACE EARTH BEARING (B) SHALL BE FIGURED AS FOLLOWS WHERE:
B = AREA OF BLOCK FACE (FT.^{2})
A = AREA OF PIPE DIA. IN SQ. IN.
P = DESIGN WORKING PRESS, PSI.
C = FITTING FACTOR

$$B = \frac{P\ A\ C}{2000}$$

THRUST BLOCKS

DETAIL 4 / LM3
NOT TO SCALE



BOLLARD

DETAIL 3 / LM3
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

NO.	DATE	REVISION

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SEAL
NORTH CAROLINA PROFESSIONAL SEAL 021608 ENGINEER PETER K. SMITH
3/13/12

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
LEACHATE MANAGEMENT SYSTEM DETAILS
(SHEET 3 OF 3)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0593	
SHEET NO. 13	DRAWING NO. LM3

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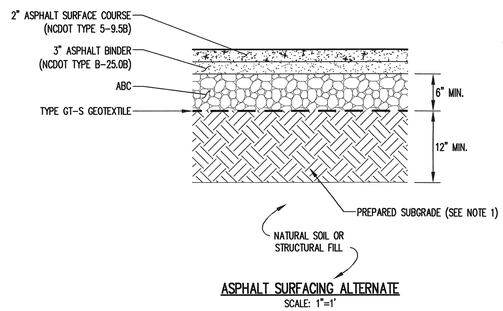
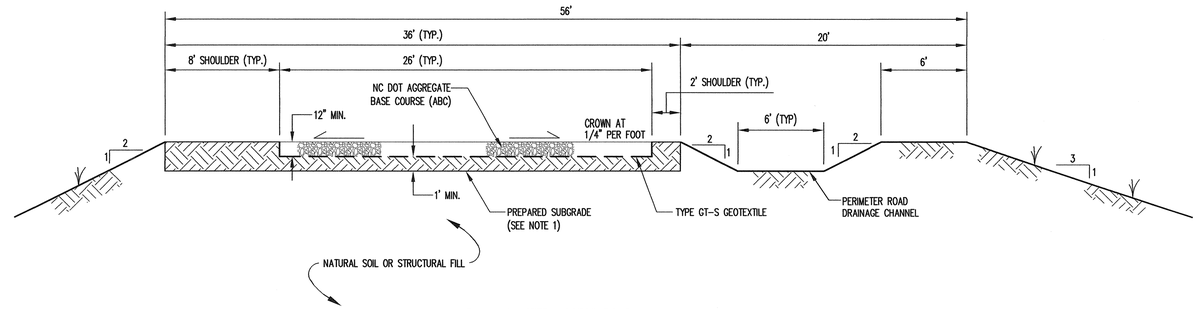


ASPHALT SURFACING ALTERNATE

SCALE: 1"=1'



LANDFILL PERIMETER ACCESS ROAD

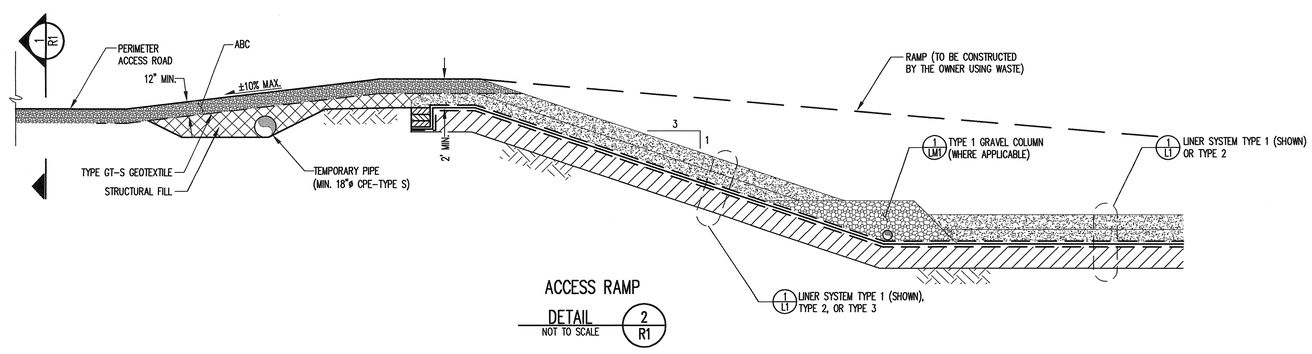
TYPICAL ROADWAY CROSS SECTIONS

DETAIL 1/R1

NOT TO SCALE

NOTE:

1. IN FILL AREAS, PREPARED SUBGRADE IS EQUIVALENT TO STRUCTURAL FILL. FOR CUT AREAS REMOVE AND REPLACE WITH STRUCTURAL FILL (SEE PROJECT SPECIFICATIONS.)



ACCESS RAMP

DETAIL 2/R1

NOT TO SCALE

PERMIT ISSUE

NOT FOR CONSTRUCTION

NO.	DATE	REVISION

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SMITH 5/31/12

PROJECT TITLE:

DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:

ROADWAY DETAILS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: ZQ	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0594	
SHEET NO. 14	DRAWING NO. R1

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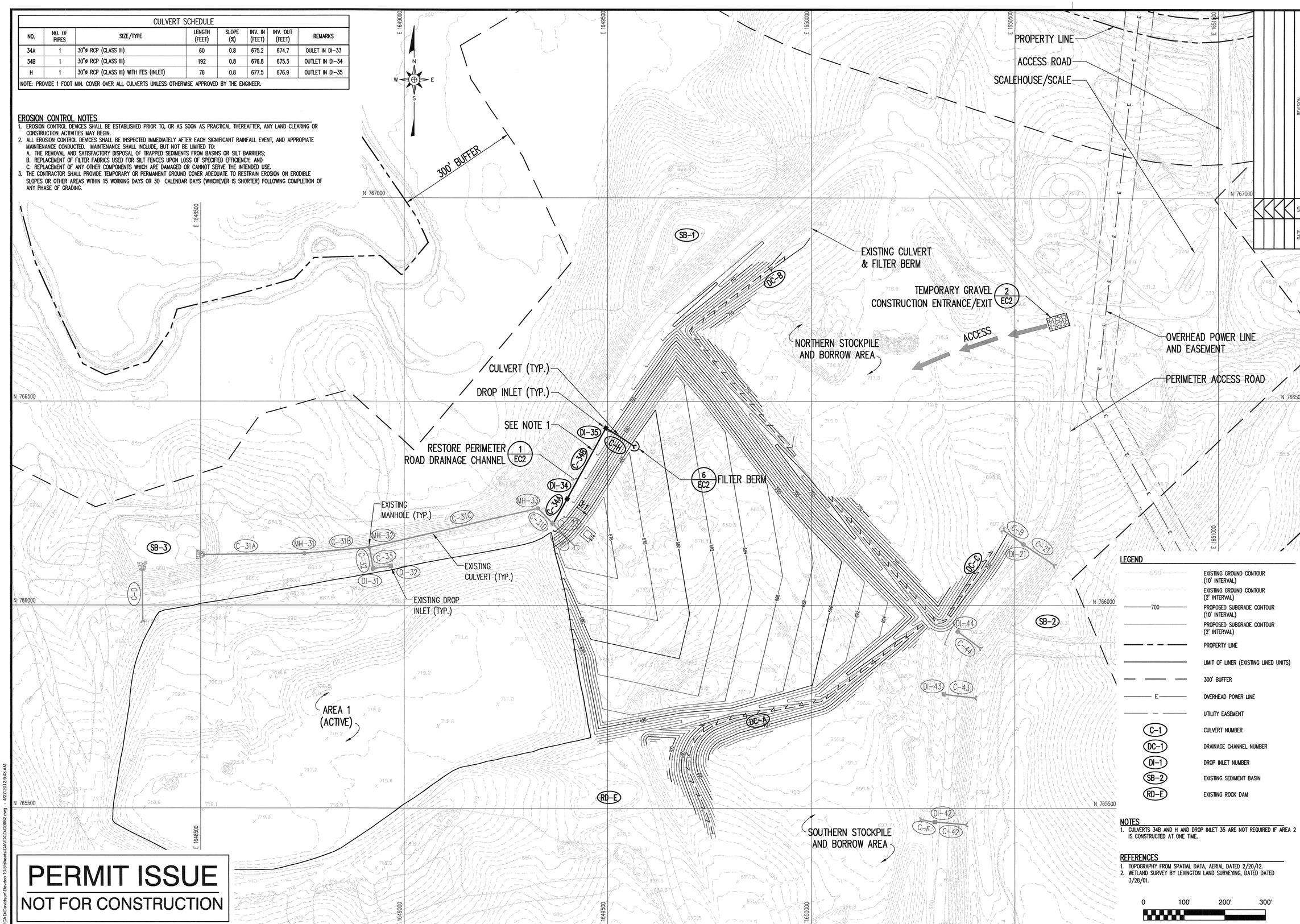
CULVERT SCHEDULE							
NO.	NO. OF PIPES	SIZE/TYPE	LENGTH (FEET)	SLOPE (%)	INV. IN (FEET)	INV. OUT (FEET)	REMARKS
34A	1	30"ø RCP (CLASS III)	60	0.8	675.2	674.7	OULET IN DI-33
34B	1	30"ø RCP (CLASS III)	192	0.8	676.8	675.3	OUTLET IN DI-34
H	1	30"ø RCP (CLASS III) WITH FES (INLET)	76	0.8	677.5	676.9	OUTLET IN DI-35
NOTE: PROVIDE 1 FOOT MIN. COVER OVER ALL CULVERTS UNLESS OTHERWISE APPROVED BY THE ENGINEER.							

EROSION CONTROL NOTES

1. EROSION CONTROL DEVICES SHALL BE ESTABLISHED PRIOR TO, OR AS SOON AS PRACTICAL THEREAFTER, ANY LAND CLEARING OR CONSTRUCTION ACTIVITIES MAY BEGIN.
2. ALL EROSION CONTROL DEVICES SHALL BE INSPECTED IMMEDIATELY AFTER EACH SIGNIFICANT RAINFALL EVENT, AND APPROPIATE MAINTENANCE CONDUCTED. MAINTENANCE SHALL INCLUDE, BUT NOT BE LIMITED TO:
   A. THE REMOVAL AND SATISFACTORY DISPOSAL OF TRAPPED SEDIMENTS FROM BASINS OR SILT BARRIERS;
   B. REPLACEMENT OF FILTER FABRICS USED FOR SILT FENCES UPON LOSS OF SPECIFIED EFFICIENCY; AND
   C. REPLACEMENT OF ANY OTHER COMPONENTS WHICH ARE DAMAGED OR CANNOT SERVE THE INTENDED USE.
3. THE CONTRACTOR SHALL PROVIDE TEMPORARY OR PERMANENT GROUND COVER ADEQUATE TO RESTRAIN EROSION ON ERODIBLE SLOPES OR OTHER AREAS WITHIN 15 WORKING DAYS OR 30 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING COMPLETION OF ANY PHASE OF GRADING.



LEGEND

690	EXISTING GROUND CONTOUR (10' INTERVAL)
	EXISTING GROUND CONTOUR (2' INTERVAL)
700	PROPOSED SUBGRADE CONTOUR (10' INTERVAL)
	PROPOSED SUBGRADE CONTOUR (2' INTERVAL)
	PROPERTY LINE
	LIMIT OF LINER (EXISTING LINED UNITS)
	300' BUFFER
E	OVERHEAD POWER LINE
	UTILITY EASEMENT
C-1	CULVERT NUMBER
DC-1	DRAINAGE CHANNEL NUMBER
DI-1	DROP INLET NUMBER
SB-2	EXISTING SEDIMENT BASIN
RD-E	EXISTING ROCK DAM

NOTES

1. CULVERTS 34B AND H AND DROP INLET 35 ARE NOT REQUIRED IF AREA 2 IS CONSTRUCTED AT ONE TIME.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.

0 100' 200' 300'

PERMIT ISSUE
NOT FOR CONSTRUCTION

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REVISION | NO. | DATE

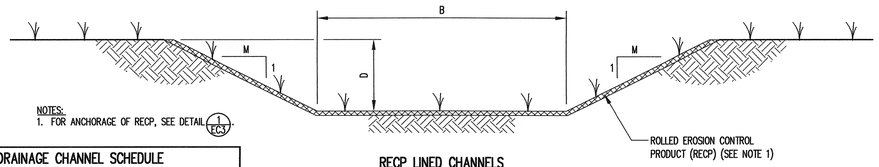
SEAL

PROJECT TITLE: DAVIDSON COUNTY MSW LANDFILL PHASE 2 AREA 2 PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE: EROSION AND SEDIMENTATION CONTROL PLAN AREA 2 CONSTRUCTION

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0652	
SHEET NO. 15	DRAWING NO. EC1

G:\CAD\Davidson\Davdco 10-5\sheets\DAVDCO-D0652.dwg - 4/27/2012 9:43 AM



NOTES:
1. FOR ANCHORAGE OF RECP, SEE DETAIL 1/EC3

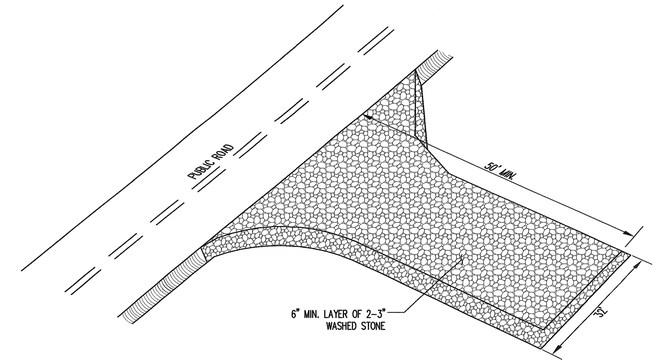
DRAINAGE CHANNEL SCHEDULE				
DRAINAGE CHANNEL NO,	LINING	B (FEET)	D (FEET)	M
PERIMETER ROAD DC	TRM*	6	2	2
DC-A	ECB**	10	2 (MIN)	3
DC-B	ECB	10	2 (MIN)	3
DC-C	ECB	10	2 (MIN)	3

*TRM – TURF REINFORCEMENT MATTING
**ECB – EROSION CONTROL BLANKET

RECP LINED CHANNELS

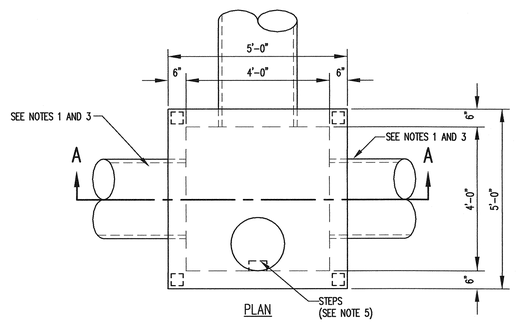
DRAINAGE CHANNEL DETAILS

DETAIL 1/EC2
NOT TO SCALE

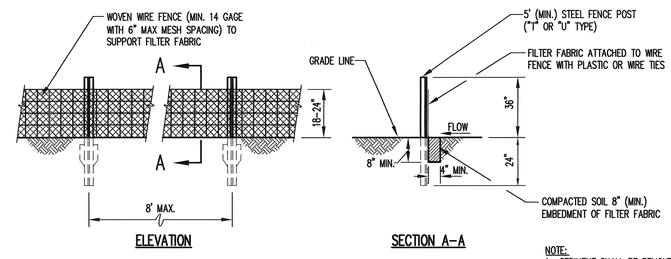


TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT

DETAIL 2/EC2
NOT TO SCALE



PLAN



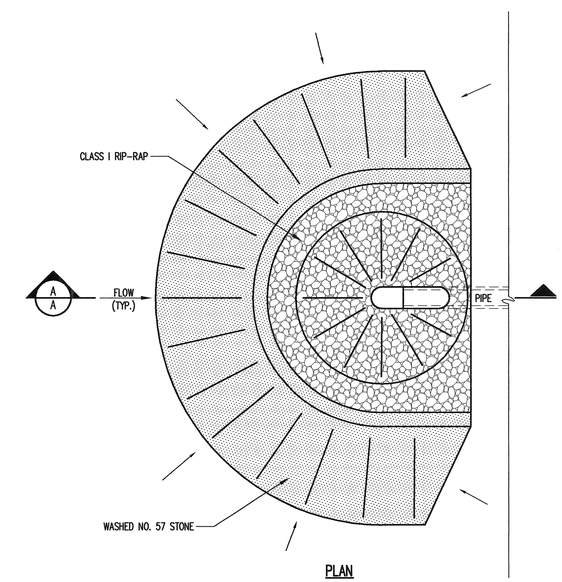
ELEVATION

SECTION A–A

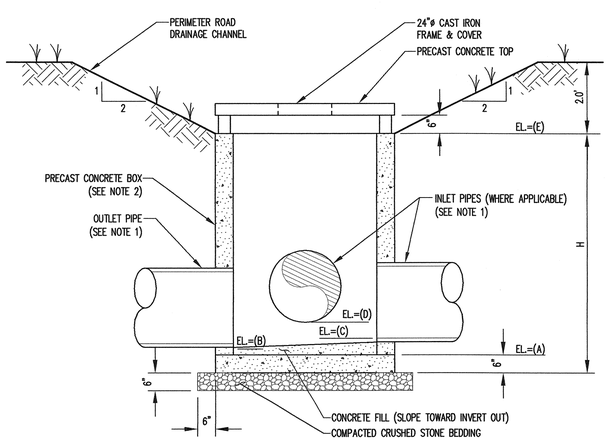
NOTE:
1. SEDIMENT SHALL BE REMOVED WHEN IT REACHES HALF THE HEIGHT OF THE FENCE.

SILT FENCE

DETAIL 4/EC2
NOT TO SCALE



PLAN



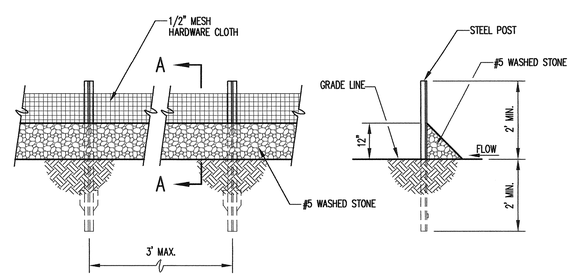
SECTION A–A

DROP INLET SCHEDULE						
DROP INLET	A (FEET)	B (FEET)	C (FEET)	D (FEET)	E (FEET)	H (FEET)
DI-33 (EXISTING)	±669	669.7	669.8	674.7	690.7	±22
DI-34	674.7	675.2	675.3	N/A	692.3	18.1
DI-35	676.3	676.8	N/A	676.9	699.3	23.5

NOTES:
1. PROVIDE WATERTIGHT JOINTS ON ALL PIPING.
2. PRECAST CONCRETE BOXES SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
   A. CONCRETE: COMPRESSIVE STRENGTH 4000 PSI
   B. REINFORCING: ASTM A-615, GRADE 60
   C. MEETS H-20 LOADING.
3. PIPES MAY BE ORIENTED DIFFERENTLY WITH RESPECT TO THE THE CHANNEL THAN DISPLAYED HERE. SEE DRAWING EC1 FOR PROPER ORIENTATION.
4. THE CONTRACTOR SHALL PROVIDE ADEQUATE PROTECTION FROM SEDIMENTATION FOR ALL DROP INLETS USING STONE FILTER FENCE OR OTHER METHOD AS APPROVED BY THE ENGINEER.
5. PROVIDE STEPS FOR DROP INLETS WITH H>4.5'. STEPS SHALL HAVE A 16" SPACING THE FULL HEIGHT OF THE DROP INLET. START FIRST STEP 6" BELOW TOP.

DROP INLET

DETAIL 3/EC2
NOT TO SCALE

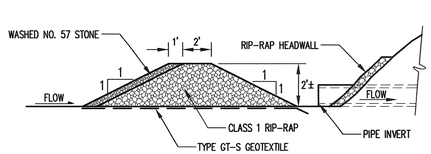


ELEVATION

SECTION A–A

STONE FILTER FENCE

DETAIL 5/EC2
NOT TO SCALE



SECTION A–A

FILTER BERM

DETAIL 6/EC2
NOT TO SCALE

PERMIT ISSUE
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REVISION		
NO.	DATE	

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SEAL

PROJECT TITLE: DAVIDSON COUNTY MSW LANDFILL PHASE 2 AREA 2 PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE: EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 1 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0595	
SHEET NO. 16	DRAWING NO. EC2

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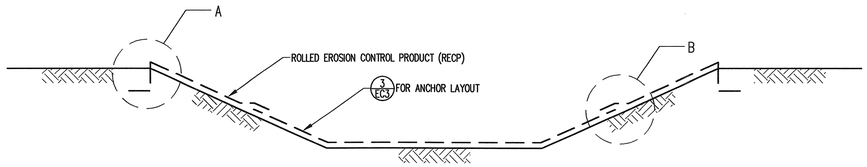
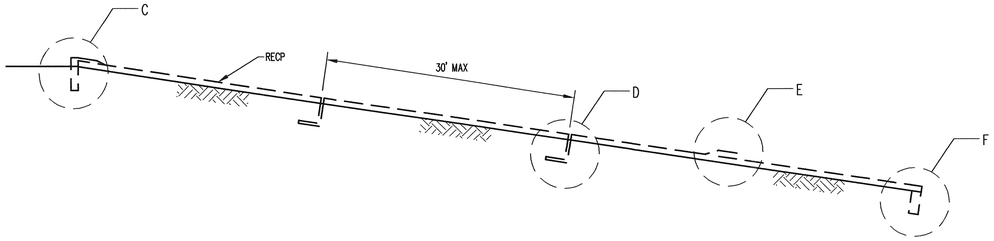
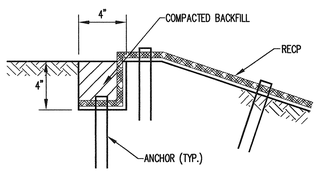


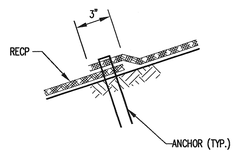
TYPICAL CHANNEL CROSS SECTION



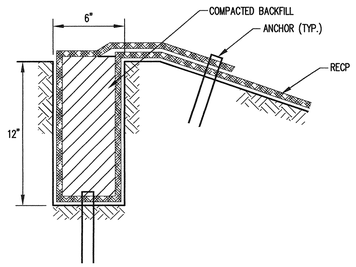
TYPICAL CHANNEL PROFILE



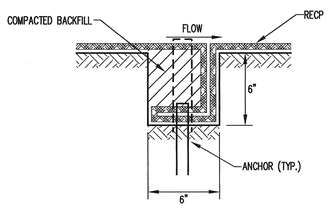
A. LONGITUDINAL ANCHOR TRENCH



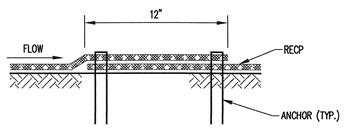
B. OVERLAP AT ADJACENT EDGES



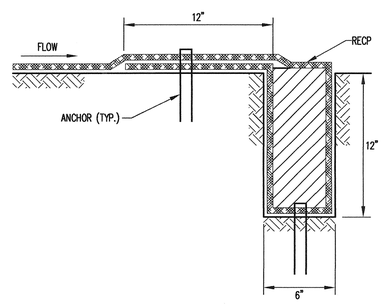
C. UPSTREAM TERMINAL ANCHOR TRENCH



D. INTERMITTENT CHECK SLOT



E. OVERLAP AT ROLL ENDS

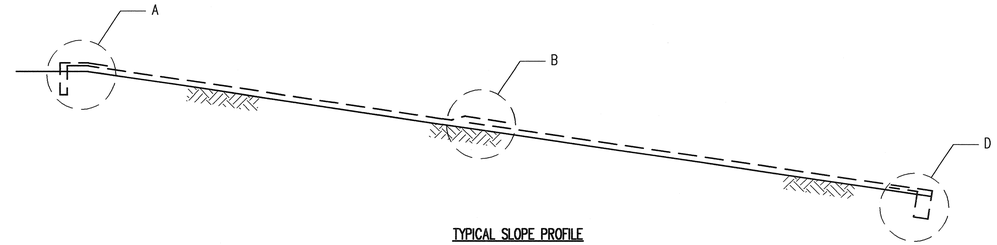


F. DOWNSTREAM TERMINAL ANCHOR TRENCH

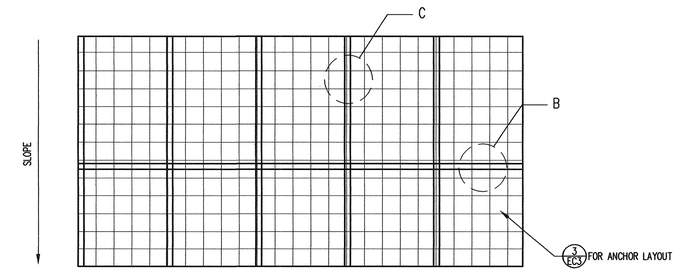
NOTES:
1. PLACE ANCHORS AT ANCHOR TRENCHES, OVERLAPS, AND CHECK SLOTS ON 1 FOOT CENTERS. IF APPLICABLE, STAGGER ANCHOR SPACING BETWEEN MULTIPLE ROWS OF ANCHORS.

INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (CHANNELS)

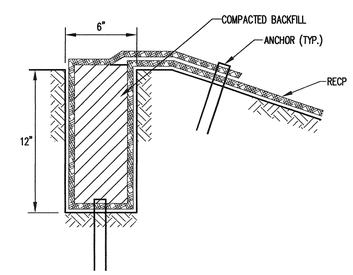
DETAIL 1/EC3
NOT TO SCALE



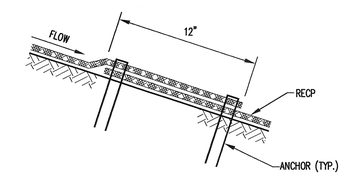
TYPICAL SLOPE PROFILE



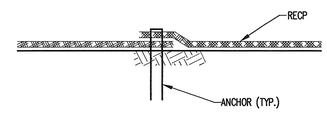
TYPICAL SLOPE PLAN VIEW



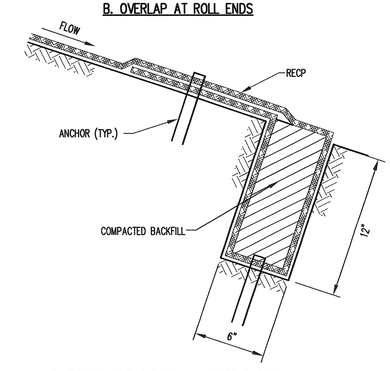
A. UPSLOPE TERMINAL ANCHOR TRENCH



B. OVERLAP AT ROLL ENDS



C. OVERLAP AT ADJACENT EDGES

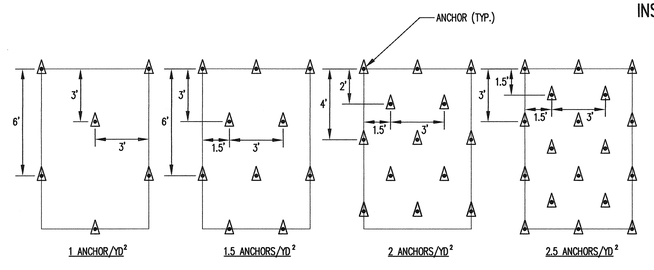


D. DOWNSLOPE TERMINAL ANCHOR TRENCH

NOTE:
1. PLACE ANCHORS AT ANCHOR TRENCHES, OVERLAPS, AND CHECK SLOTS ON 1 FOOT CENTERS. IF APPLICABLE, STAGGER ANCHOR SPACING BETWEEN MULTIPLE ROWS OF ANCHORS.

INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (SLOPES)

DETAIL 2/EC3
NOT TO SCALE



ANCHOR LAYOUT

DETAIL 3/EC3
NOT TO SCALE

ANCHOR SPACING SCHEDULE	
LOCATION	REQUIRED ANCHOR SPACING (ANCHORS/YD²)
ALL CHANNELS	2.5
1.5H:1V SLOPES	2.0
2H:1V SLOPES	2.0
2.5H:1V SLOPES	1.5
3H:1V SLOPES	1.5
3.5H:1V SLOPES	1.0
4H:1V SLOPES	1.0

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REVISION | NO. | DATE

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0598	
SHEET NO. 17	DRAWING NO. EC3

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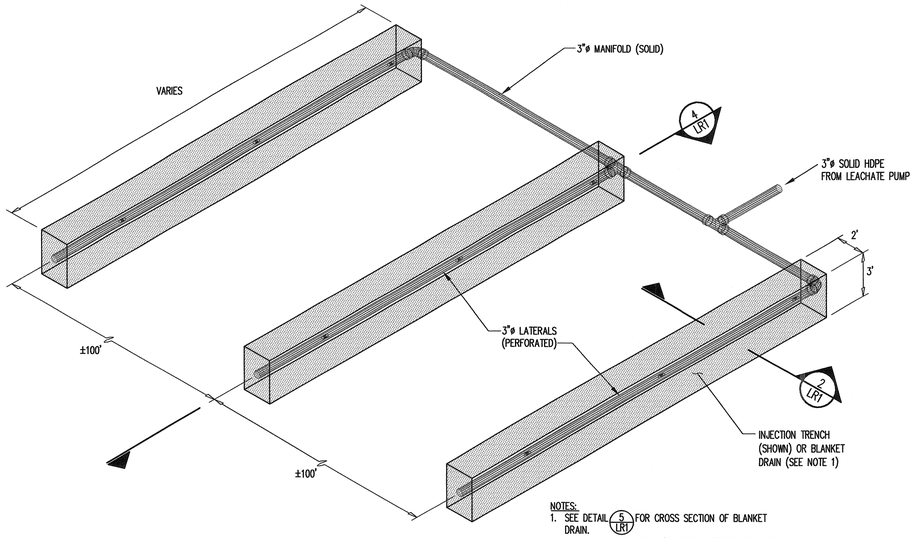
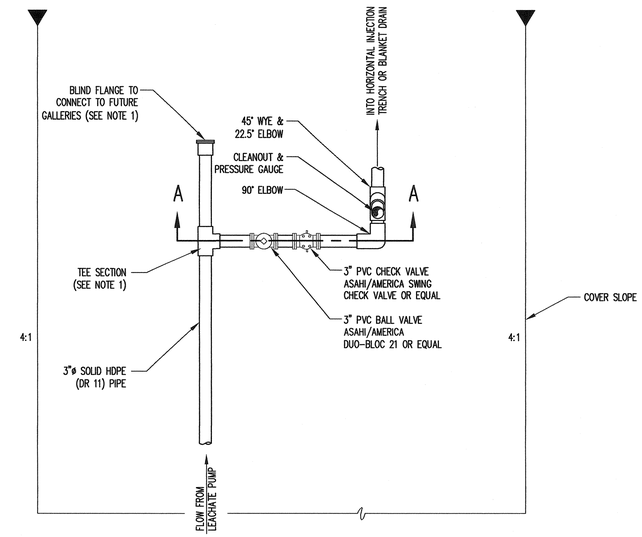


NOTES:
1. SEE DETAIL 5/LR1 FOR CROSS SECTION OF BLANKET DRAIN.
2. GAS COLLECTION PIPING (IF USED) MIRRORS LEACHATE PIPING.

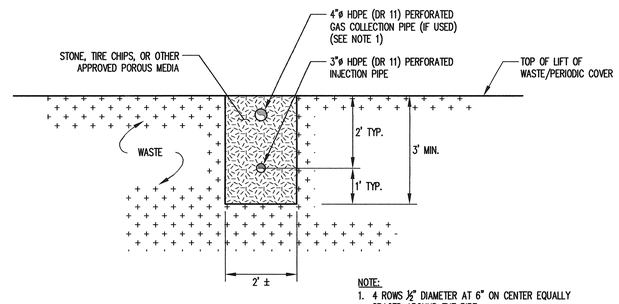
TYPICAL HORIZONTAL INJECTION SYSTEM LAYOUT

DETAIL 1/LR1
NOT TO SCALE



PLAN VIEW

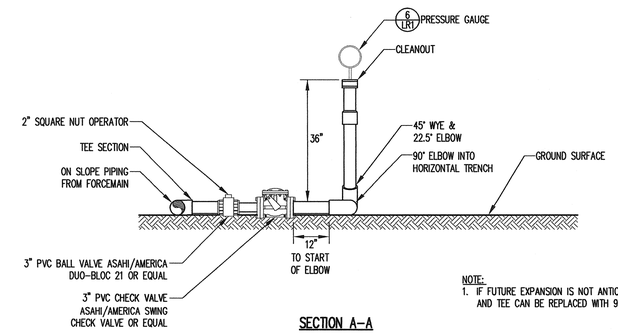
PERMIT ISSUE
NOT FOR CONSTRUCTION



NOTE:
1. 4 ROWS ½" DIAMETER AT 6" ON CENTER EQUALLY SPACED AROUND THE PIPE.

INJECTION TRENCH CROSS SECTION

DETAIL 2/LR1
NOT TO SCALE

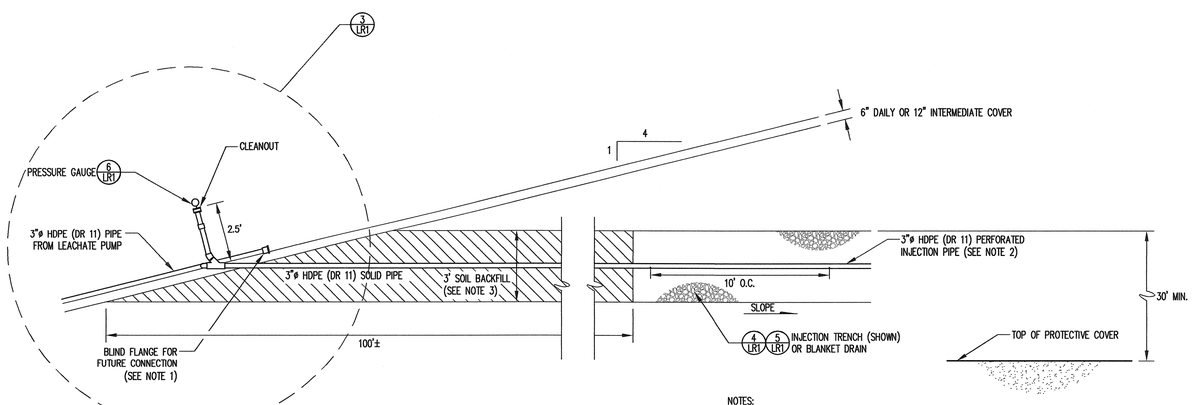


NOTE:
1. IF FUTURE EXPANSION IS NOT ANTICIPATED THE BLIND AND TEE CAN BE REPLACED WITH 90° ELBOW.

SECTION A–A

HORIZONTAL INJECTION SYSTEM VALVING

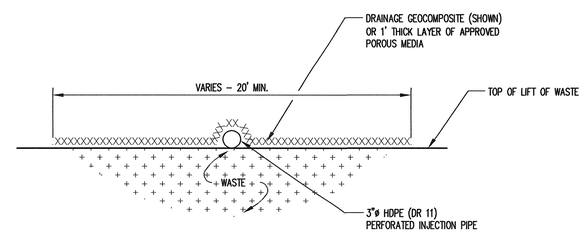
DETAIL 3/LR1
NOT TO SCALE



NOTES:
1. IF FUTURE EXPANSION IS NOT ANTICIPATED THE BLIND FLANGE AND TEE CAN BE REPLACED WITH 90° ELBOW.
2. PERFORATED INJECTION PIPE SHALL HAVE 1 ROW OF 1/8 INCH DIAMETER HOLES AT 10 FEET ON CENTER.
3. USE CLAYEY SOILS IF POSSIBLE FOR BACKFILL.

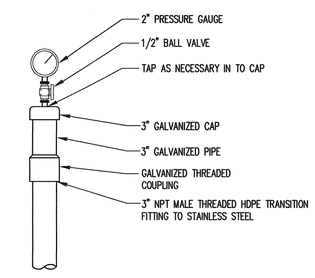
HORIZONTAL INJECTION PIPING CROSS SECTION

DETAIL 4/LR1
NOT TO SCALE



BLANKET DRAIN CROSS SECTION

DETAIL 5/LR1
NOT TO SCALE



PRESSURE GAUGE

DETAIL 6/LR1
NOT TO SCALE

REVISION	DATE

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SEAL

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
LEACHATE RECIRCULATION DETAILS
(SHEET 1 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0599	
SHEET NO. 18	DRAWING NO. LR1

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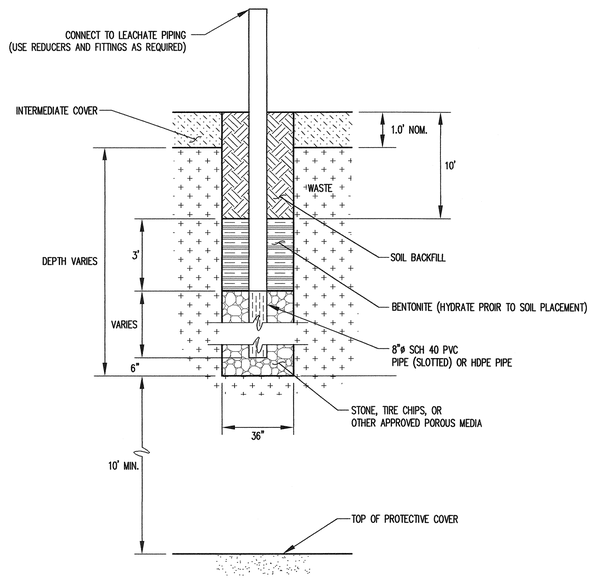
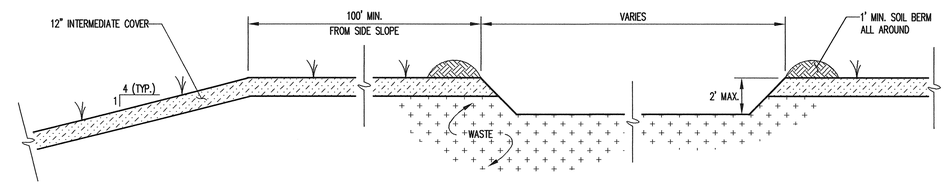


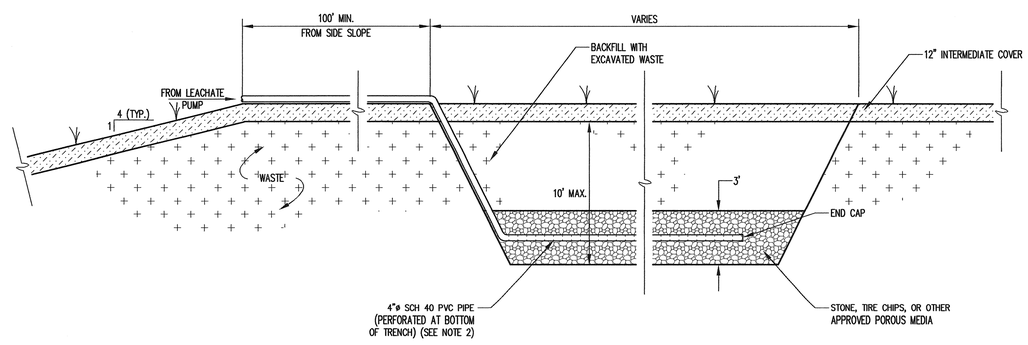
VERTICAL INJECTION WELL

DETAIL 1 / LR2
NOT TO SCALE



LEACHATE RECIRCULATION POND CROSS SECTION

DETAIL 2 / LR2
NOT TO SCALE



NEAR SURFACE LEACHATE RECIRCULATION TRENCH

DETAIL 3 / LR2
NOT TO SCALE

NOTES:
1. DO NOT ENTER TRENCH DURING CONSTRUCTION.
2. USE HDPE (DR 11) PIPE IF COLLECTING LFG LONG-TERM.
3. WIDTH OF TRENCH MAY VARY.

PERMIT ISSUE
NOT FOR CONSTRUCTION

REVISION | NO. | DATE

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021096 ENGINEER PETER K. SMITH 5/31/12

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
LEACHATE RECIRCULATION
DETAILS
(SHEET 2 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0600	
SHEET NO. 19	DRAWING NO. LR2

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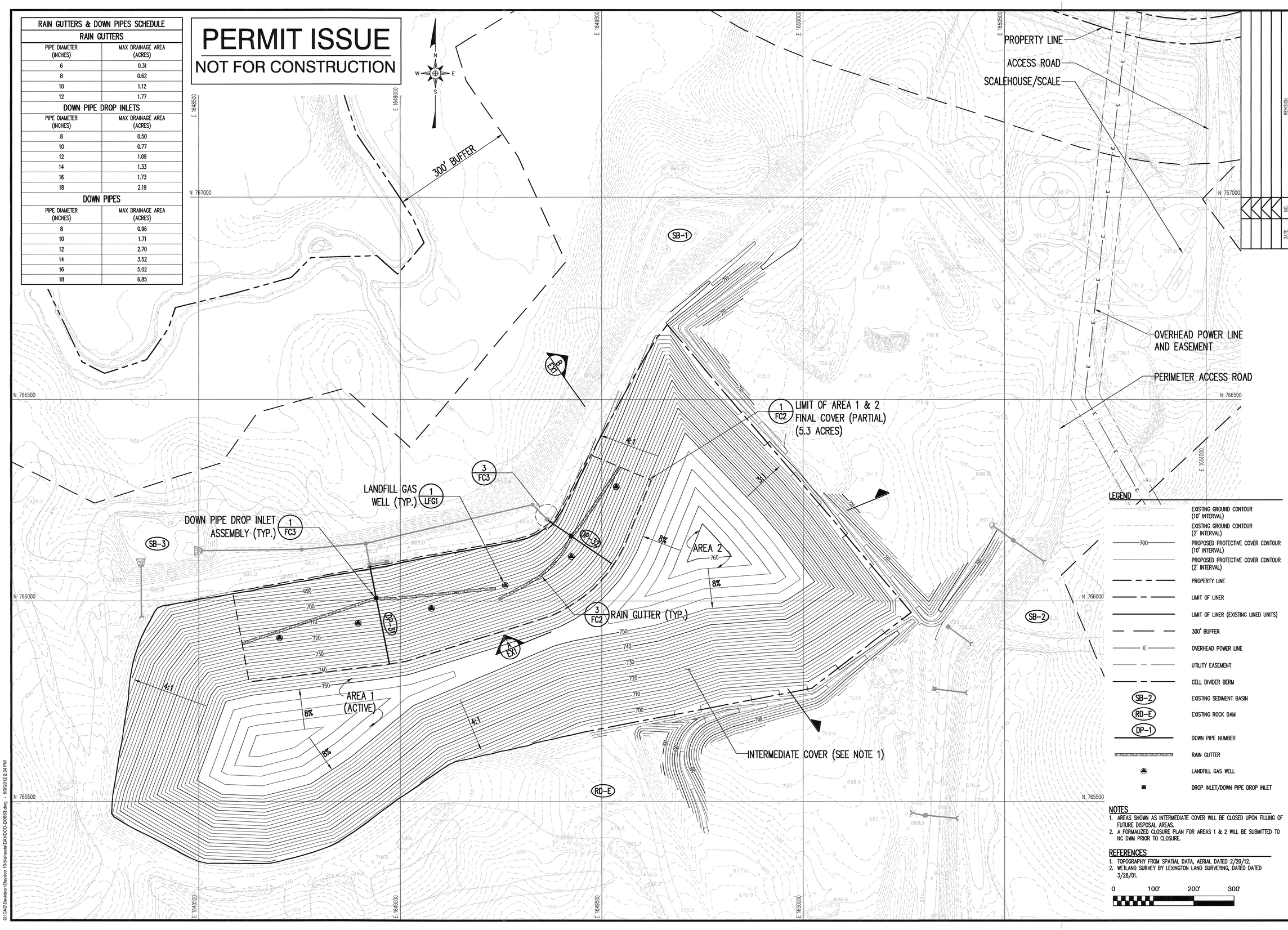
RAIN GUTTERS & DOWN PIPES SCHEDULE	
RAIN GUTTERS	
PIPE DIAMETER (INCHES)	MAX DRAINAGE AREA (ACRES)
6	0.31
8	0.62
10	1.12
12	1.77
DOWN PIPE DROP INLETS	
PIPE DIAMETER (INCHES)	MAX DRAINAGE AREA (ACRES)
8	0.50
10	0.77
12	1.09
14	1.33
16	1.73
18	2.19
DOWN PIPES	
PIPE DIAMETER (INCHES)	MAX DRAINAGE AREA (ACRES)
8	0.96
10	1.71
12	2.70
14	3.52
16	5.02
18	6.85

PERMIT ISSUE
NOT FOR CONSTRUCTION



LEGEND

- EXISTING GROUND CONTOUR (10' INTERVAL)
- EXISTING GROUND CONTOUR (2' INTERVAL)
- 700 — PROPOSED PROTECTIVE COVER CONTOUR (10' INTERVAL)
- PROPOSED PROTECTIVE COVER CONTOUR (2' INTERVAL)
- PROPERTY LINE
- LIMIT OF LINER
- LIMIT OF LINER (EXISTING LINED UNITS)
- 300' BUFFER
- E — OVERHEAD POWER LINE
- UTILITY EASEMENT
- CELL DIVIDER BERM
- SB-2 EXISTING SEDIMENT BASIN
- RD-E EXISTING ROCK DAM
- DP-1 DOWN PIPE NUMBER
- RAIN GUTTER
- LANDFILL GAS WELL
- DROP INLET/DOWN PIPE DROP INLET

NOTES
1. AREAS SHOWN AS INTERMEDIATE COVER WILL BE CLOSED UPON FILLING OF FUTURE DISPOSAL AREAS.
2. A FORMALIZED CLOSURE PLAN FOR AREAS 1 & 2 WILL BE SUBMITTED TO NC DWM PRIOR TO CLOSURE.

REFERENCES
1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.

0 100' 200' 300'

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NO.	DATE	REVISION

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SMITH 5/9/12

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
AREAS 1 & 2
FINAL COVER GRADING
AND DRAINAGE PLAN

DESIGNED BY: P.K.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0653	
SHEET NO. 20	DRAWING NO. FC1

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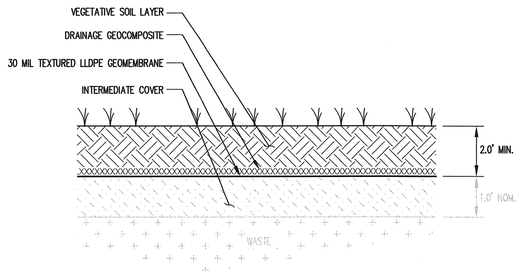
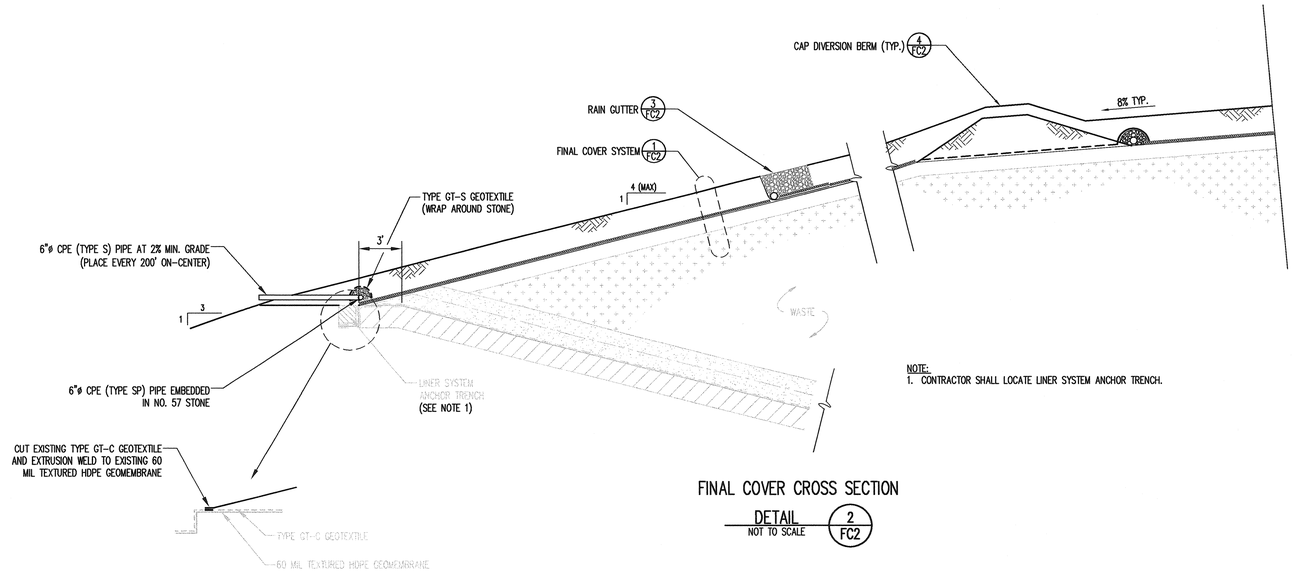


FINAL COVER SYSTEM

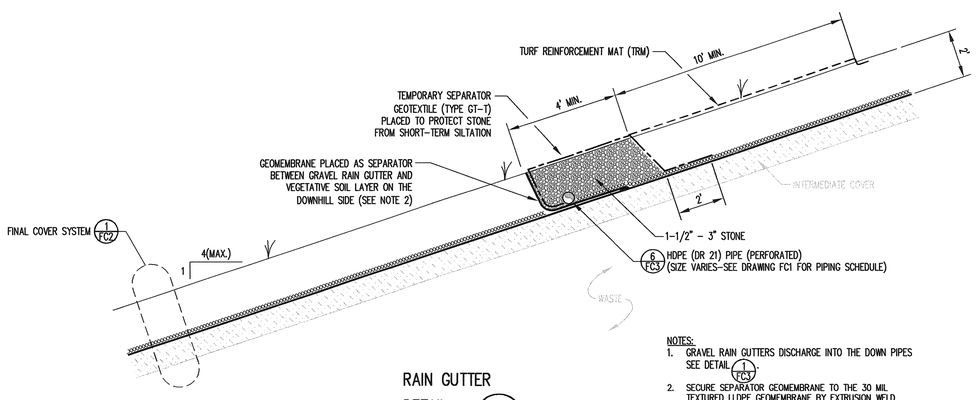
DETAIL 1/FC2
NOT TO SCALE



NOTE:
1. CONTRACTOR SHALL LOCATE LINER SYSTEM ANCHOR TRENCH.

FINAL COVER CROSS SECTION

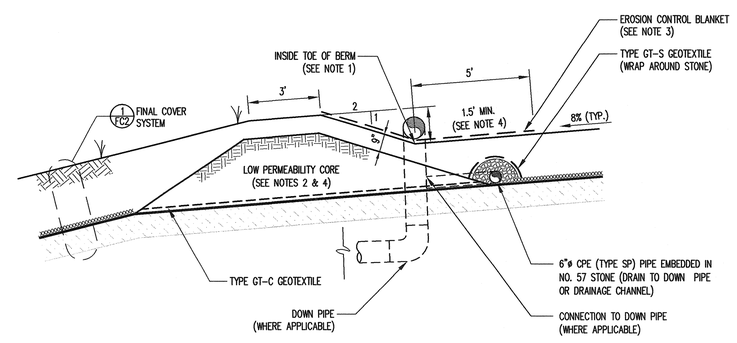
DETAIL 2/FC2
NOT TO SCALE



NOTES:
1. GRAVEL RAIN GUTTERS DISCHARGE INTO THE DOWN PIPES SEE DETAIL 1/FC3
2. SECURE SEPARATOR GEOMEMBRANE TO THE 30 MIL TEXTURED LLDPE GEOMEMBRANE BY EXTRUSION WELD.
3. 4 OZ/SY NON-WOVEN GEOTEXTILE SHALL BE USED.

RAIN GUTTER

DETAIL 3/FC2
NOT TO SCALE



CAP DIVERSION BERM

DETAIL 4/FC2
NOT TO SCALE

NOTES:
1. GRADE INSIDE TOE OF BERM TOWARD DOWN CHUTE OR DOWN PIPE AT 0.5% MIN. SLOPE.
2. CONSTRUCT CORE FROM TYPE CH, CL, MH, ML, SC, OR SM MATERIALS (USCS CLASSIFICATION).
3. ANCHOR OF EROSION CONTROL BLANKET, ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS.
4. TAPER BERM HEIGHT UP TO 3' AT DOWN PIPE LOCATION.

PERMIT ISSUE
NOT FOR CONSTRUCTION

NO.	DATE	REVISION

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SEAL

PROFESSIONAL SEAL 021666 ENGINEER PETER K. SMITH NORTH CAROLINA
5/31/12

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
FINAL COVER DETAILS
(SHEET 1 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0601	
SHEET NO. 21	DRAWING NO. FC2

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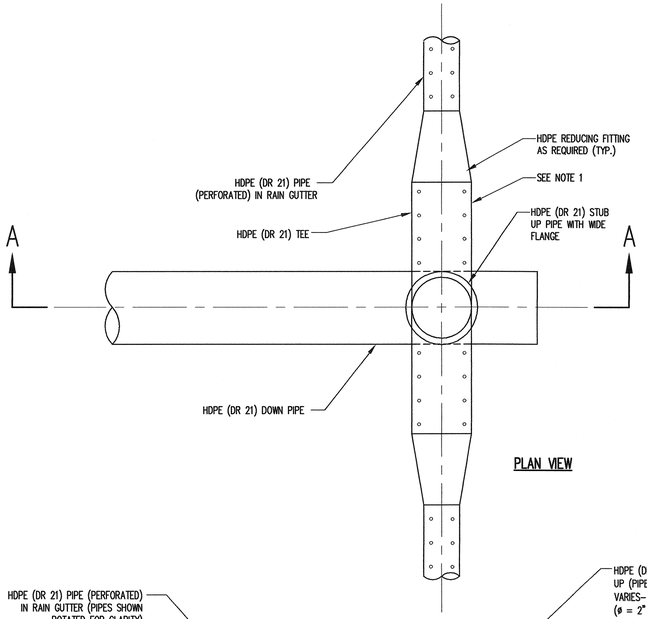
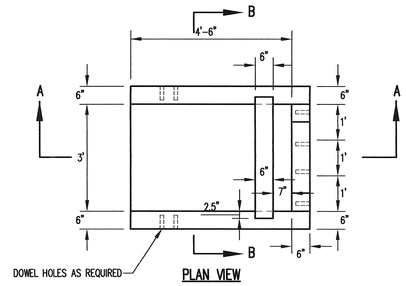
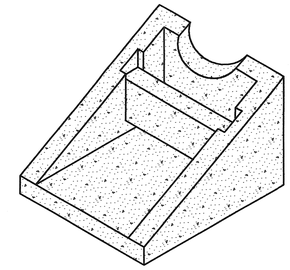


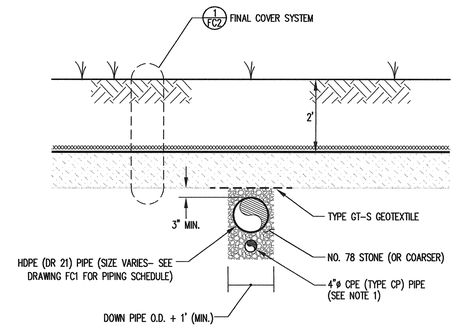
PLAN VIEW



PLAN VIEW



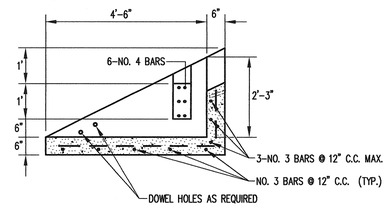
ISOMETRIC VIEW



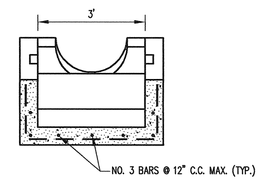
NOTE:
1. CONNECT CPE PIPE TO A LEACHATE COLLECTION PIPE CLEANOUT OR TURN DOWN INTO THE LEACHATE COLLECTION SYSTEM STONE TO DRAIN LEACHATE SEEPS ENCOUNTERED.

TYPICAL DOWN PIPE SECTION

DETAIL 4/FC3
NOT TO SCALE



SECTION A-A

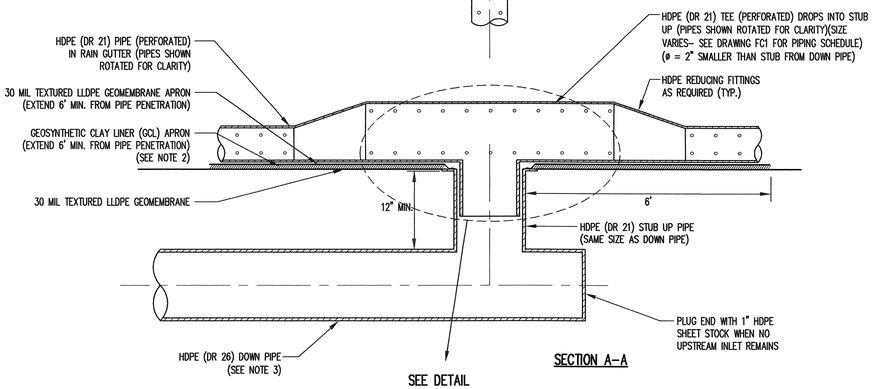


SECTION B-B

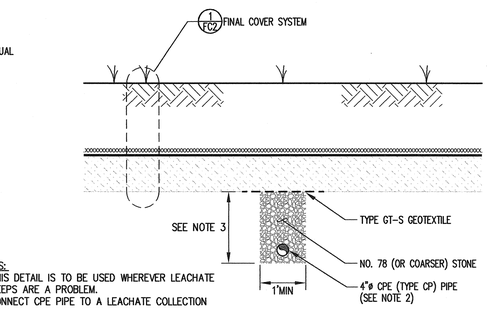
PRECAST ENERGY DISSIPATOR

DETAIL 2/FC3
NOT TO SCALE

NOTES:
1. CONCRETE STRENGTH 4000 PSI MINIMUM.
2. REINFORCING STEEL SHALL CONFORM TO ASTM A-615, GRADE 40.
3. DIMENSIONS SHOWN FOR CONCRETE THICKNESS ARE MINIMUMS. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCES.



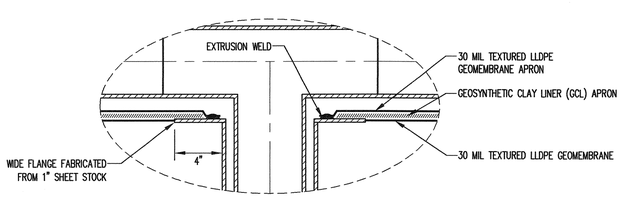
SECTION A-A



NOTES:
1 THIS DETAIL IS TO BE USED WHEREVER LEACHATE SEEPS ARE A PROBLEM.
2. CONNECT CPE PIPE TO A LEACHATE COLLECTION PIPE CLEANOUT OR TURN DOWN INTO THE LEACHATE COLLECTION SYSTEM STONE TO DRAIN SEEP COLLECTION TRENCH.
3. DEPTH OF TRENCH IS AS REQUIRED TO DRAIN SEEP(S).

SEEP COLLECTION TRENCH

DETAIL 5/FC3
NOT TO SCALE

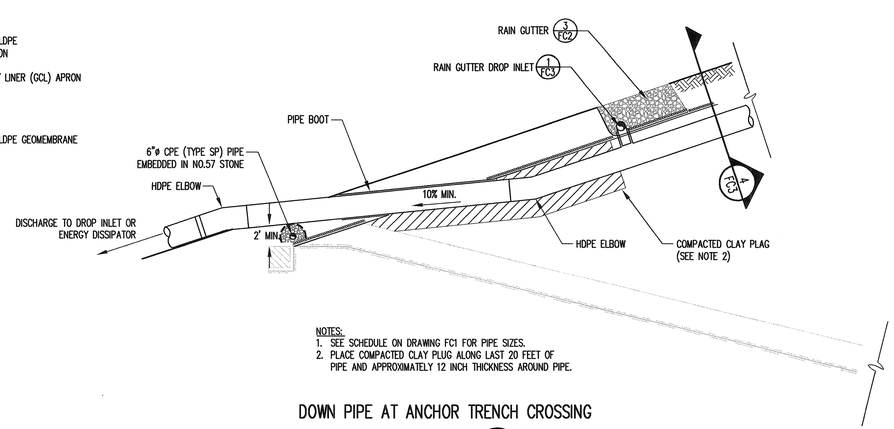


DETAIL

NOTE:
1. WHERE FLOW IS BEING DIRECTED TOWARD DOWN PIPE DROP INLET FROM ONE DIRECTION, ADD WELDED CAP ON DOWNSTREAM SIDE OF TEE.
2. GCL SHALL BE CETCO BENTOMAT SDN OR APPROVED EQUAL.
3. DOWN PIPES SHALL HAVE A MINIMUM SLOPE OF 10% UNLESS OTHERWISE APPROVED BY THE ENGINEER.

DOWN PIPE DROP INLET ASSEMBLY

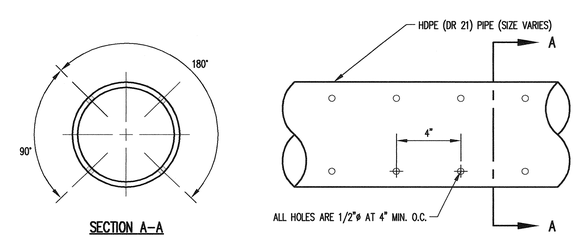
DETAIL 1/FC3
NOT TO SCALE



NOTES:
1. SEE SCHEDULE ON DRAWING FC1 FOR PIPE SIZES.
2. PLACE COMPACTED CLAY PLUG ALONG LAST 20 FEET OF PIPE AND APPROXIMATELY 12 INCH THICKNESS AROUND PIPE.

DOWN PIPE AT ANCHOR TRENCH CROSSING

DETAIL 3/FC3
NOT TO SCALE



SECTION A-A

RAIN GUTTER PIPE PERFORATIONS

DETAIL 6/FC3
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

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NO.	DATE	REVISION

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SMITH 5/31/12

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
FINAL COVER DETAILS
(DETAILS 2 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0602	
SHEET NO. 22	DRAWING NO. FC3

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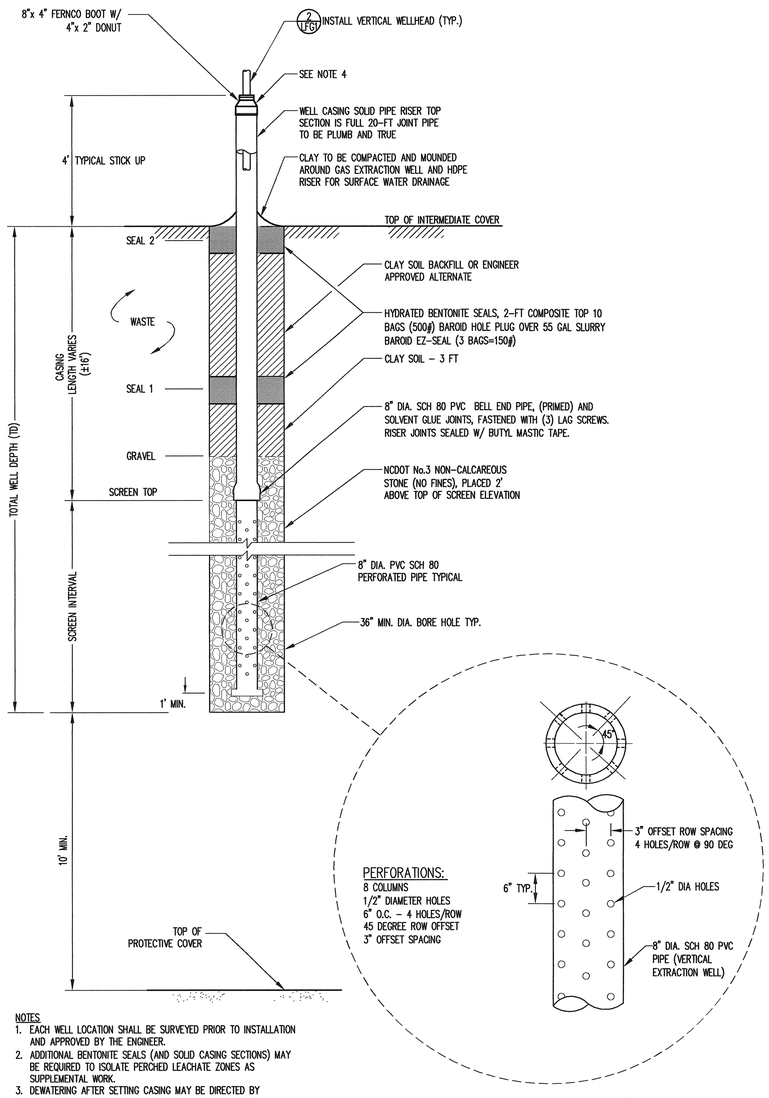
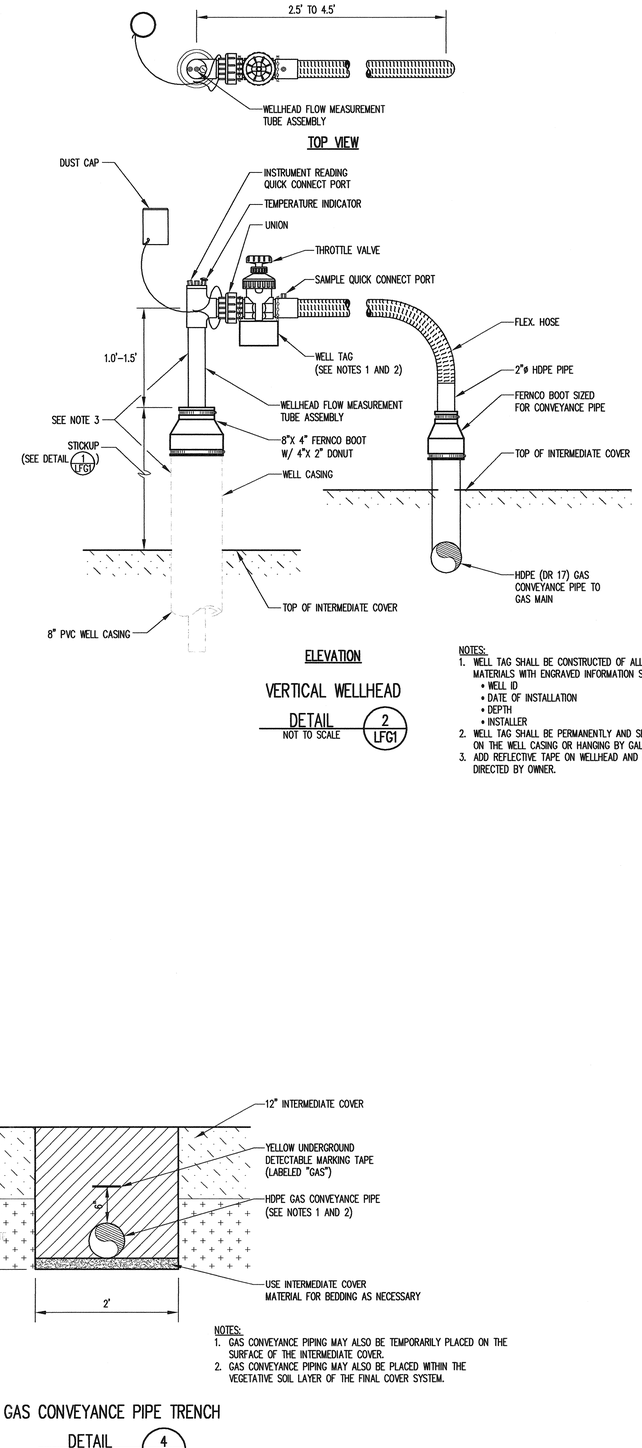


NOTES:
1. EACH WELL LOCATION SHALL BE SURVEYED PRIOR TO INSTALLATION AND APPROVED BY THE ENGINEER.
2. ADDITIONAL BENTONITE SEALS (AND SOLID CASING SECTIONS) MAY BE REQUIRED TO ISOLATE PERCHED LEACHATE ZONES AS SUPPLEMENTAL WORK.
3. DEWATERING AFTER SETTING CASING MAY BE DIRECTED BY ENGINEER AS SUPPLEMENTAL WORK.
4. AS AN ALTERNATE TO USE OF A WELLHEAD, THE WELL MAY BE TEMPORARILY CAPPED, VENTED, OR FITTED WITH A LFG UTILITY FLARE SUBJECT TO ANY AIR QUALITY REQUIREMENTS.

EXTRACTION WELL

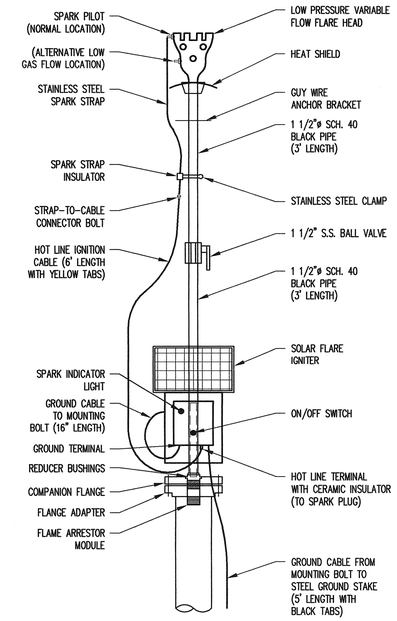
DETAIL 1 LFG1
NOT TO SCALE



VERTICAL WELLHEAD

DETAIL 2 LFG1
NOT TO SCALE

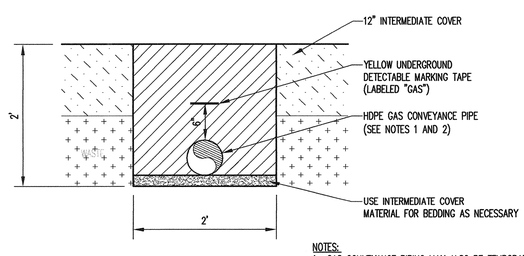
NOTES:
1. WELL TAG SHALL BE CONSTRUCTED OF ALL WEATHER MATERIALS WITH ENGRAVED INFORMATION SHOWING:
   - WELL ID
   - DATE OF INSTALLATION
   - DEPTH
   - INSTALLER
2. WELL TAG SHALL BE PERMANENTLY AND SECURELY INSTALLED ON THE WELL CASING OR HANGING BY GALVANIZED CHAIN.
3. ADD REFLECTIVE TAPE ON WELLHEAD AND WELL CASING AS DIRECTED BY OWNER.



LFG UTILITY FLARE

DETAIL 3 LFG1
NOT TO SCALE

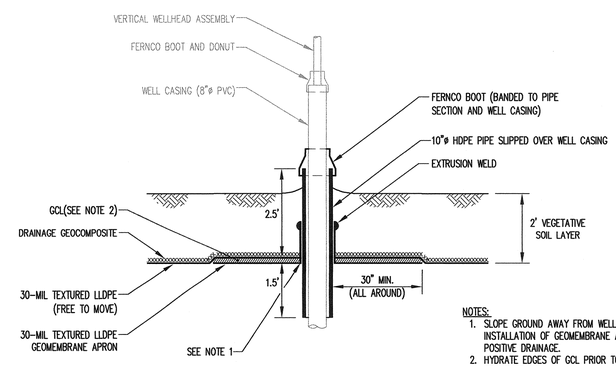
NOTE:
1. USE LANDFILL TECHNOLOGIES, INC. CF-5 SOLAR FLARE OR OTHER APPROVED EQUAL.



NOTES:
1. GAS CONVEYANCE PIPING MAY ALSO BE TEMPORARILY PLACED ON THE SURFACE OF THE INTERMEDIATE COVER.
2. GAS CONVEYANCE PIPING MAY ALSO BE PLACED WITHIN THE VEGETATIVE SOIL LAYER OF THE FINAL COVER SYSTEM.

GAS CONVEYANCE PIPE TRENCH

DETAIL 4 LFG1
NOT TO SCALE



NOTES:
1. SLOPE GROUND AWAY FROM WELL CASING PRIOR TO INSTALLATION OF GEOMEMBRANE APRON TO PROMOTE POSITIVE DRAINAGE.
2. HYDRATE EDGES OF GCL PRIOR TO INSTALLATION OF GEOMEMBRANE.

LFG WELL PENETRATION

DETAIL 5 LFG1
NOT TO SCALE

LFG MANAGEMENT NOTES

1. THE DETAILS SHOWN HERE ARE GENERAL IN NATURE. PHASE 2 IS ANTICIPATED TO BE CONNECTED WITH THE SITE'S ACTIVE LFG COLLECTION AND CONTROL SYSTEM.
2. ALL LFG RELATED WORK WILL BE IN ACCORDANCE WITH APPLICABLE LFG COLLECTION AND CONTROL SYSTEM PLANS AND AIR QUALITY REQUIREMENTS.

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NO.	DATE	REVISION

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
LANDFILL GAS
MANAGEMENT DETAILS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0603	
SHEET NO. 23	DRAWING NO. LFG1

PERMIT ISSUE
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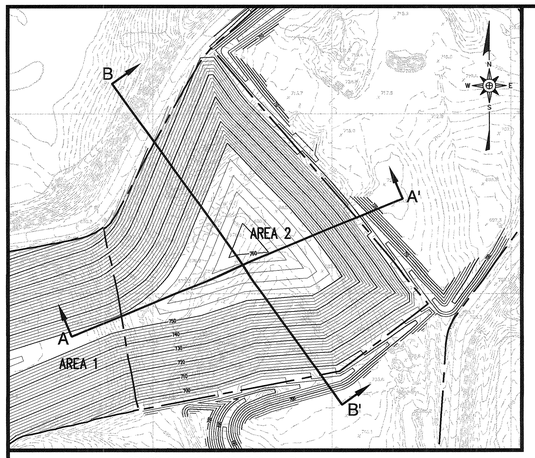


CROSS SECTION LOCATION MAP
SCALE: 1"= 200'

LEGEND

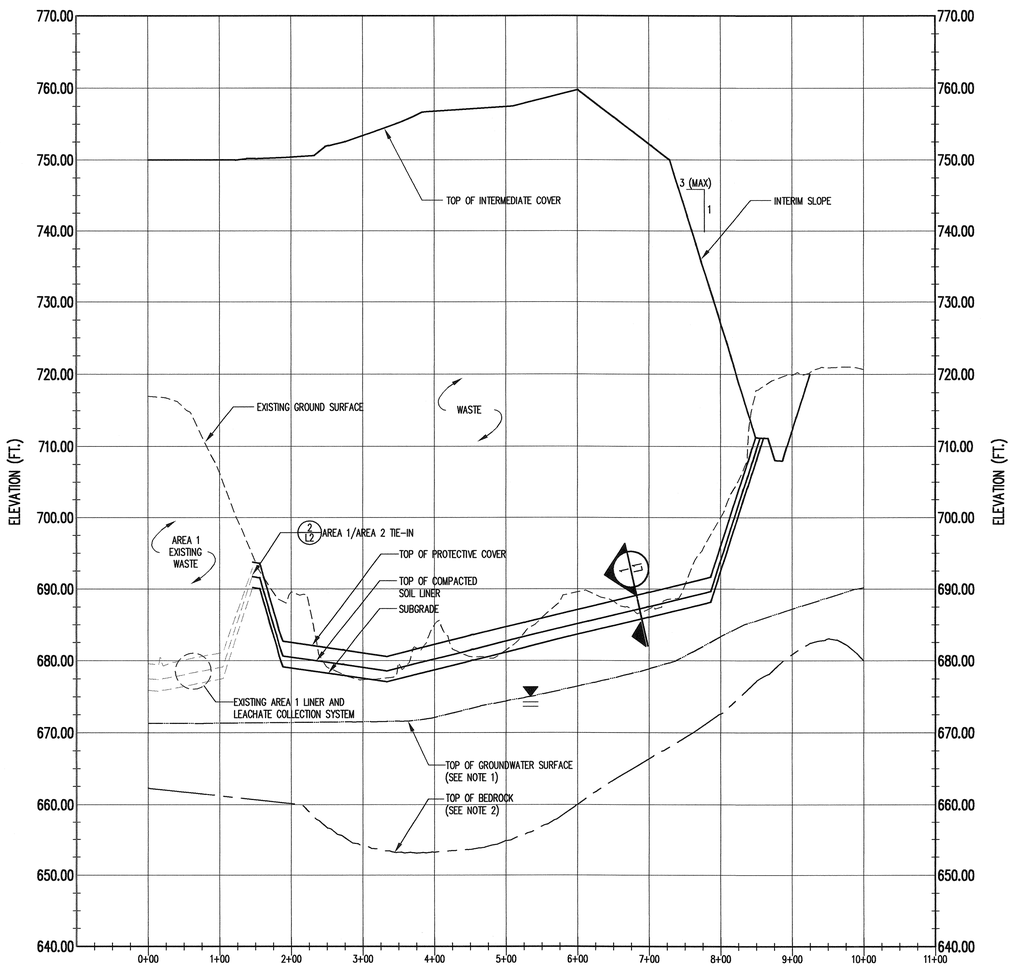
- EXISTING GROUND (SEE REFERENCE 1)
- PROPOSED GRADES
- MAXIMUM SEASONAL HIGH GROUND WATER SURFACE
- TOP OF BEDROCK

NOTES

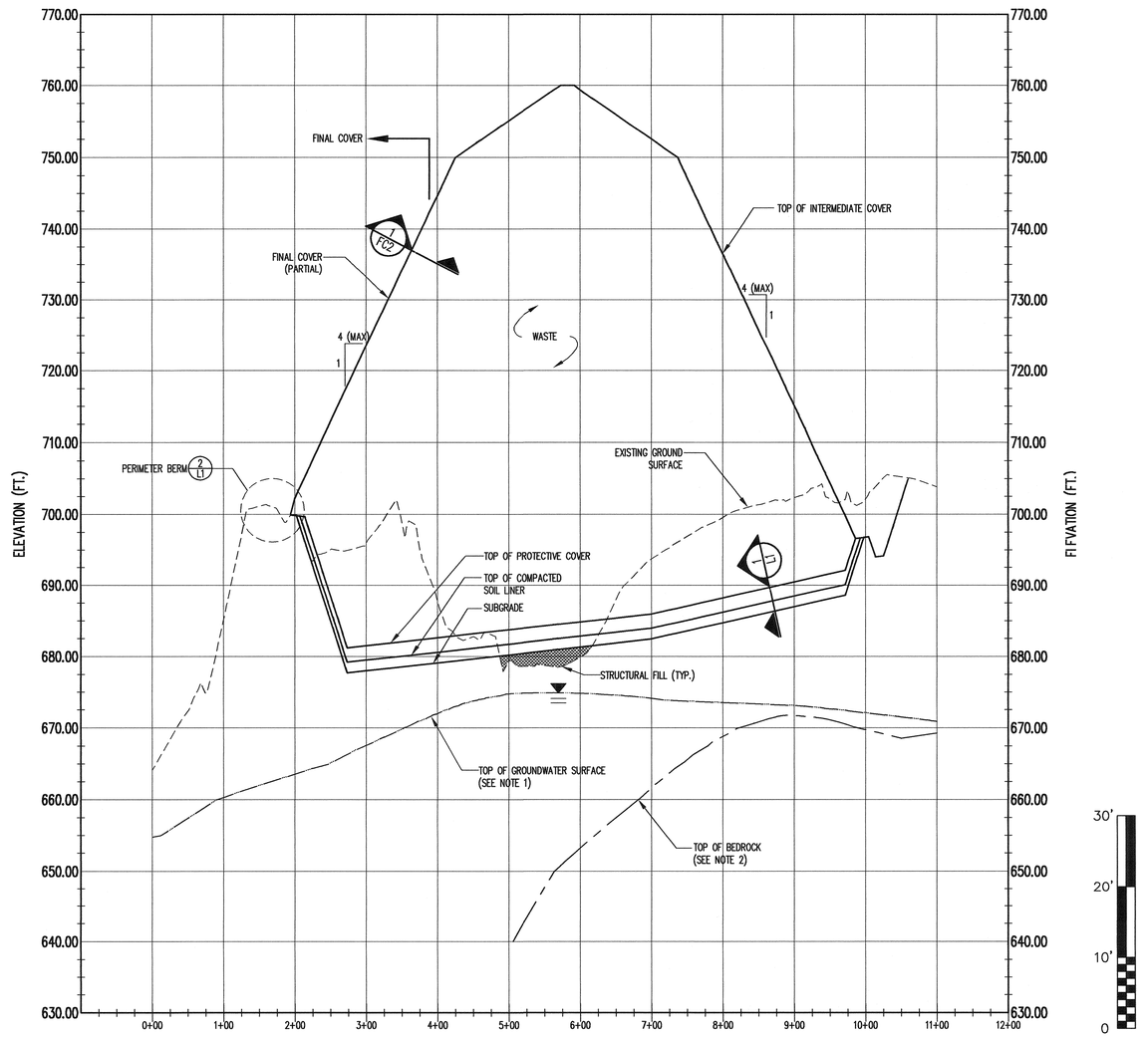
1. THE GROUND WATER SURFACE IS BASED ON COMPOSITE HIGH GROUND WATER LEVELS AS PRESENTED IN THE SITE SUITABILITY REPORT. (DASHED WHERE INFERRED.)
2. THE BEDROCK SURFACE IS BASED ON THE CONTOURS PRESENTED IN THE SITE SUITABILITY REPORT.

REFERENCES

1. TOPOGRAPHY IN ACTIVE C&D AND MSW AREAS FROM SPATIAL DATA, AERIAL DATED 2/20/12.



SECTION A / EX1
AS SHOWN



SECTION B / EX1
AS SHOWN

0 100' 200' 300'

30' 20' 10' 0

REVISION | NO. | DATE

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
ENGINEERING CROSS SECTIONS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0654	
SHEET NO. 24	DRAWING NO. X1

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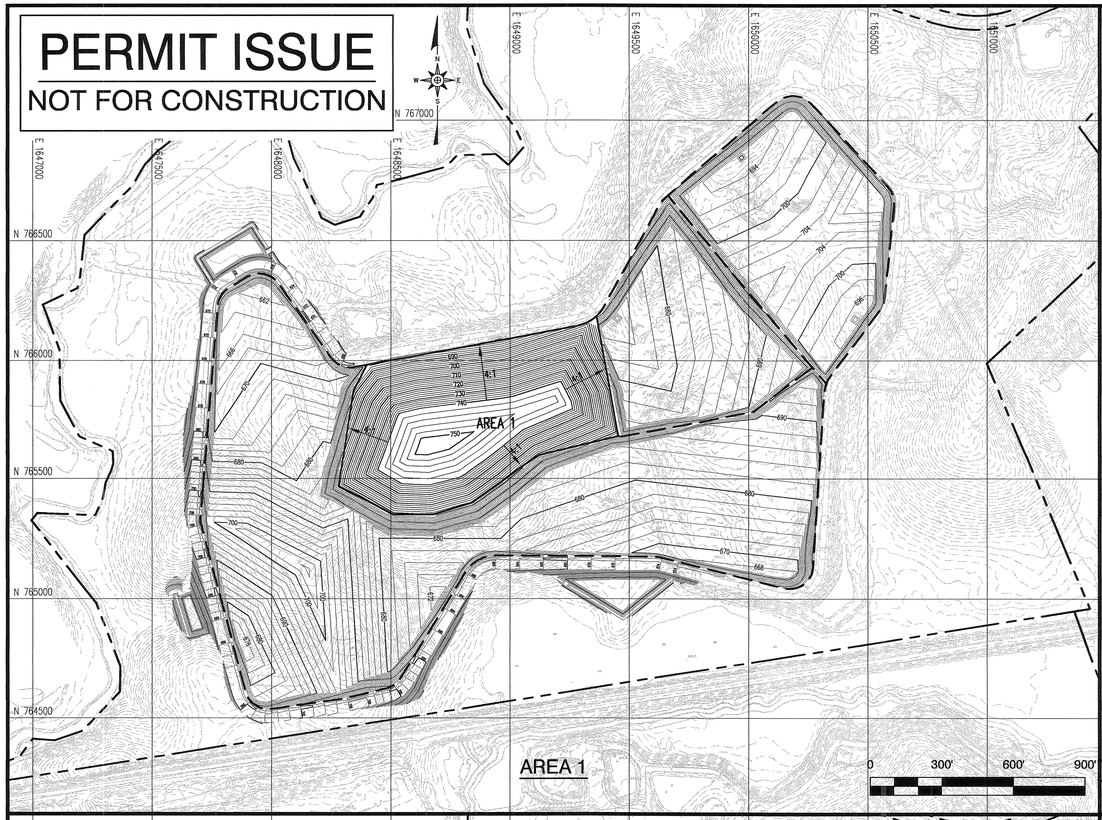
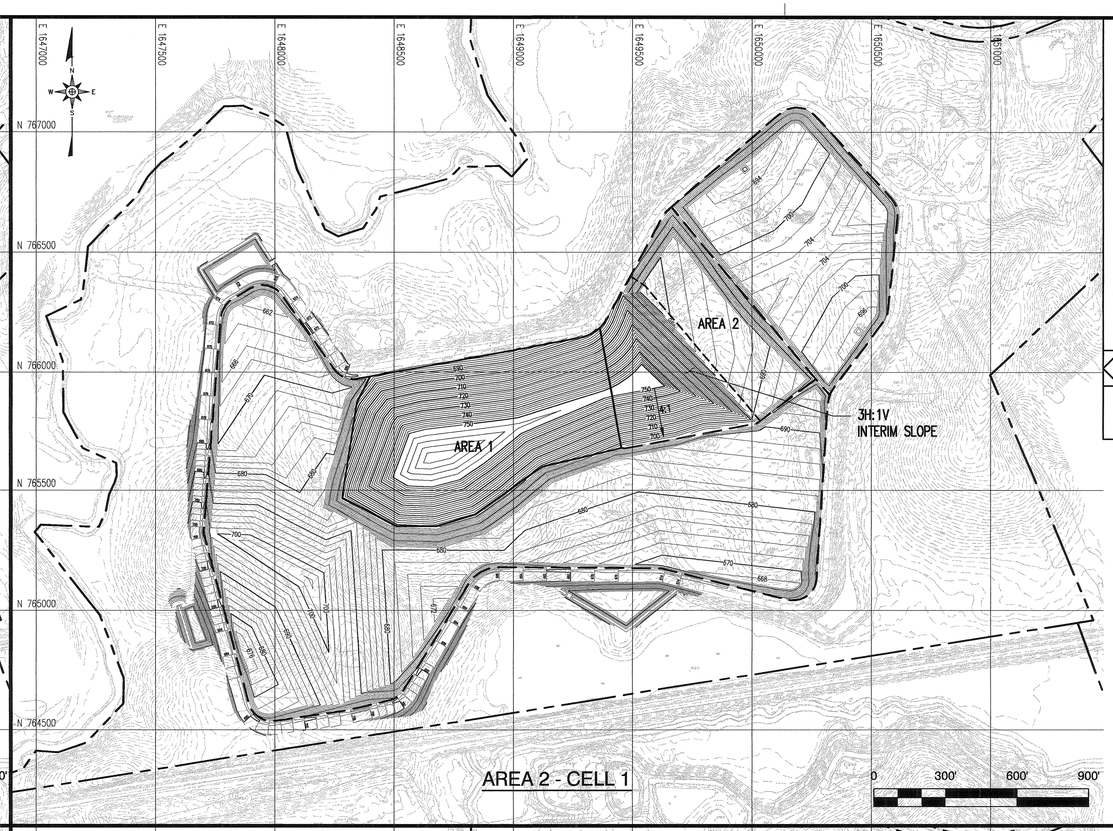
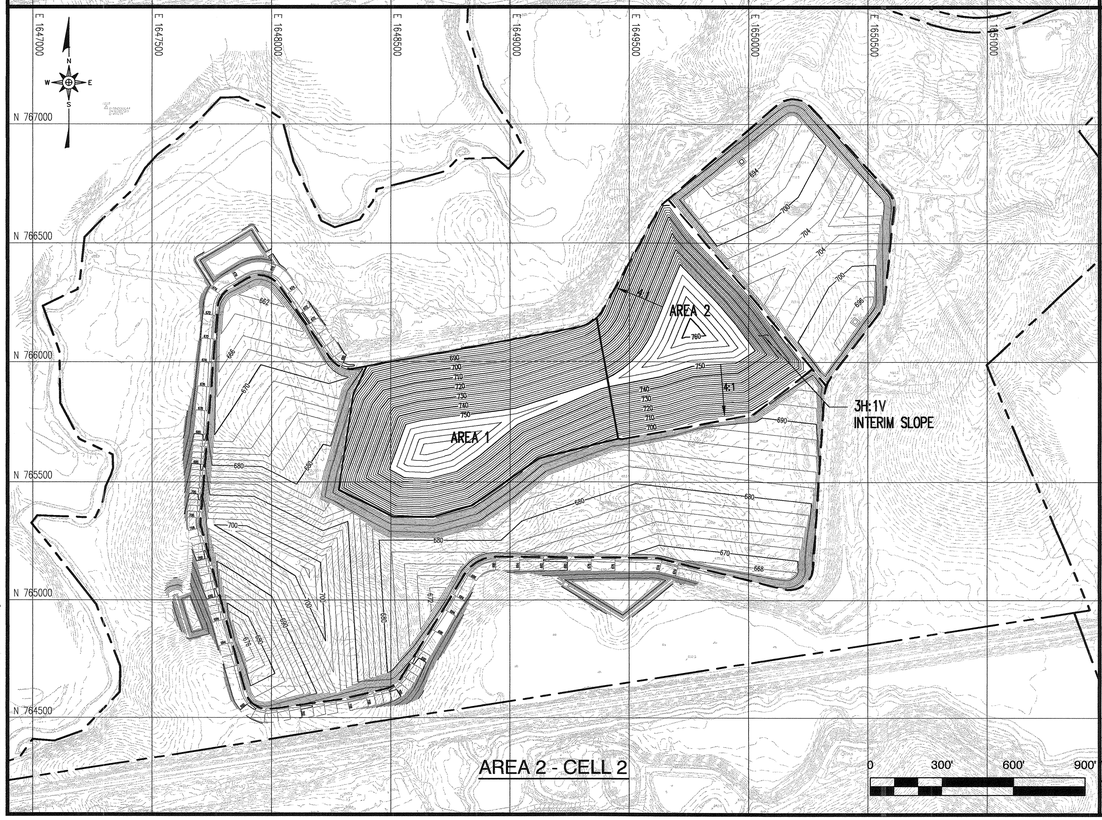


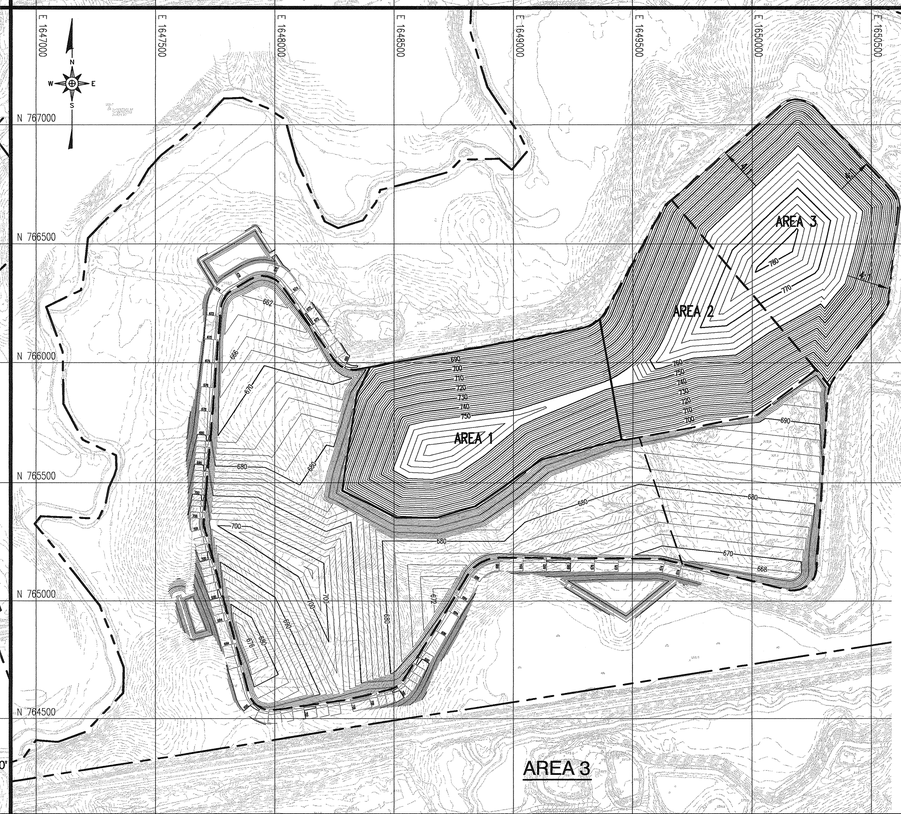
AREA 1



AREA 2 - CELL 1



AREA 2 - CELL 2



AREA 3

LEGEND

- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- 660 PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- FACILITY BOUNDARY (PROPERTY LINE)
- LIMIT OF LINER (EXISTING LINED UNITS)
- LIMIT OF LINER (FUTURE LINED UNITS)

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.

0 300' 600' 900'

NO.	DATE	REVISION

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SEAL

SEAL 021666 PROFESSIONAL ENGINEER PETER K. SMITH 5/31/12

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
PHASING PLAN
(SHEET 1 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
FILE NAME: DAVDCO-D0655	
SHEET NO. 25	DRAWING NO. P1

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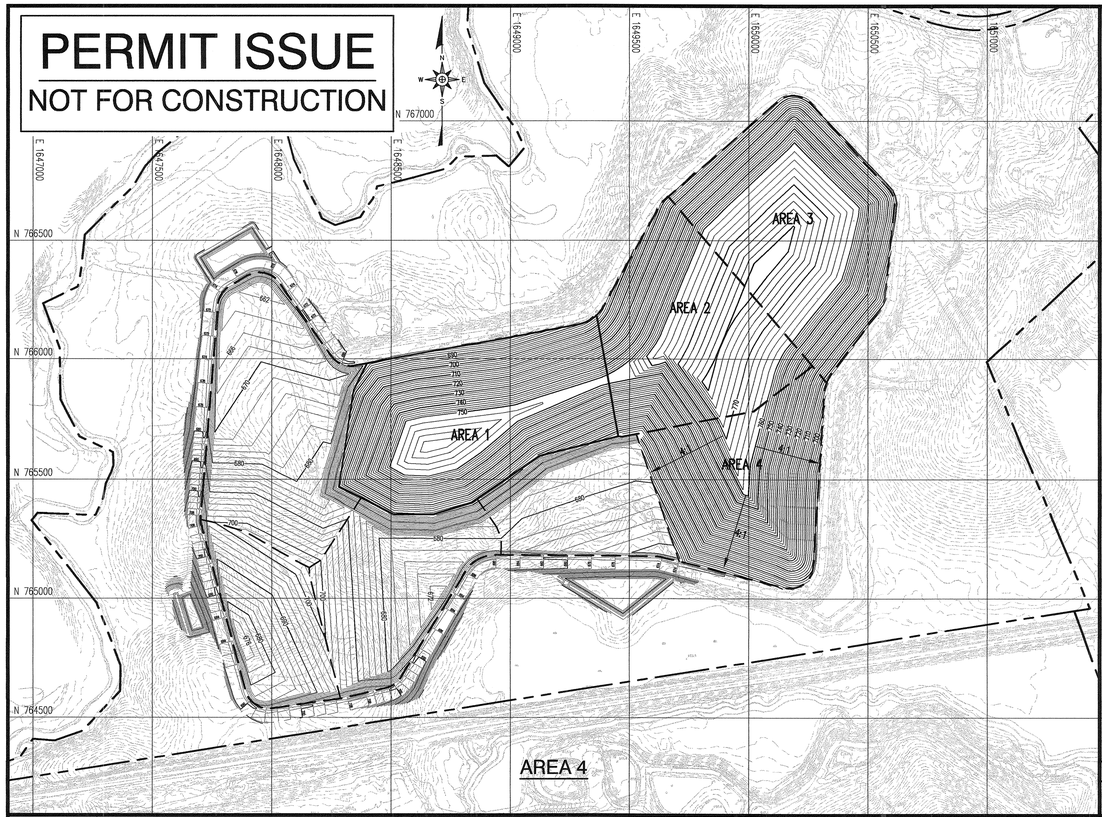
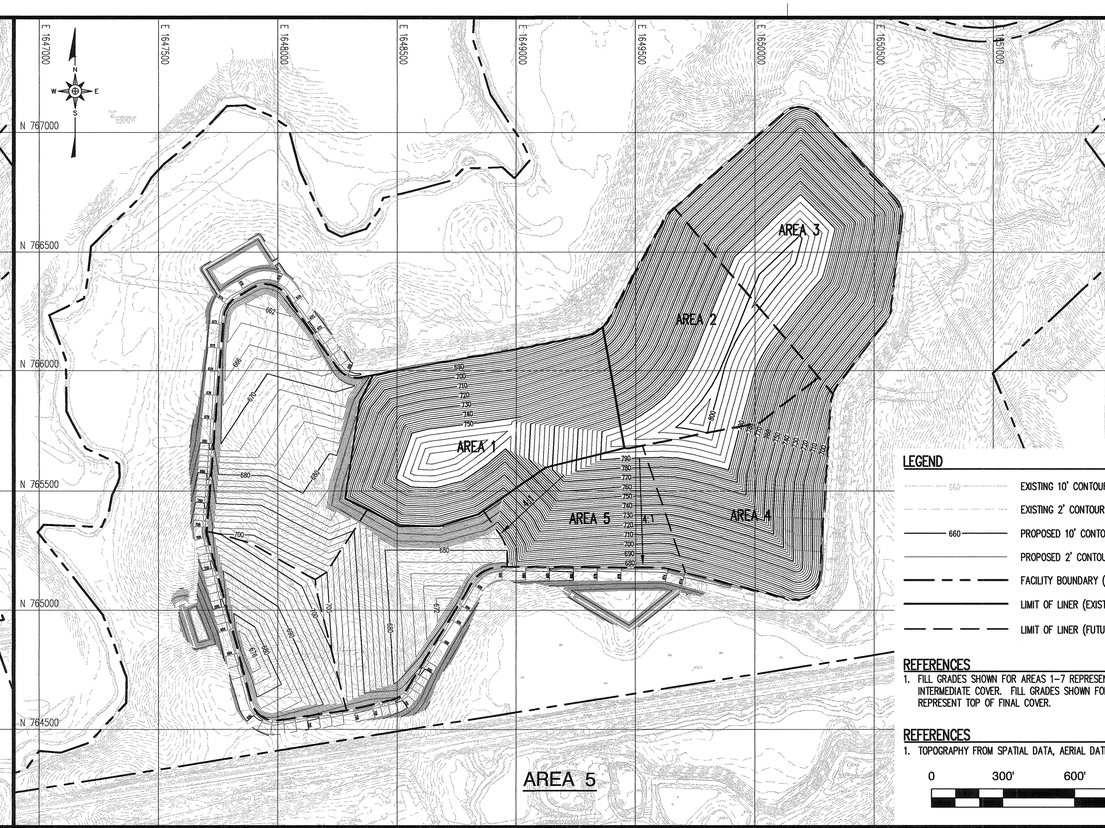
NOT FOR CONSTRUCTION





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- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- FACILITY BOUNDARY (PROPERTY LINE)
- LIMIT OF LINER (EXISTING LINED UNITS)
- LIMIT OF LINER (FUTURE LINED UNITS)

REFERENCES
1. FILL GRADES SHOWN FOR AREAS 1–7 REPRESENT TOP OF INTERMEDIATE COVER. FILL GRADES SHOWN FOR AREA 8 REPRESENT TOP OF FINAL COVER.

REFERENCES
1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.

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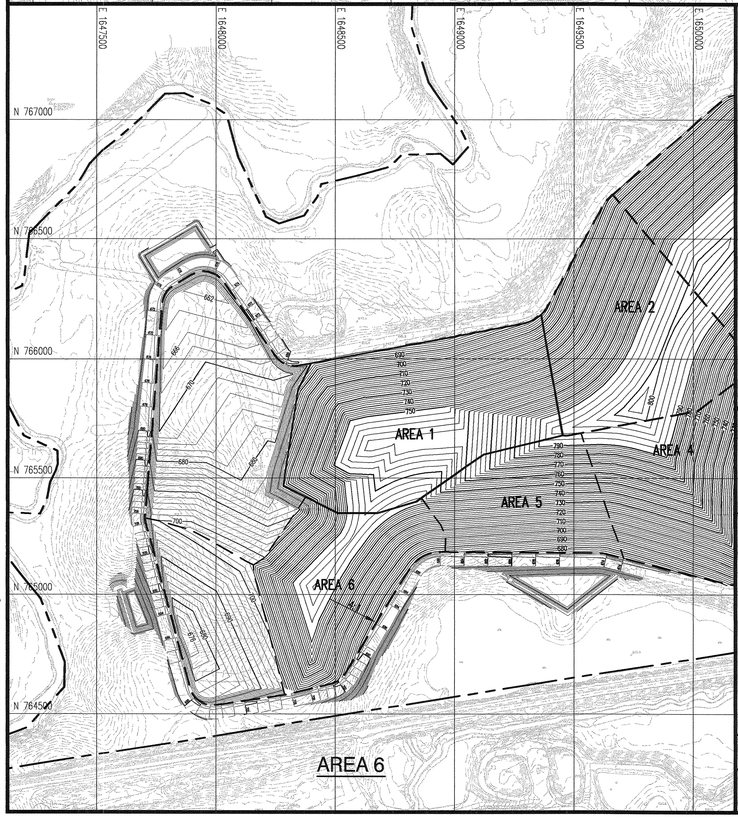

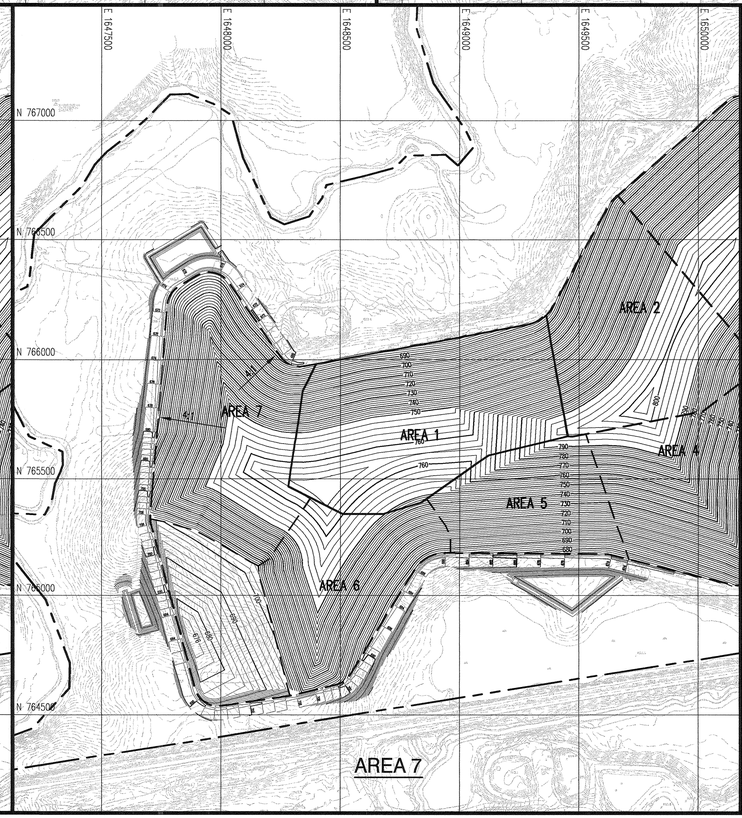

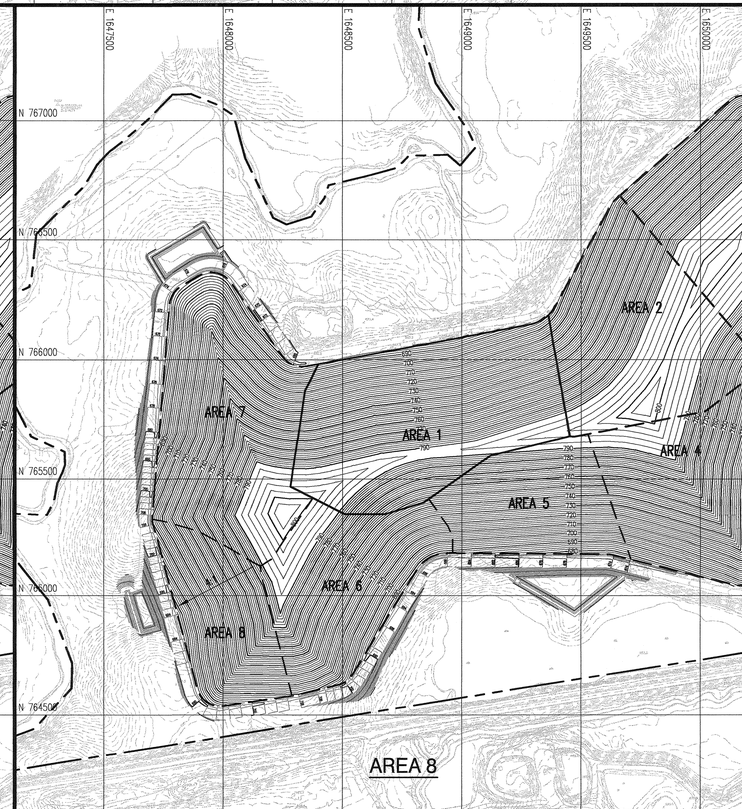

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SEAL

PROJECT TITLE:
DAVIDSON COUNTY
MSW LANDFILL
PHASE 2 AREA 2
PERMIT TO CONSTRUCT DRAWINGS

DRAWING TITLE:
PHASING PLAN
(SHEET 2 OF 2)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 10-5
SCALE: AS SHOWN	DATE: MAY 2012
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Design Hydrogeologic Report

Davidson County MSW Landfill
Phase 2 Area 2
Thomasville, North Carolina

NC Solid Waste Permit No. 29-06

Prepared For:

Davidson County Integrated Solid Waste
1242 Old US Hwy 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER
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SERVICES

May 2012

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Design Hydrogeologic Report

Davidson County MSW Landfill - Phase 2 Area 2
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, North Carolina

RSG Project No. DAVDCO-10-5

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DAVIDSON COUNTY
DAVIDSON COUNTY MSW LANDFILL - PHASE 2 AREA 2

PERMIT TO CONSTRUCT APPLICATION
DESIGN HYDROGEOLOGIC REPORT

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 Study Purpose and Scope 1
1.2 Site Background 1
2 SITE AND FACILITY DESCRIPTION 2
2.1 Location and Area Use 2
2.2 Previous Site Studies 2
3 GEOLOGY AND GROUND WATER CHARACTERISTICS 3
3.1 Surface Topography and Drainage 3
3.2 Site Investigation Methodology 3
3.3 Soil Characteristics 5
3.4 Regional and Site Geology 5
3.4.1 Regional Geologic Characteristics 5
3.4.2 Site Geologic Characteristics 6
3.4.3 Laboratory Analyses 7
3.4.4 Potential Natural or Man-Made Influences on Ground Water Levels 7
3.5 Site Hydrogeology 8
3.5.1 General 8
3.5.2 Aquifer Slug Testing and Analysis 8
3.5.3 Aquifer Characteristics 9
3.5.4 Ground Water Recharge/Discharge 9
3.5.5 Long Term and Short Term Seasonal High Ground Water Trends 10
3.5.6 Potentiometric Surface and Ground Water Gradients 11
4 WATER QUALITY MONITORING PLAN 12

Table of Contents (Continued)

Figures

Figure 1 – Existing Conditions
Figure 2 - Phase 2 Area 2 Site Map
Figure 3 - Topographic Map
Figure 4 - Aerial Photograph
Figure 5 – Bedrock Surface Map with Diabase Dike and Fracture Locations
Figure 6 - Geologic Cross-Section A-A'
Figure 7 - Geologic Cross-Section B-B'
Figure 8 - Geologic Cross-Section C-C'
Figure 9 - Composite High Potentiometric Surface & Area 2 Basegrade
Figure 10 – Long Term Seasonal High Potentiometric Surface Map

Tables

Table 1 - Piezometer Construction Details and Groundwater Elevations
Table 2A – Historic Ground Water Table Elevations
Table 2B - Recent Ground Water Table Elevations
Table 3 - Geotechnical Test Results
Table 4 - Bedrock Data
Table 5 - Hydrogeologic Properties Summary
Table 6 - Historical Precipitation Data (1975 - 2011) with Hydrograph
Table 7 - Gradients and Ground Water Velocities
Table 8A - Vertical Hydraulic Gradient PZ-21S/D
Table 8B – Vertical Hydraulic Gradient PZ-25S/D
Table 8C – Vertical Hydraulic Gradient PZ-35S/D
Table 8D – Vertical Hydraulic Gradient PZ–37S/D

Appendices

Appendix 1 - Boring Logs
Appendix 2 - Geotechnical Laboratory Data
Appendix 3 - Aquifer "Slug" Testing Results
Appendix 4 - Water Quality Monitoring Plan
Appendix 5 – Landfill Gas Monitoring Plan

1 INTRODUCTION

1.1 Study Purpose and Scope

This *Design Hydrogeologic Study* was undertaken to assess the local and regional geologic, hydrogeologic and hydrologic characteristics of the uppermost aquifer regime at the proposed Phase 2 Area 2 expansion of the Davidson County Subtitle D Municipal Solid Waste Landfill Facility (MSWLF). Field information collected for this study was used to determine hydrogeologic and engineering properties of the subsurface, to perform evaluations of hydrogeologic and geologic conditions, to evaluate base grade elevations for compliance with vertical separation requirements and to design an effective monitoring plan for early detection of a potential release into groundwater. Data, conclusions and recommendations for hydrologic and geologic conditions are provided to fulfill the requirements for the Design Hydrogeologic Study described in the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Waste Management (DWM), Solid Waste Section (SWS), under Rule 15A NCAC 13B, .1623 (b).

1.2 Site Background

The proposed Phase 2 Area 2 landfill unit is an expansion of the existing Area 1 MSWLF unit (14.7 acres) and will operate under Permit 29-06. Phase 1 was closed at the end of 2010; the CQA closure report was submitted to NCDENR in 2011 under permit number 29-06 and is awaiting approval. The closed Holly Grove Landfill (Permit 29-02) is located approximately 2,000 feet southeast of the active Davidson County Landfill (permit 29-06). The Holly Grove Landfill was permitted for municipal solid waste disposal operation from January 1975 until October 1993.

The Phase 2 site is located on county property north of the existing Phase 1 landfill and will have a combined lined area of approximately 88 acres. This Design Hydrogeologic Report will focus on the approximately 11.9 acre Area 2. Existing site conditions of Phase 2 Area 1 and Area 2 are illustrated on **Figure 1**. The proposed Area 2 site layout is shown on **Figure 2**.

Geological and geotechnical conditions at the proposed Phase 2 expansion site are typical of the North Carolina Piedmont physiographic province. On-site soils consist primarily of sandy silt and clays. These soils are expected to provide adequate foundation support conditions for landfill stability.

Ground water flow characteristics are well understood in Area 2. In the uppermost aquifer, ground water elevations at the site generally flow within the soil overburden. Two perennial streams, Jimmy's Creek and

Rich Fork Creek, serve as the ground water discharge features south, west and north-northwest for the proposed Area 2 portion of the landfill facility south of Old Highway 29. No potable wells are located between the landfill and the ground water discharge features. Cell construction is not expected to be adversely affected by bedrock or ground water.

Current development plans for the site will observe the buffer requirements in accordance with 15A NCAC13B.1624 (b) (3) (E). The new phase will be operated as an area fill.

The facility meets the applicable location requirements of Rule .1622 (1) through (6). This document and its attachments meet the hydrogeological report requirements outlined in Rule.1623 (a) and (b). Design submittal requirements of .1617 (e), including a Facility Plan, Engineering Plan, Construction Quality Assurance (CQA) Plan, Closure/Post Closure Plan, and Operations Plan, are included elsewhere in the permit application for Area 2. This document includes a certified Water Quality Monitoring Plan (WQMP), in accordance with .1623 (b) (3) and a Landfill Gas Monitoring Plan, in accordance with 15A NCAC 13B.

2 SITE AND FACILITY DESCRIPTION

2.1 Location and Area Use

The Davidson County MSWLF is located between Old U.S. Highway 29 and the North Carolina Railroad right of way, to the north of the existing Davidson County Phase 1 MSWLF approximately three and a half miles northeast of the City of Lexington, NC. The site topography on the USGS topographic map from the Lexington East quadrangle is shown as **Figure 3**. **Figure 4** shows an aerial photograph of the site and surrounding area.

The land area for the proposed Phase 2 Area 2 development is currently being used as a borrow area in support of the active Area 1 landfill unit. The area surrounding the landfill facility is a mix of undeveloped land and land used for residential and agriculture. **Figure 3** illustrates several relatively large tracts of undeveloped land adjacent to the landfill. Most development is located along the main roads. Public road haul routes are shown on **Figure 3**.

2.2 Previous Site Studies

A limited Site Suitability investigation was conducted in 1995 by Camp Dresser & McKee Inc. (CDM). Excerpts from the CDM study have been used to augment recently completed site studies conducted by Richardson Smith Gardner and Associates, Inc. (RSG) formerly known as G. N. Richardson & Associates,

Inc. (GNRA). A Site Suitability Report was submitted by GNRA in May 2006 with revisions in November 2006. The Site Suitability Report included drilling and site investigation for the Design Hydrogeologic Report for Area 1. A Supplemental Geologic Study was submitted by RSG in August 2011 to further address the suitability of properties of the Phase 2 site not included in the prior approval.

3 GEOLOGY AND GROUND WATER CHARACTERISTICS

3.1 Surface Topography and Drainage

Davidson County is located in the Piedmont physiographic province and the Yadkin-Pee Dee drainage basin. The existing Phase 2 area site topography ranges from 730 to 650 feet above mean sea level (fmsl). Existing area 2 topography ranges from approximately 720 fmsl to 670 fmsl.

Locally, the Phase 2 site is bounded by two streams, Jimmy's Creek to the south and Rich Fork Creek to the northwest and west. Both are perennial streams with large flood plains in some areas. The Phase 2 site has a ground water divide at its center. Ground water and surface water in Area 2 drain in a general west and northwestern direction ultimately discharging in Rich Fork Creek, which flows into the Yadkin River.

3.2 Site Investigation Methodology

The approximately 11.9 acre Area 2 landfill unit was investigated utilizing 14 soil and rock borings, each advanced to depths between 23 and 73 feet below grade. Boring locations were based on topographical and geologic features, access and existing site knowledge. RSG installed piezometers PZ-11, PZ-12 and PZ-17 in October and November 2000 with Engineering Tectonics, PA. Piezometers PZ-25S and PZ-25D were installed by RSG with Engineering Tectonics, PA in February 2002. Piezometers PZ-35S, PZ-35D, PZ-37 and PZ-37D were installed by RSG with Engineering Tectonics, PA in September 2004. RSG and Geologic Explorations installed piezometers PZ-52, PZ-58, PZ-59, PZ-62 and PZ-63 in November 2010. Boring logs and information from these previous investigations are included in **Appendix 1**. **Figure 2** illustrates boring locations. 2010 borings were drilled with a track mounted Geoprobe 7822DT and air hammer rig. Field work was performed under the supervision of a North Carolina licensed geologist.

Table 1 presents a well construction detail summary that includes depths to the various strata for recently and previously installed test borings. **Table 2A** presents a historic ground water data summary, including data since the piezometer installation. Seasonal water levels are provided in **Table 2B**.

Most borings were sampled by the standard penetration test. Representative split spoon samples,

undisturbed (shelby tube) samples and bulk soil samples from the auger cuttings were procured for laboratory testing. Samples from PZ-12 were analyzed by Engineering Tectonics for Plasticity, Grain Size Distribution, Consolidation, and Permeability. Samples from PZ-52, PZ-58, PZ-59 and PZ-62 were analyzed by Geotechnics for Moisture, Atterberg Limits and Wash Sieve and Hydrometer Analysis. Soils were classifications under the Unified Soil Classification System (USCS). Laboratory testing was performed in accordance with appropriate ASTM test procedures. Geotechnical laboratory data is included in **Appendix 2**.

Piezometers were constructed in the borings using 2-inch inside diameter (ID) Schedule 40 0.010 machine-slotted well screens with sufficient same-diameter PVC riser to extend approximately three feet above the existing ground surface. Screens were set to bracket the static water table in the upper-most aquifer as observed during drilling. Deep well screens were set into water-bearing zones to assess vertical hydrogeological properties. No. 2 filter sand ("sand pack") was poured in the annular space to a height of approximately two feet above screen intervals, hydrated bentonite was placed as a seal to a height of approximately two feet above the sand pack and a grout mixture was pumped via tremie pipe into the annulus from the top of the bentonite to the ground surface. Piezometers were fitted with adjustable locking expansion caps to protect the well integrity. Piezometer construction records are included in **Appendix 1**.

Piezometers were surveyed for location and elevation by Michael Green Associates, a N.C. registered land surveying company. Each piezometer was developed using a downhole pump or bailer until clear water was retrieved. After development, a minimum of 24 hours was allowed for the aquifer to return to normal levels before a rising head slug test was performed on each piezometer. This test involved placing a pressure transducer near the piezometer bottom and removing the volume of two bailers (2 liters) from the piezometer. A Hermit Mini Troll Professional environmental data logger was used to record the water influx rate until equilibrium was re-established. Slug test results were used to calculate ground water velocities across the site. The hydrological data and calculations are presented in **Appendix 3**. Monthly water level measurements were recorded since the initial piezometer installation, in 2001 and 2003, through May 2005. Additional water level data has been collected from December 2010 until July 2011 since supplementary piezometers were installed. The recorded water elevations are summarized in **Table 2A**. Piezometers located within Phase 2 Area 2 footprint will be properly abandoned by a certified well driller under direction of a licensed geologist prior to landfill construction.

3.3 Soil Characteristics

The Soil Survey of Davidson County, published in July 1994[1] indicates the predominant soil types for Phase 2 include the Poindexter and Zion sandy loams and the Enon fine sandy loam soils. Other soils include the Wickham fine sandy loam, and the Pacolet sandy loam.

According to the USDA web soil survey[2], Area 2 is generally composed of Pacolet sandy loam and the Poindexter-Wynott complex. The Pacolet sandy loam is a well drained soil with a moderately high capacity to transmit water; slopes are generally from eight to fifteen percent. The Poindexter-Wynott complex is a well drained soil with a capacity to transmit water that ranges from low to high; slopes range from eight to twenty-five percent. Please note the top layers of Area 2 have generally been removed and used elsewhere in the facility.

3.4 Regional and Site Geology

3.4.1 Regional Geologic Characteristics

The Davidson County Landfill facility is located in the Piedmont Physiographic Province of North Carolina. More specifically, the Geologic Map of North Carolina (*USGS, 1985*) indicates that the site lies within, but at the western margin of, the Carolina Slate Belt. This belt includes predominantly volcanic and sedimentary rocks of Late Proterozoic to Cambrian age that have been metamorphosed and intruded by numerous igneous plutons. The boundary zone between the Carolina Slate Belt and the adjacent Charlotte Belt is known as the Gold Hill/Silver Hill Shear Zone.

The most detailed mapping of the area was published by the US Geological Survey in the Geologic Map of Charlotte by Goldsmith, Milton and Horton (1988). This mapping indicates that the site vicinity is underlain by two stratigraphic units: metavolcanic rocks (mv) and metamorphosed granodiorite (mgd).

The metavolcanic rocks include mafic, intermediate and felsic volcanic rocks, rocks from the Flat Swamp Member of the Cid Formation, and metavolcanic rocks of the Battleground Formation. The Battleground Formation is characterized as a quartz-sericite schist and phyllite. It contains subordinate beds of quartz-pebble conglomerate, quartzite, kyanite or sillmanite quartzite and manganiferous schist. The

[1] McCachren, Clifford M., Soil Survey of Davidson County, North Carolina. US Department of Agriculture, Soil Conservation Service. Issued July 1994.
[2] United States Department of Agriculture, Natural Resource Conservation Service, "Web Soil Survey". http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

metamorphosed granodiorite (mgd) occurs in the central portion of the proposed Phase 2 area. This unit is locally porphyritic.

3.4.2 Site Geologic Characteristics

The entire Phase 2 area geology must be reviewed to understand the complex site geology. RSG has installed numerous piezometers across the site. These piezometers were installed using a combination of hollow stem auger, geoprobe, air rotary, air hammer and rock coring techniques. In general, auger refusal was encountered between approximately 10 feet below grade and 75 feet below grade. The boring, PZ-25d, located in the proposed Phase 2 Area 3 landfill unit, was advanced to a depth of 75 feet below grade and did not encounter bedrock. Similarly, PZ-35d in Area 2 was advanced to 73 feet bgs without encountering bedrock.

Soils encountered include sandy silt and partially weathered rock. In this report, partially weathered rock is defined as soils with a standard penetration test blow count of 100+ blows per foot.

Bedrock beneath Phase 2 is granite, granite aplite, granodiorite, biotite gneiss, diabase and diorite. Seams of these bedrock types have been seen on other portions of the site as well. Seventeen rock core samples were collected from borings PZ-1, PZ-5d, PZ-9, PZ-13, PZ-19, PZ-21d, PZ-31, PZ-32d, PZ-34, PZ-37d, PZ-38d, PZ-39, PZ-41d, PZ-42d, PZ-43d, PZ-45d, PZ-49 and a rock core of a boulder encountered above bedrock in PZ-29. PZ-37d is located in Area 2. Rock quality data (RQD) of the cores indicates the uppermost ten feet of competent bedrock is highly fractured. It should also be noted that the partially weathered rock and highly fractured bedrock (as defined by auger refusal) have been rippable using the heavy equipment on other portions of the site. No bedrock outcrops have been noted within the proposed footprint area.

RSG performed multiple geophysical evaluations of Phase 2 to better understand the interaction between ground water in bedrock and ground water in unconsolidated sediments. These evaluations included: 1) Piezometer installation, 2) Geophysical resistivity evaluation and 3) Down-hole geophysical logging on bedrock wells prior to completion as piezometers.

Two geophysical studies were performed. A resistivity study to evaluate where fractures in bedrock were located in Area 1 was performed in July 2003. Additionally, a down-hole geophysical study was performed in several Area 1 bedrock wells at this time.

In February 2005, a second set of geophysical studies were performed on the remaining areas of the site; including a resistivity study to evaluate fracture locations. Based on the fracture locations, bedrock wells were drilled in nested pairs to further evaluate the fractures detected. Once drilled, the bedrock wells were utilized for a down-hole geophysical analysis of the fractures in the bedrock encountered by the well.

These studies identified nine major bedrock fractures, trending NW-SE across the proposed Phase 2 site. Additionally, five diabase dikes trending NE-SW were also documented. Only three dikes show extensive expression (D-3 through D-5), while two (D-1 and D-2) are inferred from minor results in limited areas. Two bedrock fractures and one diabase dike are located underneath Area 2. The site bedrock surface map with fractures and diabase dikes are shown on **Figure 5** while geologic cross-sections are shown on **Figures 6, 7 and 8**. **Table 4** summarizes rock coring information including rock quality data and recovery amounts.

Down hole geophysical evaluations also indicate NW-SE and NE-SW are the predominant fracture directions. In some cases the bedrock appears to be so highly fractured/weathered that it is likely transmitting water in a manner more closely resembling unconsolidated sediments than fracture flow. Based on these investigation results, it appears that Area 2 is located where ground water consistently flows above the bedrock. In general, Area 2 can be characterized as having a mantle of silty clayey soil in some areas with either a granitic or dioritic bedrock below.

3.4.3 Laboratory Analyses

Test borings were sampled using the standard penetration test (ASTM D1586). Samples were analyzed for grain size and Atterberg limits to verify soil classifications as well as Standard Proctor compaction, consolidation, and flexible wall permeability (hydraulic conductivity). A geotechnical laboratory testing summary is presented on **Table 3**. Laboratory testing was performed in accordance with the appropriate ASTM test procedures. Geotechnical laboratory data is included in **Appendix 2**.

3.4.4 Potential Natural or Man-Made Influences on Ground Water Levels

Natural or man-made activities which have the potential to cause (or influence) long-term water table fluctuations include the landfill development. Landfill development activities will influence the site in that the covering of a portion of the ground water recharge area in Phase 2 with the landfill liner system will reduce surface water infiltration which will lower the water table over time. Primary ground water flow for Phase 2 is toward the north, west and south.

3.5 Site Hydrogeology

3.5.1 General

Ground water conditions within the Area 2 site have been characterized using 10 piezometers located in and around the Phase 2 Area 2 footprint. As previously stated, these piezometers were installed over several mobilizations; under supervision of a licensed geologist from GNRA/RSG. Piezometer "nests" occur at PZ-12s and PZ-12d, PZ-35s and PZ-35d, PZ-37 and PZ-37d.

3.5.2 Aquifer Slug Testing and Analysis

The potentiometric data (**Table 2A and 2B**) and aquifer "slug" testing data (**Appendix 3**) are adequate to identify recharge and discharge zones, determine flow directions and gradients, and estimate ground water flow velocities.

Utilizing the results of the slug tests, hydraulic conductivities were calculated for the screened intervals using the Bouwer and Rice (1976) method (**Table 5**). The curve fitting solutions for the hydraulic conductivities were performed through *AquiferTest*, an aquifer stress test analysis program (**Appendix 3**).

The Bouwer and Rice (1976) method (as modified by Bouwer, 1989) was developed for partially penetrating wells in an unconfined (or semi-confined) aquifer. Hydraulic conductivity (**K**) is determined using the following equation:

$$K = \frac{r_c^2 \ \ln \frac{r_e}{r_w} \ln \frac{Y_o}{Y_t}}{2\ L\ t}$$

Where:

L = the screened interval length

$\mathbf{Y_o}$ = the initial rise in water level from the introduction of the slug

$\mathbf{r_e}$ = the effective radius through which $\mathbf{Y_o}$ is dissipated

$\mathbf{r_w}$ = the horizontal distance from the well center to the aquifer

$\mathbf{r_c}$ = the well casing radius of the well casing and **t** is time (**Appendix 3**).

The variable, $\mathbf{Y_o}$, is determined from semi-logarithmic plots of drawdown versus time. The variable, $\mathbf{Y_t}$, is the drawdown (recovery) at any specific time **t**. The variable, $\mathbf{\ln(r_e/r_w)}$, is determined using the following equation:

$$\ln\frac{r_e}{r_w} = \frac{1}{\frac{1.1}{\ln\left(\frac{H}{r_w}\right)} + \frac{A + B\ln\frac{D-H}{r_w}}{\frac{L}{r_w}}}$$

Where:

D = total aquifer thickness

H = the portion of the aquifer tapped by the well

A and **B** = constants derived from curves relating coefficients **A** and **B** to $\mathbf{L/r_w}$ (Bouwer and Rice, 1976).

A total aquifer thickness (**D**) for the water-table aquifer was estimated to be between 50 and 100 feet due to varying depths/weathering characteristics of the bedrock.

3.5.3 Aquifer Characteristics

Stratigraphy shown in the hydrogeologic cross-sections (**Figures 6, 7 and 8**) and described in detail in the test boring records (**Appendix A**) indicate that the primary aquifer for Phase 2 consists of unconfined, surficial unconsolidated sandy silts and clays. **Table 1** presents the piezometer construction information.

The uppermost aquifer for Phase 2 is located at an approximate elevation of 645 feet to 695 feet. This is an unconfined aquifer. In Phase 2 Area 2 the unconfined aquifer is present at an elevation of approximately 665 -675 feet. Vertical gradient evaluation indicates a general downward gradient in the Area 2 vicinity. **Table 1** presents 24-hour ground water levels and groundwater elevation observations over time.

Based on the Phase 2 hydrogeological characterization study, there are two distinct hydrogeologic units present:

Unit 1- Unconfined surficial soils (uppermost aquifer) and

Unit 2 - Bedrock aquifer (fracture flow)

An interpretation of the upper most aquifer thickness was made based on the water table (upper most saturation point) as the upper boundary, with competent bedrock as the lower boundary. The resulting aquifer thickness in Area 2 ranges between 5 to 40 feet.

3.5.4 Ground Water Recharge/Discharge

Discharge from the uppermost aquifer occurs year-round along Rich Fork Creek and Jimmy's Creek, north, west and south of Phase 2. Groundwater gradients and velocities in the uppermost aquifer are presented in **Table 7**. In general, the established ground water divide between flow to the north, northwest (toward Rich

Fork Creek) and flow to the south (toward Jimmy's Creek) is generally located along Area 2's southern border. The ridge represents a recharge zone, while the creeks represent the discharge zones.

The uppermost aquifer for Phase 2 appears to exhibit lateral flow with potentiometric surfaces that reflect a subdued expression of the surface topography. The potentiometric surface is shown on the hydrogeological cross sections (**Figures 6, 7 and 8**) and a composite long-term seasonal high potentiometric surface is shown on **Figure 9**.

Vertical gradients measured between PZ-21S and PZ-21D, PZ-25S and PZ-25D, PZ-35S and PZ-35D and PZ-37S and PZ-37D generally indicate a slight upward and downward gradient depending on the date and well locations; which is indicative of both slight recharge and slight discharge in this portion of the site (which is adjacent to an ephemeral stream). Nested pairs PZ-21S and PZ-21D and PZ37S and PZ-37D illustrate the fluctuation due to proximity to discharge and recharge locations. PZ-25S and PZ-25D illustrated a distinct upward trend while PZ-35S and PZ-35D indicate a downward vertical gradient. Vertical gradients are discussed in more detail in **Section 3.5.6**.

3.5.5 Long Term and Short Term Seasonal High Ground Water Trends

Ground water recharge occurs through a balance of rainfall, evapotranspiration, surface run-off and infiltration. Historical rainfall data indicate that highest cumulative rainfall amounts typically occur in March and April. Although peak rainfall amounts typically occur during the summer months, these are also times of elevated evapotranspiration. Infiltration is lower than it would be in March, when evapotranspiration is relatively low. Due to relatively high infiltration in January through March, ground water levels are expected to be elevated to their seasonal high at that time. However, it should be noted that the site has been timbered and therefore water levels are likely altered by the lack of evapotranspiration on-site.

Table 2 shows that ground water elevations across the site appear to be relatively stable. Area 2 piezometers were monitored from their respective installation dates through May 2005 and from December 2010 until July 2011. Piezometer data indicates the highest water levels were generally found in April and May. A composite seasonal high potentiometric surface map of the data is included as **Figure 9**.

Estimated long-term seasonal high ground water levels have been evaluated for Phase 2. This evaluation included a Davidson County precipitation study from 1975 through 2011 (**Table 6 and associated hydrograph)**. Our precipitation evaluation indicates that recent years 2000, 2001, 2004, 2005 and 2010

were below average for this area over a 30 year period. Although the highest precipitation was most recently seen in 2009, comparable levels were observed in 2003. Groundwater levels from 2003 were significantly lower than those seen in 2005, which is likely due to timbering activities on-site.

Using the single day high water level measurements from the Area 2 piezometers, a long term-seasonal high water level map was constructed (**Figure 10)**. The potentiometric surface and flow directions are consistent with water level data collected over the course of this investigation.

The proposed subgrade contours within the Phase 2 footprint were established to meet the DWM requirements for four feet of vertical separation (post-settlement) between the subgrade bottom and the seasonal high ground water levels or bedrock. Subgrade elevations are shown on **Figure 9** with the composite high water elevations for Area 2.

3.5.6 Potentiometric Surface and Ground Water Gradients

High ground water levels primarily occur in April and May. Low ground water levels have generally occurred in January or July but have been reported throughout the year at various well locations. Because ground water may flow in bedrock during low water periods, it is important to consider ground water movement during low water conditions. Our evaluation indicates that even during times of low water, ground water continues to flow in the unconsolidated sediments below the site, and does not revert to only fracture flow. Two ground water potentiometric surface maps were prepared from available piezometer and monitoring well data: a composite high water level map and a long term seasonal high potentiometric map. These figures are presented as **Figures 9 and 10**, respectively. The potentiometric surface indicates ground water flows generally north, northeast and northwest with secondary flow across the ground water divide in a southern direction.

Calculated horizontal ground water gradients in Area 2 (units are ft/ft) vary from 0.09 in PZ-12 to 0.22 in PZ-62 with an average of 0.15. A horizontal gradient summary is presented on **Table 7**. The vertical gradient between PZ-21S and PZ-21D averaged 0.14 upward, PZ-25S and PZ-25D averaged 2.92E-5, PZ-35S and PZ-35D averaged -0.0014 and PZ-37S and PZ-37D averaged -0.016. Hydraulic conductivity values calculated for the upper aquifer ranged from 0.159 ft/day in PZ-63 to 2.17 ft/day in PZ-12s and averaged 0.852 ft/day. These calculations are included in **Tables 8A-8D**.

Ground water velocities were calculated from the slug test data acquired at the site by the equation:

$$V = KI/n$$

Where:

V = Ground Water Velocity

K = Hydraulic Conductivity (from rising head tests)

I = Hydraulic Gradient (from water table elevations)

n = Porosity (based on referenced values).

A calculated ground water velocity and gradient summary is provided as **Table 7**. Ground water velocities in Area 2 range from 0.159 ft/day in PZ-63 to 2.17 ft/day in PZ-12, and average of 0.852 ft/day.

4 WATER QUALITY MONITORING PLAN

The intention of the water quality monitoring system is to create a plan to effectively detect an early release of hazardous constituents to the uppermost aquifer. The Water Quality Monitoring Plan is included as **Appendix 4**, in this report. This section is an outline of that proposed plan.

The construction of Area 2 requires the addition of two groundwater quality monitoring wells (MW-10S and MW-10D) to the existing monitoring network already in place. Monitoring network details are incorporated into the Water Quality Monitoring Plan and are presented in **Appendix 4**.

In summary, the following actions are proposed to provide groundwater, surface water, landfill gas and leachate monitoring for Phase 2 Area 2 of the Davidson County Subtitle D Landfill.

1. Properly abandon eleven wells in the Phase 2 Area 2 footprint. (PZ-12, PZ-12d, PZ- 35s, PZ-35d, PZ-37, PZ-37d, PZ-52, PZ-58, PZ-59, PZ-62s and PZ-63)
2. Include MW-10S & MW-10D into sampling plan.
3. Remove MW-6D and MW-7 from the monitoring plan because they are continually dry.
4. Continue use of Phase 2 Area 1 monitoring wells. (MW-1, MW-2, MW-3S, MW-3D, MW-4S, MW-4D, MW-5, MW-6S, MW-8 and MW-9)
5. Utilize the existing leachate sampling location.
6. Use existing surface water monitoring locations SW-1 and SW-2.
7. Continue sampling landfill gas probes quarterly and submit results to the solid waste section, in accordance with the updated Guidance.

5 LANDFILL GAS MONITORING PLAN

The intention of the landfill gas monitoring system is to create a plan to effectively detect an early release of hazardous constituents to the uppermost aquifer. The Water Quality Monitoring Plan is included as **Appendix 5**, in this report. This section is an outline of that proposed plan.

The Phase 2 Area 2 monitoring plan uses the existing landfill gas monitoring network. No additional monitoring wells are proposed. Monitoring network details are incorporated into the Landfill Gas Monitoring Plan (**Appendix 5)**.

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Figures

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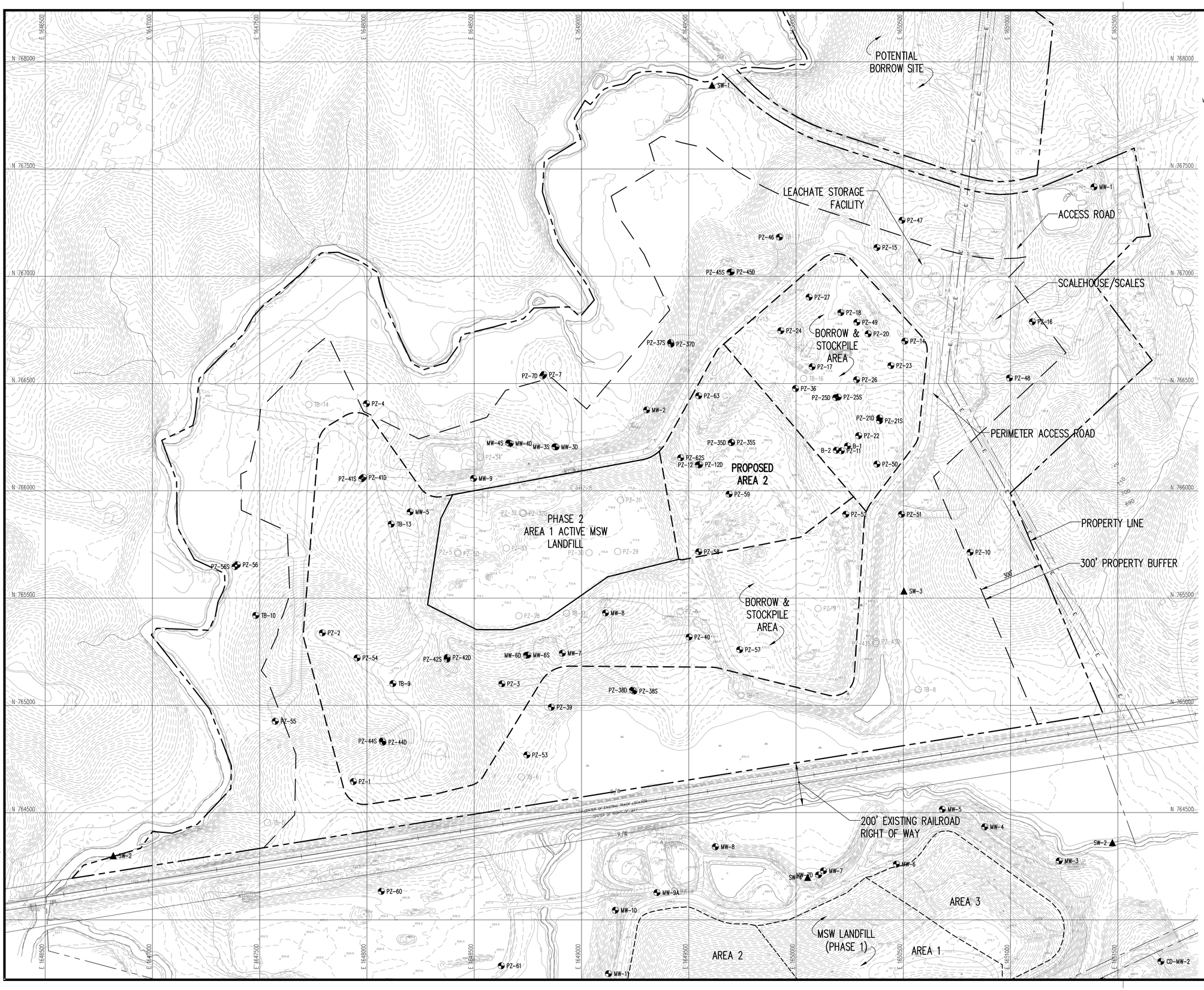

LEGEND

660	EXISTING CONTOURS
	PROPERTY LINE (APPROXIMATE)
	300' BUFFER
	LIMIT OF LINER (EXISTING LINED UNITS)
	LIMIT OF LINER (FUTURE LINED UNITS)
	APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
E	OVERHEAD POWER LINE AND UTILITY EASEMENT
MW-8D	EXISTING MONITORING WELL
PZ-31	PIEZOMETER (ABANDONED)
SW-3	EXISTING SURFACE WATER SAMPLING POINT

REFERENCES

1. TOPOGRAPHY INSIDE PROPERTY LINE FROM SPATIAL DATA, AERIAL DATED 2/20/12. TOPOGRAPHY OUTSIDE OF PROPERTY LINE PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.

NO.	DATE	REVISION

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SEAL

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PROJECT TITLE:
DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
EXISTING SITE CONDITIONS

DESIGNED BY: J.A.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO-10-5
SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0659	
SHEET NO.	DRAWING NO. FIG. 1

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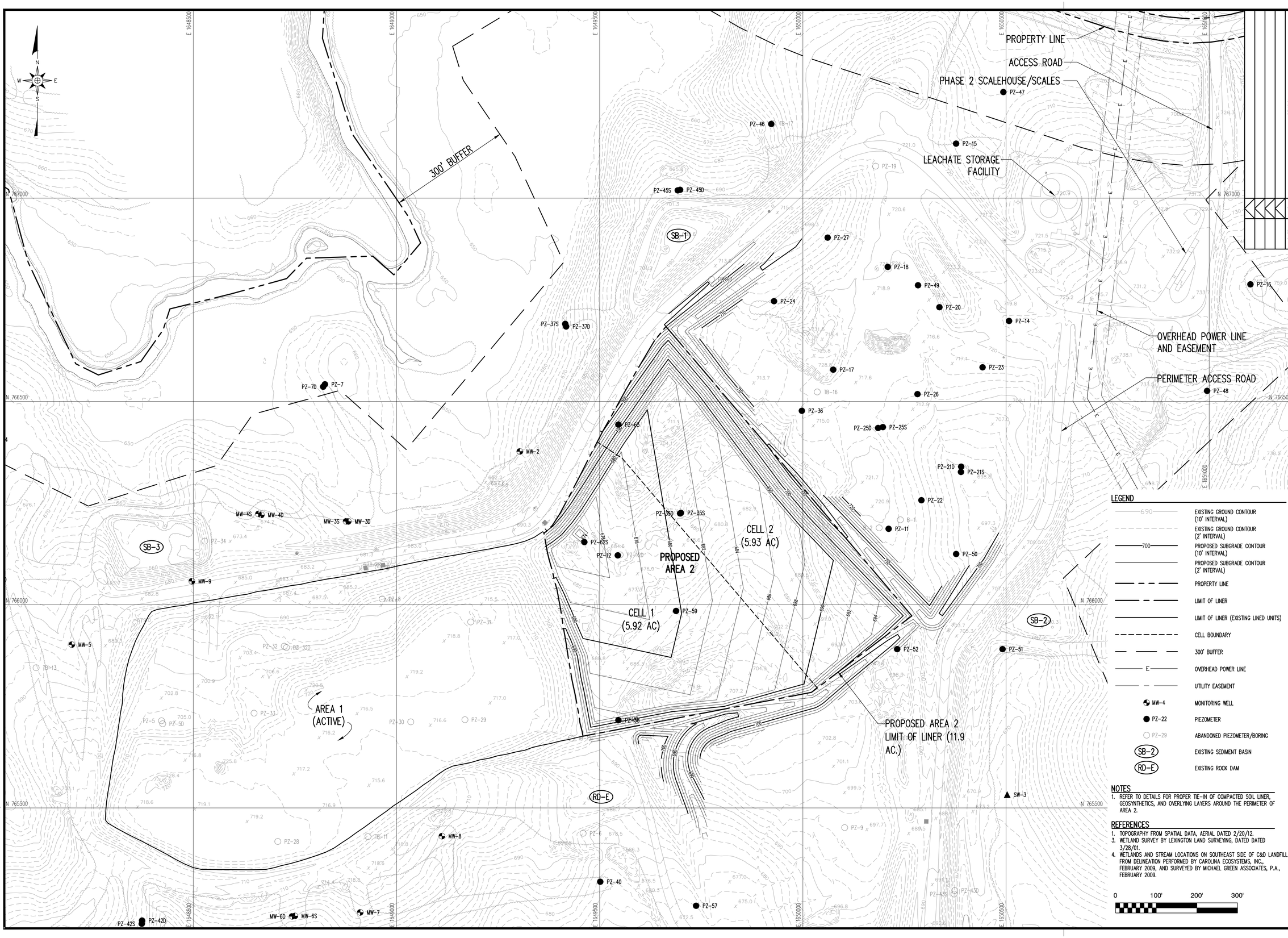

LEGEND

690	EXISTING GROUND CONTOUR (10' INTERVAL)
	EXISTING GROUND CONTOUR (2' INTERVAL)
700	PROPOSED SUBGRADE CONTOUR (10' INTERVAL)
	PROPOSED SUBGRADE CONTOUR (2' INTERVAL)
	PROPERTY LINE
	LIMIT OF LINER
	LIMIT OF LINER (EXISTING LINED UNITS)
	CELL BOUNDARY
	300' BUFFER
E	OVERHEAD POWER LINE
	UTILITY EASEMENT
MW-4	MONITORING WELL
PZ-22	PIEZOMETER
PZ-29	ABANDONED PIEZOMETER/BORING
SB-2	EXISTING SEDIMENT BASIN
RD-E	EXISTING ROCK DAM

NOTES

1. REFER TO DETAILS FOR PROPER TIE-IN OF COMPACTED SOIL LINER, GEOSYNTHETICS, AND OVERLYING LAYERS AROUND THE PERIMETER OF AREA 2.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
3. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
4. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 100' 200' 300'

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PROJECT TITLE:
DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
PHASE 2 AREA 2
SITE MAP

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CHECKED BY:	PROJECT NO.: DAVDCO-10-5
SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME DAVDCO-D0660	
SHEET NO.	DRAWING NO. FIG. 2

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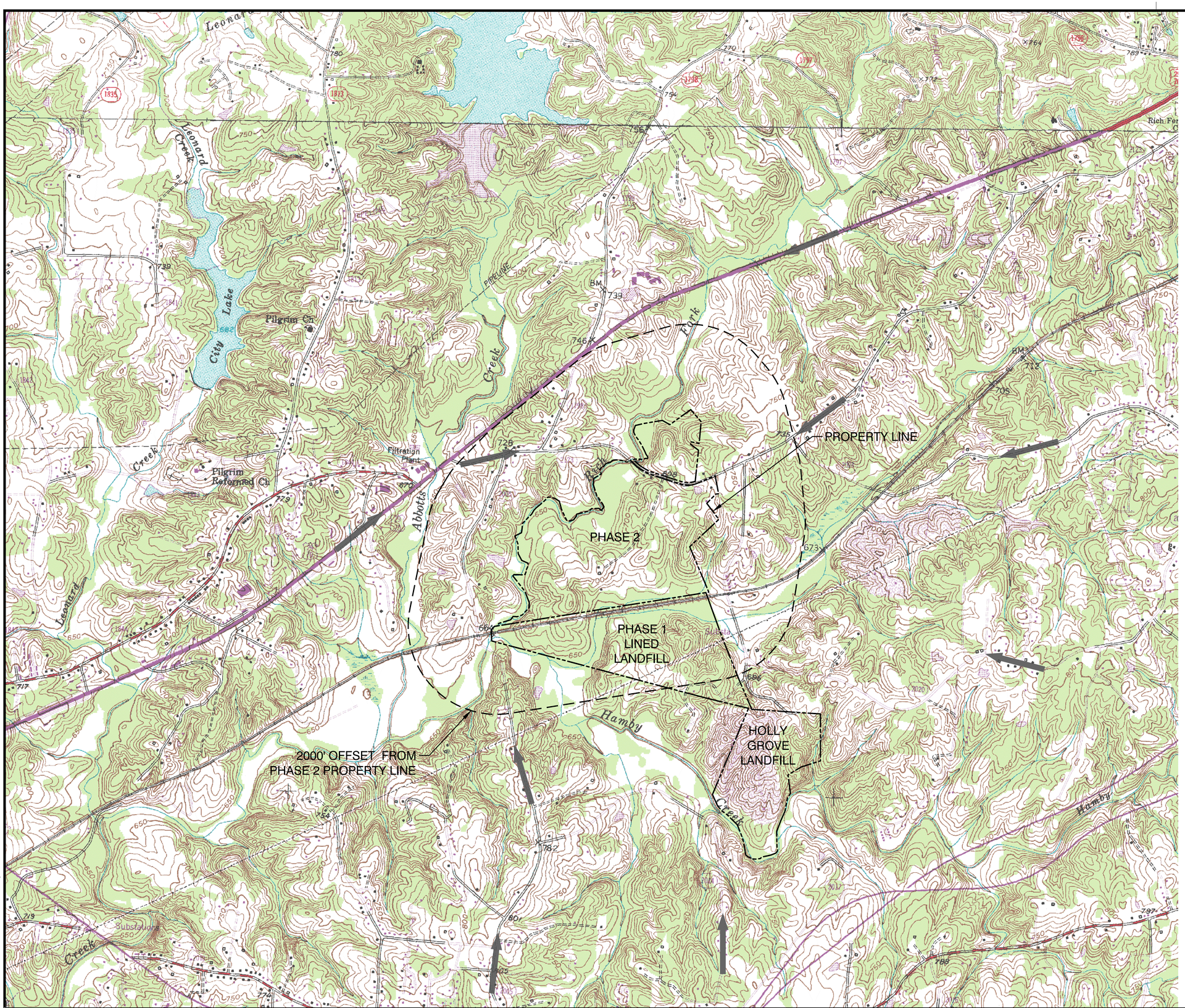

LEGEND

- PHASE 2 FACILITY BOUNDARY
- 2000' PROPERTY BOUNDARY OFFSET
- EXISTING ACCESS/HAUL ROAD

REFERENCE:

1. TOPOGRAPHY FROM U.S.G.S. 7.5 MIN. QUADRANGLE "LEXINGTON EAST, NC", DATED 1950, PHOTOREVISED 1994, AND FROM U.S.G.S. 7.5 MIN. QUADRANGLE "MIDWAY, NC", DATED 1969, PHOTOREVISED 1994.

0 1000' 2000' 3000'

DATE	NO.	REVISION

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PROJECT TITLE:
DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
USGS TOPOGRAPHIC MAP
DAVIDSON LANDFILL FACILITY

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FILE NAME DAVDCO-D0661	
SHEET NO.	DRAWING NO. FIG. 3

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N
W E
S

LEGEND

- PROPERTY LINE
- ADJACENT PROPERTY LINE
- LIMIT OF LINER (EXISTING LINED UNITS)
- LIMIT OF LINER (FUTURE LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- 2000' RADIUS
- STREAMS/PONDS

REFERENCES

1. AERIAL PHOTOGRAPHY WITHIN THE AREA OF THE LANDFILL PROPERTY PROVIDED BY SPATIAL DATA, FROM AERIAL SURVEY DATED FEBRUARY 20, 2012. SURROUNDING AERIAL IMAGERY FROM ESRI ARCGIS ONLINE BASEMAP SERVICES, DATE UNKNOWN.

0 500' 1000' 1500'

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PROJECT TITLE:
DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
AERIAL MAP

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SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0662	
SHEET NO. 4	DRAWING NO. FIG. 4

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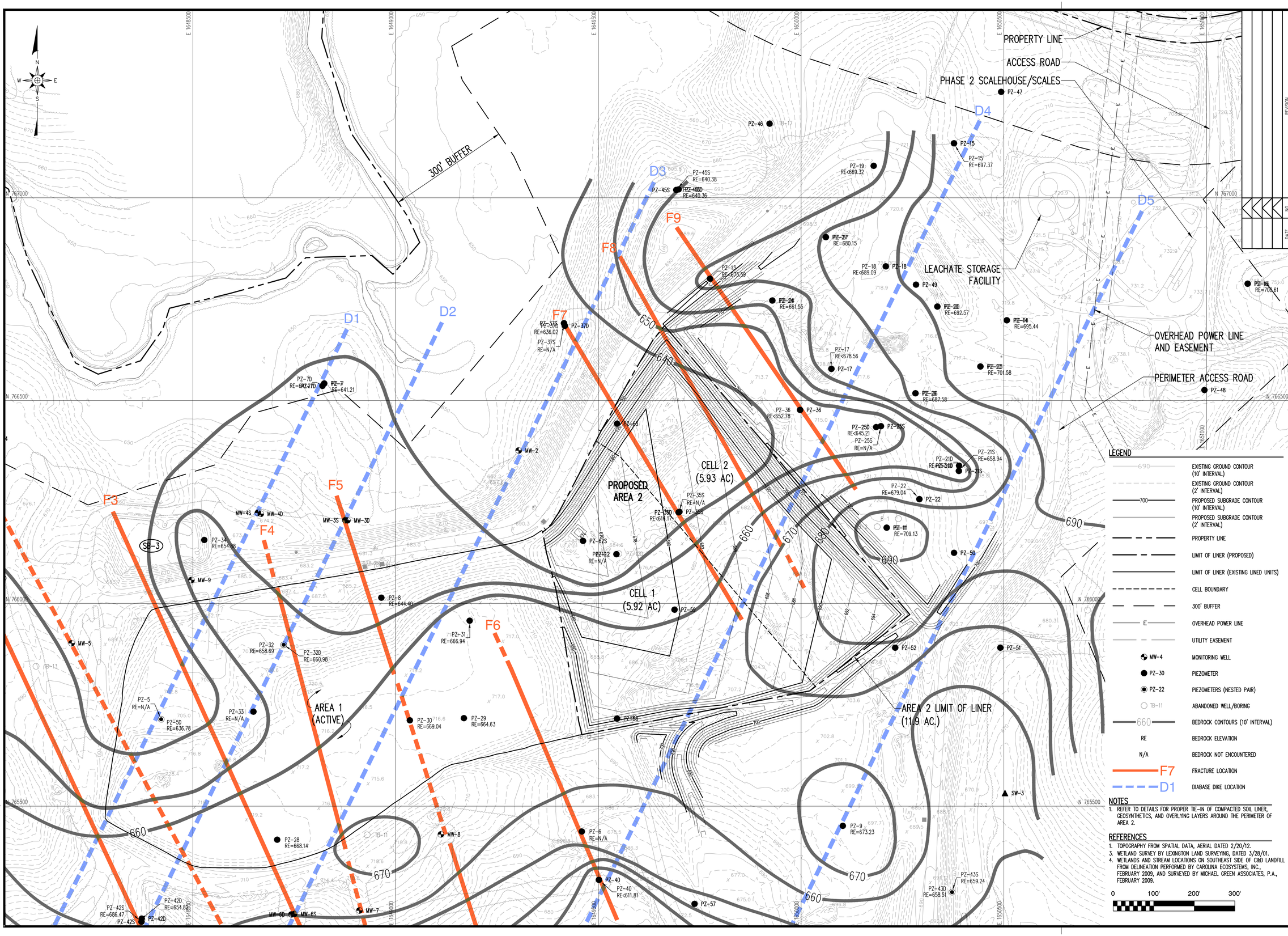

NOTES

1. REFER TO DETAILS FOR PROPER TIE-IN OF COMPACTED SOIL LINER, GEOSYNTHETICS, AND OVERLYING LAYERS AROUND THE PERIMETER OF AREA 2.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
3. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED 3/28/01.
4. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

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DRAWING TITLE: BEDROCK CONTOUR MAP WITH DIABASE DIKE AND FRACTURE LOCATIONS

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SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0663	
SHEET NO.	DRAWING NO. FIG. 5

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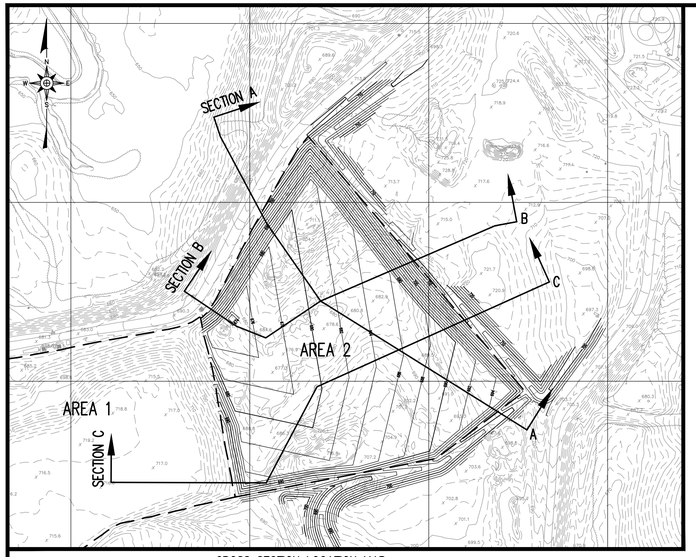


CROSS SECTION LOCATION MAP
SCALE: 1" = 200'

LEGEND

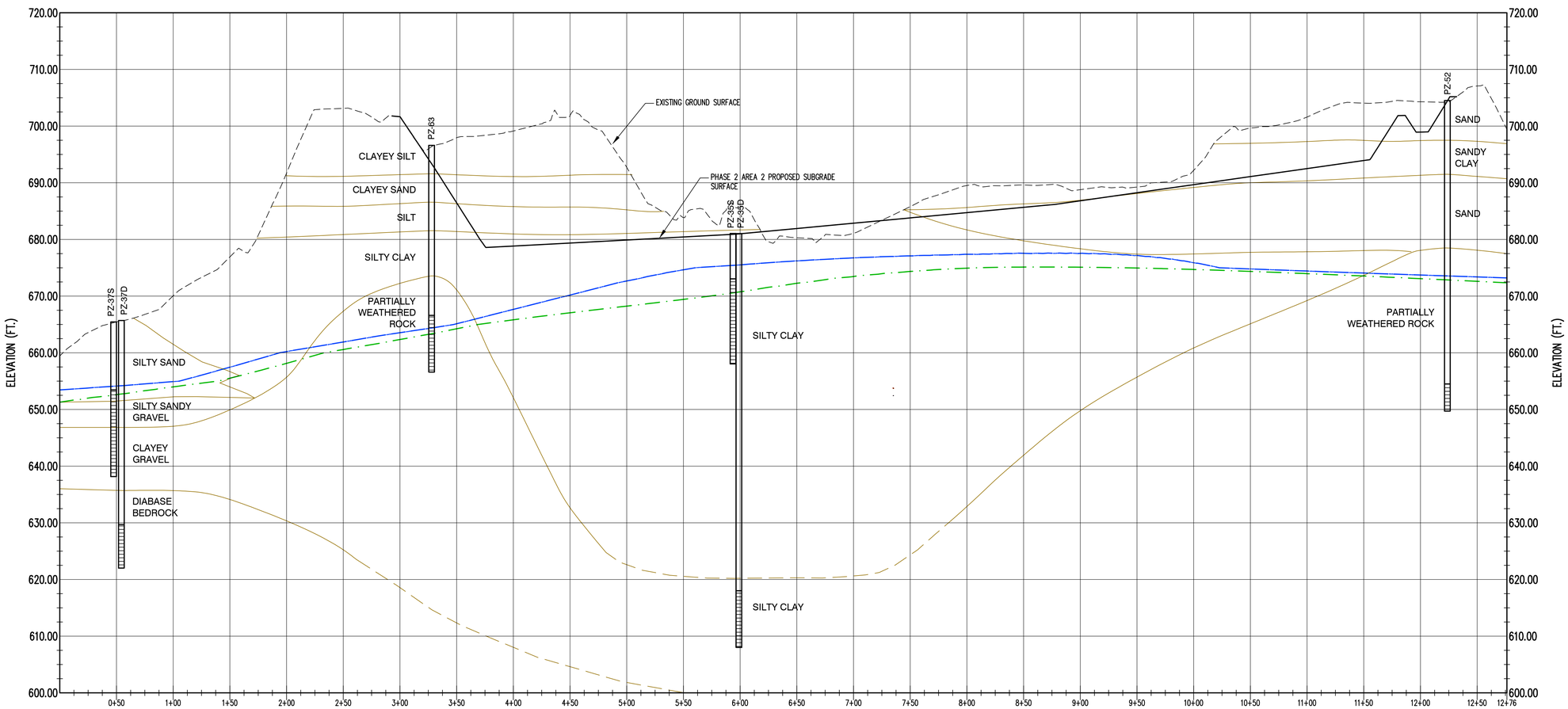
- EXISTING GROUND SURFACE
- SEASONAL HIGH GROUNDWATER
- ESTIMATED LONG TERM SEASONAL HIGH GROUNDWATER
- ROCK/SOIL LAYER (DASHED WHERE INFERRED)

NOTES

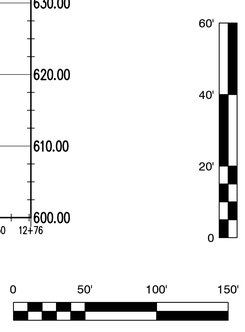
1. GROUND WATER ELEVATION DATA FROM MAY 2005, EXCEPT FOR PIEZOMETERS PZ-46 THROUGH PZ-63 FOR WHICH THE DATA IS FROM APRIL 2011.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. GROUNDWATER ELEVATION DATA IS A COMPOSITE OF HIGHEST ELEVATIONS COLLECTED IN EACH WELL.



SECTION AA
SCALE: AS NOTED
FIG.6



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DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
CROSS SECTION A-A

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SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0667	
SHEET NO.	DRAWING NO. FIG.6

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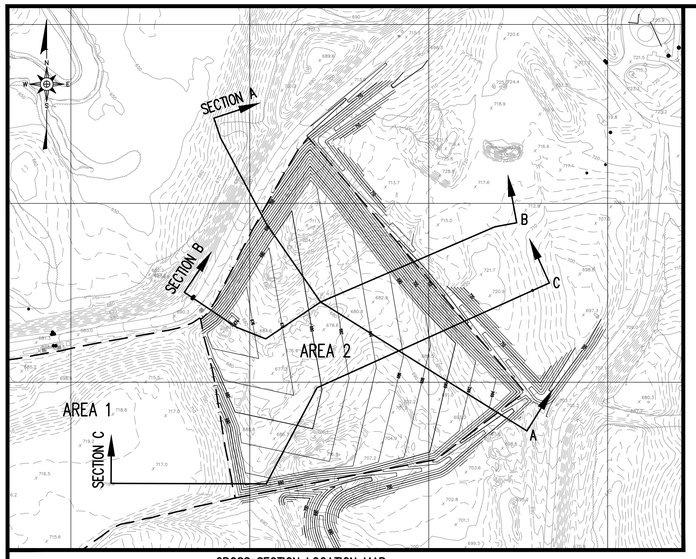
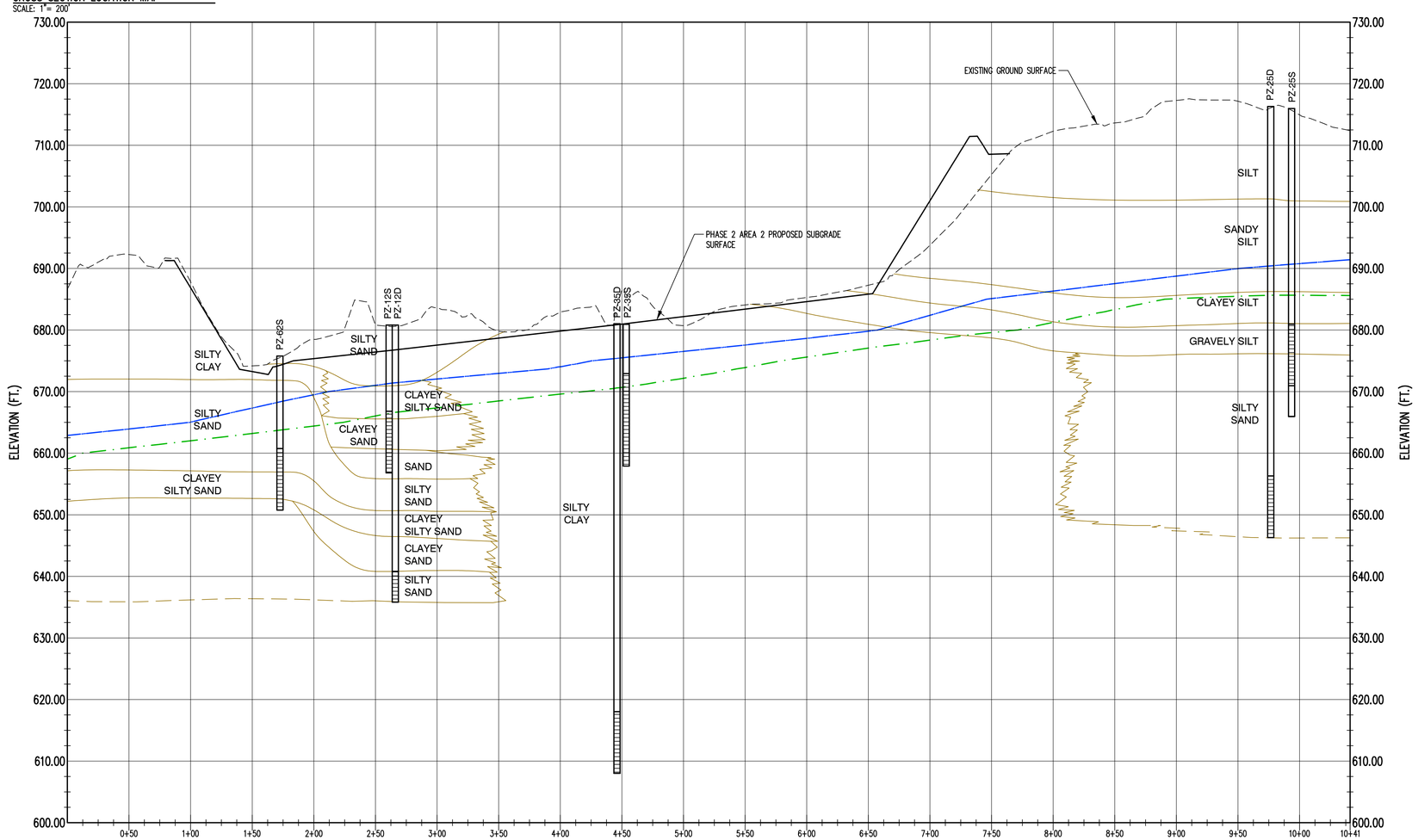


CROSS SECTION LOCATION MAP
SCALE: 1" = 200'



SECTION BB
SCALE: AS NOTED
FIG.7

LEGEND

- EXISTING GROUND SURFACE
- SEASONAL HIGH GROUNDWATER
- ESTIMATED LONG TERM SEASONAL HIGH GROUNDWATER
- ROCK/SOIL LAYER (DASHED WHERE INFERRED)

NOTES

1. GROUND WATER ELEVATION DATA FROM MAY 2005, EXCEPT FOR PIEZOMETERS PZ-46 THROUGH PZ-63 FOR WHICH THE DATA IS FROM APRIL 2011.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. GROUNDWATER ELEVATION DATA IS A COMPOSITE OF HIGHEST ELEVATIONS COLLECTED IN EACH WELL.

60' 40' 20' 0

0 50' 100' 150'

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DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
CROSS SECTION B-B

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SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0668	
SHEET NO.	DRAWING NO. FIG.7

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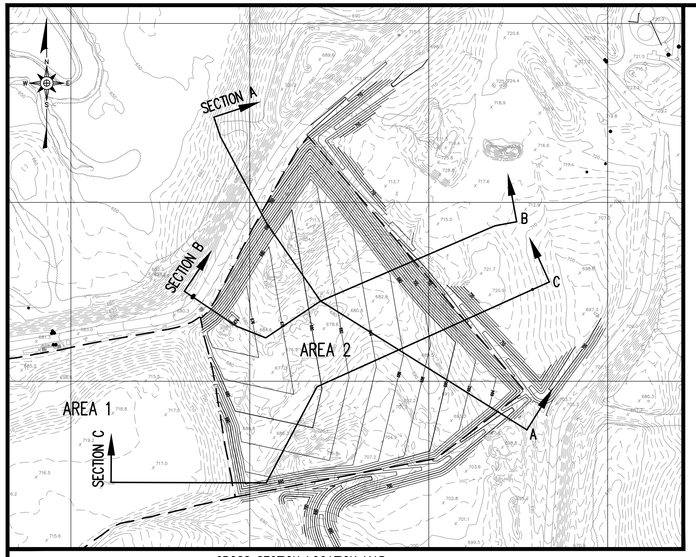


CROSS SECTION LOCATION MAP
SCALE: 1" = 200'

LEGEND

- EXISTING GROUND SURFACE
- SEASONAL HIGH GROUNDWATER
- ESTIMATED LONG TERM SEASONAL HIGH GROUNDWATER
- ROCK/SOIL LAYER (DASHED WHERE INFERRED)

NOTES

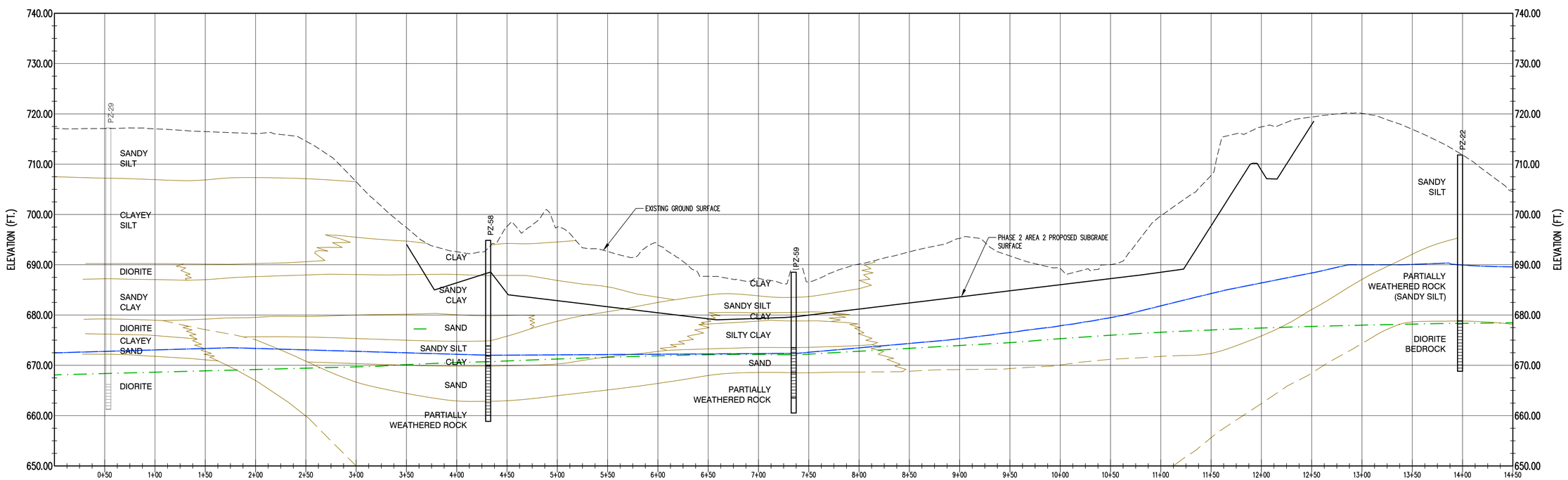
1. GROUND WATER ELEVATION DATA FROM MAY 2005, EXCEPT FOR PIEZOMETERS PZ-46 THROUGH PZ-63 FOR WHICH THE DATA IS FROM APRIL 2011.

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.
2. GROUNDWATER ELEVATION DATA IS A COMPOSITE OF HIGHEST ELEVATIONS COLLECTED IN EACH WELL.

60' 40' 20' 0

0 50' 100' 150'



SECTION CC
SCALE: AS NOTED
FIG.8

REVISION | NO. | DATE

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PROJECT TITLE:
DAVIDSON COUNTY
PHASE 2 AREA 2
DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE:
CROSS SECTION C-C

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CHECKED BY:	PROJECT NO.: DAVDCO-10-5
SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0669	
SHEET NO.	DRAWING NO. FIG.8

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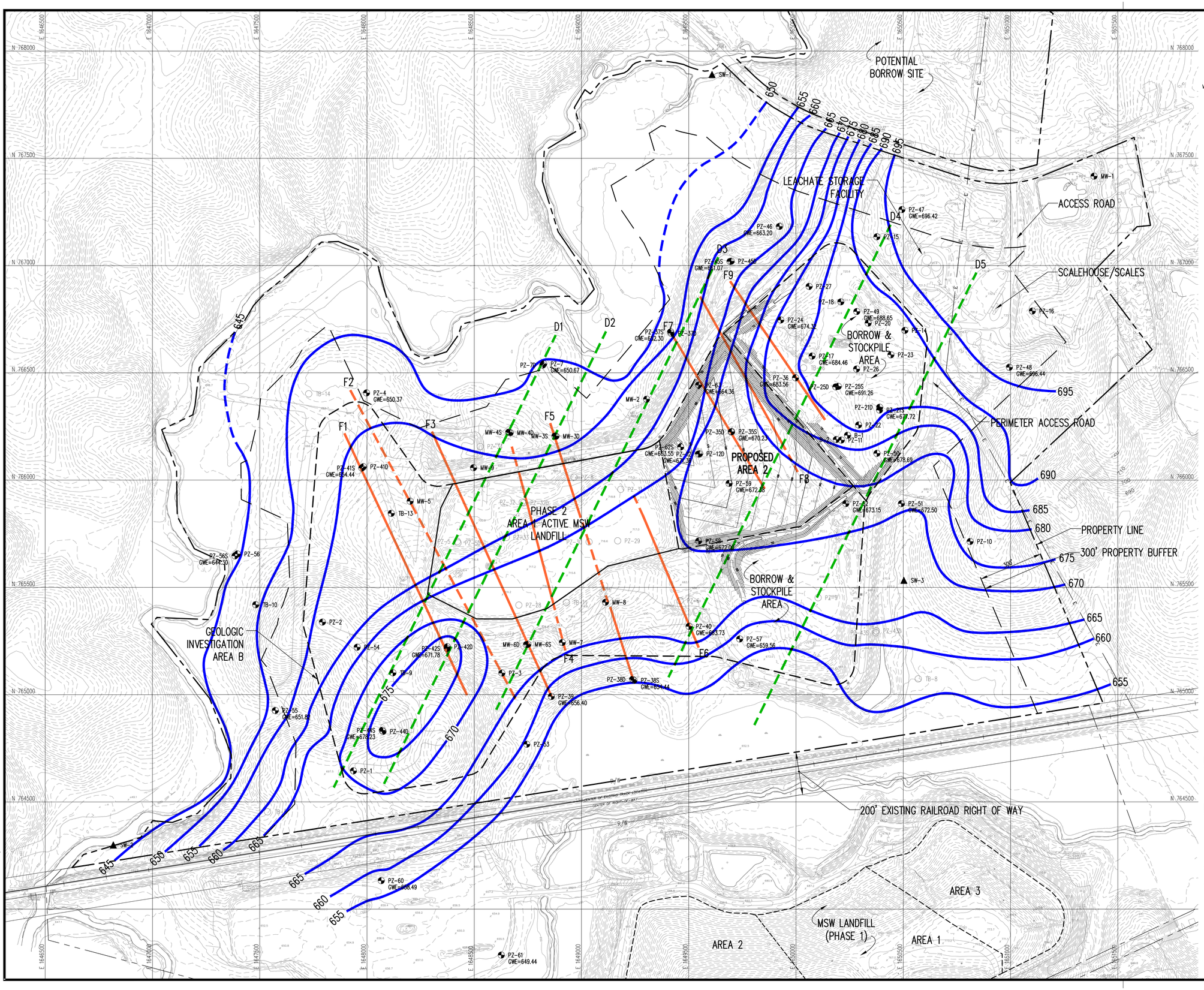

LEGEND

- EXISTING CONTOURS
- PROPOSED SUBGRADE CONTOUR (10' INTERVAL)
- PROPOSED SUBGRADE CONTOUR (2' INTERVAL)
- PROPERTY LINE (APPROXIMATE)
- 300' BUFFER
- LIMIT OF LINER (EXISTING LINED UNITS)
- LIMIT OF LINER (FUTURE LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- OVERHEAD POWER LINE
- PIEZOMETER
- PZ-31 PIEZOMETER (ABANDONED)
- 670 GROUND WATER CONTOUR (5' INTERVAL) (SEE NOTE X)
- FRACTURE LOCATION
- DIABASE DIKE LOCATION
- GROUND WATER FLOW
- GWE GROUND WATER ELEVATION

NOTES

1. GROUND WATER ELEVATION DATA FROM MAY 2005, EXCEPT FOR PIEZOMETERS PZ-46 THROUGH PZ-63 FOR WHICH THE DATA IS FROM APRIL 2011.

REFERENCES

1. TOPOGRAPHY INSIDE PROPERTY FROM SPATIAL DATA, AERIAL DATED 2/20/12. TOPOGRAPHY OUTSIDE OF PROPERTY LINE PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. GROUNDWATER ELEVATION DATA IS A COMPOSITE OF HIGHEST ELEVATIONS COLLECTED IN EACH WELL.

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PROJECT TITLE: DAVIDSON COUNTY PHASE 2 AREA 2 DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE: LONG-TERM/COMPOSITE HIGH POTENTIOMETRIC SURFACE AND AREA 2 BASEGRADES

DESIGNED BY: J.A.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO-10-5
SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0664	
SHEET NO.	DRAWING NO. FIG. 9

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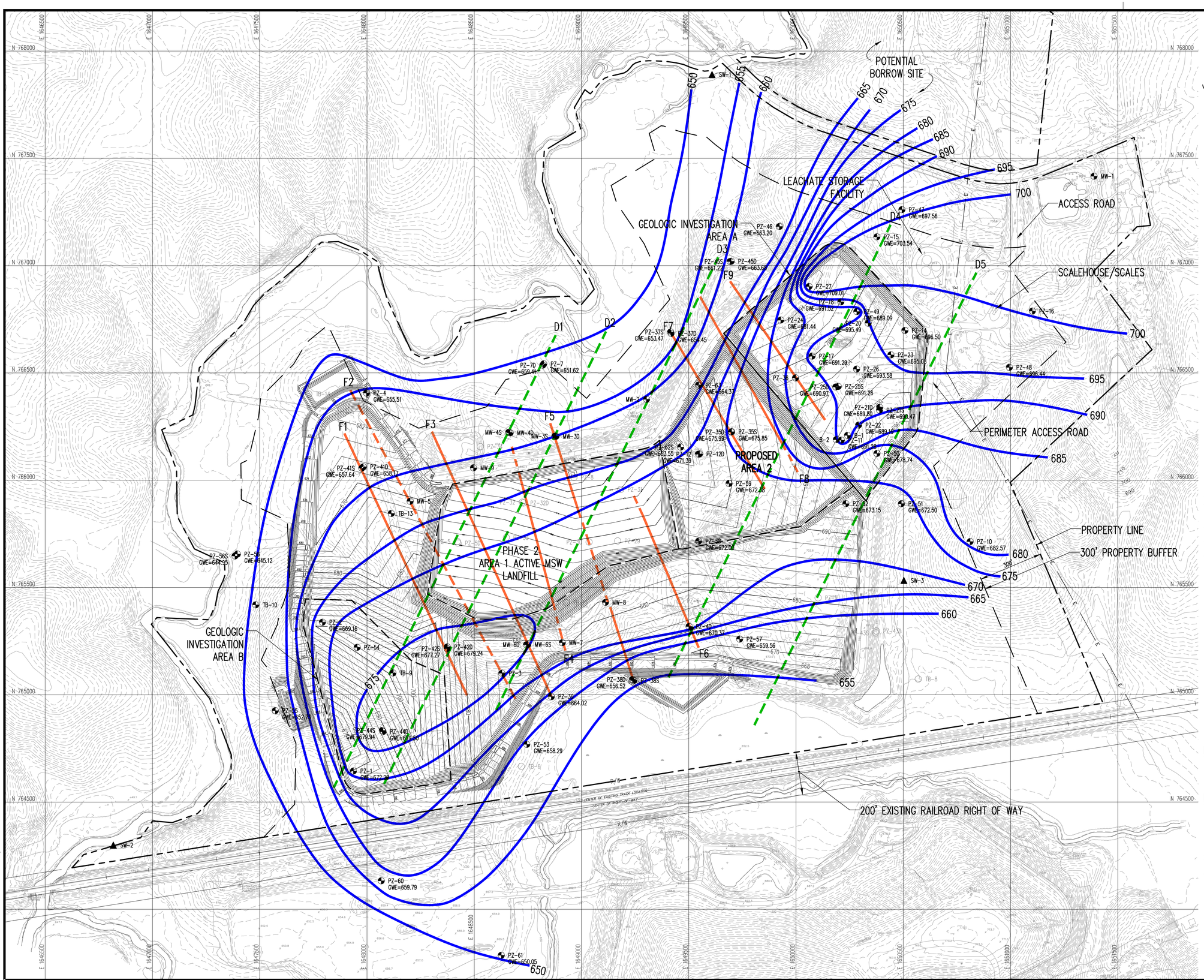

NOTES

1. GROUND WATER ELEVATION DATA FROM MAY 2005, EXCEPT FOR PIEZOMETERS PZ-46 THROUGH PZ-63 FOR WHICH THE DATA IS FROM APRIL 2011.

REFERENCES

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2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. GROUNDWATER ELEVATION DATA IS A COMPOSITE OF HIGHEST ELEVATIONS COLLECTED IN EACH WELL.

NO.	DATE	REVISION

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SEAL

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PROJECT TITLE: DAVIDSON COUNTY PHASE 2 AREA 2 DESIGN HYDROGEOLOGIC STUDY

DRAWING TITLE: ESTIMATED LONG TERM SEASONAL HIGH POTENTIOMETRIC SURFACE MAP

DESIGNED BY: J.A.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: DAVDCO-10-5
SCALE: AS SHOWN	DATE: APR. 2012
FILE NAME: DAVDCO-D0685	
SHEET NO.	DRAWING NO. FIG.10

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Tables

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RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

Table 1
Piezometer Construction Details and Groundwater Elevations
Davidson County Design, Phase 2 Area 2

By: JAS
Date: 8/17/2011

Well Name	Date Installed	Ground Elevation	Datum Elevation	Northing	Easting	Well Depth	Completion Elevation	Top of Screen	Top of Screen Elevation	Screen Bottom	Bottom Elevation	Bedrock Depth	Bedrock Elevation	Depth to PWR	PWR Elevation	Drilling Water Level	24 Hour Water Level	24 Hour Water Elevation
PZ-11	11/20/2000	719.13	720.48	766186.6004	1650211.0407	54.0	665.13	44.0	675.13	54.0	665.13	10	709.13	N/A	N/A	49.0	38.41	682.07
PZ-12	11/01/2000	679.52	682.71	766121.3320	1649544.3370	25.0	654.52	14.0	665.52	24.0	655.52	N/A	N/A	N/A	N/A	15.9	15.90	666.81
PZ-21s	02/18/2002	692.94	695.64	766326.4440	1650389.0209	34.0	658.94	24.0	668.94	34.0	658.94	34.0	658.94	25.0	667.94	DRY	16.37	679.27
PZ-21d	02/21/2002	693.00	698.59	766339.4554	1650389.4891	53.5	639.50	43.5	649.50	53.5	639.50	36.0	657.00	25.0	668.00	N/A	N/A	N/A
PZ-24	02/20/2002	711.55	714.55	766746.5336	1649928.9481	50.0	661.55	40.0	671.55	50.0	661.55	50.0	661.55	N/A	N/A	DRY	45.35	669.20
PZ-25s	02/19/2002	714.82	717.46	766436.7723	1650196.8280	50.0	664.82	35.0	679.82	45.0	664.82	N/A	N/A	N/A	N/A	35.0	39.85	677.61
PZ-25d	02/20/2002	715.21	717.91	766434.6009	1650185.1010	70.0	645.21	60.0	655.21	70.0	645.21	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PZ-35s	09/20/2004	687.47	689.12	766225.7197	1649699.8802	23.0	664.47	8.0	679.47	23.0	664.47	N/A	N/A	N/A	N/A	18.0	N/A	N/A
PZ-35d	09/16/2004	687.52	689.17	766224.4094	1649697.9430	73.0	614.52	63.0	624.52	73.0	614.52	N/A	N/A	N/A	N/A	18.0	N/A	N/A
PZ-37s	09/21/2004	665.17	668.58	766690.7204	1649415.2654	27.0	638.17	12.0	653.17	27.0	638.17	N/A	N/A	N/A	N/A	19.0	N/A	N/A
PZ-37d	10/14/2006	666.02	668.76	766684.2050	1649417.4280	44.0	622.02	36.0	630.02	44.0	622.02	30	636.02	19.5	646.52	N/A	N/A	N/A
PZ-40	09/23/2004	675.81	676.93	765318.2295	1649501.3640	64.0	611.81	49.0	626.81	64.0	611.81	N/A	N/A	N/A	N/A	64.0	N/A	N/A
PZ-50	11/18/2010	701.46	704.36	766124.5920	1650377.1220	40.0	661.46	35.0	666.46	40.0	661.46	NA	NA	NA	NA	NA	NA	NA
PZ-51	11/11/2010	681.34	683.35	765890.5170	1650491.3150	18.0	663.34	8.0	673.34	18.0	663.34	NA	NA	NA	NA	8.0	11.52	671.83
PZ-52	11/30/2010	704.71	707.52	765890.5780	1650232.0250	55.0	649.71	50.0	654.71	55.0	649.71	NA	NA	26.0	678.71	52.0	NA	NA
PZ-57	11/11/2010	674.24	676.54	765259.1320	1649737.2550	23.0	651.24	13.0	661.24	23.0	651.24	NA	NA	NA	NA	14.0	17.27	659.27
PZ-58	11/11/2010	695.16	697.40	765715.8240	1649546.0030	36.0	659.16	26.0	669.16	36.0	659.16	NA	NA	32.0	663.16	33.0	25.85	671.55
PZ-59	11/11/2010	688.88	691.34	765984.4800	1649687.8420	25.0	663.88	15.0	673.88	25.0	663.88	NA	NA	20.0	668.88	23.0	19.32	672.02
PZ-62	11/15/2010	676.76	679.56	766153.9850	1649462.1670	25.0	651.76	15.0	661.76	25.0	651.76	NA	NA	NA	NA	20.0	18.00	661.56
PZ-63	11/11/2010	697.20	700.05	766442.8080	1649546.0800	40.0	657.20	30.0	667.20	40.0	657.20	NA	NA	23.0	674.20	36.0	NA	NA

Notes:
N/A = PWR/bedrock not encountered, or information not available.
PWR = Partially weathered rock defined as material exhibiting standard penetration test results of greater than 100 blows per foot.
Measurements are presented in Feet
TB- borings advanced by Westinghouse, 1989. Water table information from Westinghouse boring logs.
Water elevations for borings were measured from the ground surface
The borehole for PZ-54 was dry at 75 feet and abandoned. No piezometer installed in this location.

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

Date 3/13/2012
By MG

Table 2A
Historic Ground Water Table Elevations
Davidson County Landfill Phase 2 Landfill

Well Name	TOC Elevation	2/01/2001	3/01/2001	4/01/2001	5/01/2001	6/01/2001	7/01/2001	8/01/2001	9/01/2001	10/01/2001	11/01/2001	12/01/2001	1/02/2002	2/02/2002
PZ-11	720.48	NA	664.31	664.59	663.93	663.17	662.84	661.82	662.29	661.68	661.38	661.38	661.15	661.75
PZ-12	682.71	663.82	664.34	664.61	663.96	663.26	662.89	661.88	662.33	661.68	661.41	NA	NA	661.81

Well Name	TOC Elevation	3/28/2002	4/22/2002	5/10/2002	6/11/2002	7/09/2002	8/01/2002	9/03/2002	10/07/2002	11/14/2002	12/11/2002	1/03/2003	2/04/2003	3/12/2003
PZ-11	720.48	NA	NA	NA	NA	NA	NA	NA	NA	675.91	676.30	676.88	677.38	672.60
PZ-12	682.71	NA	NA	NA	NA	NA	NA	NA	NA	659.17	659.90	660.29	660.41	NA
PZ-21s	695.64	689.17	689.04	688.91	688.73	688.50	688.41	688.24	688.00	688.18	688.82	689.79	690.47	677.89
PZ-21d	698.59	669.20	669.11	669.05	668.89	668.68	668.55	668.21	667.82	667.63	667.64	667.87	668.49	680.63
PZ-22	714.47	679.47	679.37	679.27	679.06	678.87	678.64	678.31	677.97	677.67	677.88	678.46	679.02	679.32
PZ-24	714.55	681.44	681.29	681.15	680.92	680.71	680.46	680.10	679.68	679.30	679.44	679.98	680.68	669.42
PZ-25s	717.46	668.33	668.28	668.22	668.04	667.88	667.68	667.36	667.03	666.76	666.87	667.29	668.24	679.91
PZ-25d	717.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	679.81
PZ-35s	689.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-35d	689.17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-37s	668.58	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-37d	668.76	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-40	676.93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTE:
NA = Data Not Available

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

Table 2A
Historic Ground Water Table Elevations
Davidson County Landfill Phase 2 Landfill

Date 40981
By MG

Well Name	TOC Elevation	4/03/2003	4/24/2003	5/09/2003	5/30/2003	6/10/2003	7/09/2003	8/07/2003	9/04/2003	10/14/2003	3/24/2004	4/07/2004	5/12/2004
PZ-11	720.48	679.65	681.10	681.63	682.26	682.79	NA	683.66	683.98	684.66	686.15	686.48	686.77
PZ-12	682.71	665.51	667.24	667.77	668.15	668.63	NA	668.16	668.45	669.49	670.76	670.93	670.96
PZ-21s	695.64	678.94	680.02	680.89	681.59	682.23	682.68	682.93	683.31	683.76	685.09	685.36	685.48
PZ-21d	698.59	681.67	682.99	683.63	684.39	684.95	685.46	685.70	686.11	686.59	687.99	688.28	688.38
PZ-22	714.47	680.37	681.97	682.57	683.18	683.71	684.47	684.68	684.98	685.60	687.12	687.43	688.03
PZ-24	714.55	670.34	671.68	672.92	674.45	675.20	677.46	678.05	678.85	679.79	680.23	680.55	680.60
PZ-25s	717.46	680.76	681.80	682.44	683.36	683.79	685.69	685.95	686.51	687.51	689.01	689.25	689.60
PZ-25d	717.91	690.61	681.53	682.32	683.22	683.80	685.40	685.86	686.48	687.26	688.86	689.15	689.42

Well Name	TOC Elevation	6/11/2004	7/08/2004	8/17/2004	9/03/2004	10/28/2004	11/29/2004	12/14/2004	1/12/2005	2/08/2005	3/11/2005	4/11/2005	5/05/2005
PZ-11	720.48	686.75	686.68	686.40	686.23	686.39	686.24	686.48	686.67	686.84	687.17	687.78	688.13
PZ-12	682.71	670.71	670.56	670.08	669.78	670.09	669.93	670.20	670.27	670.41	670.78	671.33	671.39
PZ-21s	695.64	685.39	685.45	685.08	684.81	685.04	685.07	685.38	685.38	685.69	686.11	686.84	686.68
PZ-21d	698.59	688.28	688.36	688.00	687.73	687.97	687.64	688.34	688.34	688.69	661.59	689.80	689.65
PZ-22	714.47	687.67	687.60	687.32	687.12	687.27	687.13	687.38	687.55	687.76	688.13	689.19	689.13
PZ-24	714.55	680.64	680.37	680.13	679.93	679.74	679.55	679.55	679.69	679.74	NR	679.95	680.23
PZ-25s	717.46	689.63	689.74	689.81	679.70	690.01	689.79	689.89	690.04	690.11	690.36	690.87	691.26
PZ-25d	717.91	689.57	689.57	689.56	689.42	689.68	689.49	689.66	689.83	689.95	690.20	690.66	690.97
PZ-35s	689.12	NA	NA	NA	NA	674.60	674.46	674.72	674.76	674.91	675.28	675.83	675.85
PZ-35d	689.17	NA	NA	NA	NA	NA	674.56	674.85	674.92	675.06	675.40	675.93	675.99
PZ-37s	668.58	NA	NA	NA	NA	NA	651.75	652.13	651.45	651.90	652.32	653.47	652.30
PZ-37d	668.76	NA	NA	NA	NA	NA	653.39	653.64	653.13	653.51	653.83	654.45	653.82
PZ-40	676.93	NA	NA	NA	NA	NA	665.84	667.56	666.55	667.21	668.01	670.37	668.20

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Table 2B
Recent Ground Water Table Elevations
Davidson County Landfill Phase 2 Landfill

Date: 3/13/2012
By: MG

Well Name	TOC Elevation	12/22/2010	1/31/2011	2/08/2011	3/14/2011	4/26/2011	5/31/2011	6/15/2011	7/25/2011	8/09/2011	9/12/2011	10/13/2011	11/30/2011	12/28/2011	1/30/2012	2/22/2012	3/27/2012
PZ-11	720.48	681.78	681.28	691.28	681.30	682.05	682.21	682.18	681.85	681.69	681.24	681.11	NR	NR	NR	NR	NR
PZ-12	682.71	665.14	665.01	665.09	665.11	665.29	665.46	665.14	664.74	664.61	664.41	664.17	664.19	664.58	664.87	665.05	665.06
PZ-21s	695.64	673.59	670.14	673.19	673.59	677.72	674.69	674.55	677.04	676.81	676.23	676.05	673.24	676.86	674.10	674.41	677.67
PZ-21d	698.59	679.59	679.10	679.15	679.57	677.61	680.71	680.59	676.93	676.71	676.17	675.99	678.22	676.73	680.10	680.43	677.54
PZ-22	714.47	682.62	682.13	682.08	682.18	683.03	683.20	683.22	682.82	682.65	682.15	681.97	NR	714.47	714.47	714.47	714.47
PZ-24	714.55	674.55	674.05	673.99	673.95	674.32	674.39	674.33	674.00	673.86	673.48	673.36	673.22	673.58	674.06	674.41	674.31
PZ-25s	717.46	684.86	684.26	684.21	684.20	685.01	685.23	685.25	684.91	684.72	684.20	684.07	683.61	683.96	684.31	684.51	684.56
PZ-25d	717.91	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke	broke
PZ-35s	689.12	669.97	669.87	670.20	670.02	670.23	670.22	669.97	669.59	669.44	668.98	668.95	669.20	669.51	669.81	669.92	669.84
PZ-35d	689.17	670.02	669.92	670.17	670.12	670.33	670.24	669.95	669.63	669.47	669.07	669.04	669.22	669.55	669.84	669.98	669.87
PZ-37s	668.58	651.28	651.41	651.67	652.03	651.90	651.26	650.53	650.29	649.28	649.70	650.60	651.78	652.02	651.61	651.89	651.99
PZ-37d	668.76	650.84	650.96	651.20	651.36	651.19	650.62	649.81	649.71	650.13	649.36	650.55	651.66	651.62	650.98	651.27	651.32
PZ-40	676.93	660.94	653.54	653.88	654.68	663.73	654.45	653.93	653.31	652.99	652.27	652.83	NR	676.93	676.93	676.93	676.93
PZ-50	704.36	677.91	677.59	677.71	677.92	678.69	678.74	678.67	678.30	678.12	677.66	677.56	NR	704.36	704.36	704.36	704.36
PZ-51	683.35	671.69	671.76	672.03	672.27	672.50	672.35	672.03	671.85	671.75	671.45	671.75	672.24	672.47	672.35	672.60	672.58
PZ-52	707.52	673.17	672.88	672.94	672.90	673.15	673.02	672.98	672.89	672.82	703.57	703.62	672.75	673.08	673.10	704.27	673.22
PZ-57	676.54	659.14	659.04	659.25	659.41	659.56	659.29	659.04	658.89	658.79	658.54	658.94	659.22	659.54	659.41	659.61	659.59
PZ-58	697.40	671.08	670.75	670.93	671.38	672.00	671.60	671.31	670.76	670.60	670.20	670.06	670.03	671.90	670.72	671.01	670.92
PZ-59	691.34	671.58	671.34	671.54	671.94	672.38	671.97	671.63	671.19	671.03	670.64	670.54	670.50	670.81	671.14	671.35	671.25
PZ-62	679.56	663.19	662.86	663.01	663.04	663.55	663.40	663.25	512.89	662.75	662.34	662.37	662.35	662.71	662.92	663.27	663.16
PZ-63	700.05	664.00	663.64	663.70	663.72	664.36	664.37	664.30	663.86	663.72	663.28	663.20	663.28	663.80	664.26	664.50	664.48

Notes
NR = Not reported

By: JAS
Date: 8/17/2011

Table 3
Geotechnical Test Results
Davidson County Landfill Phase 2

Well Name	Atterberg Limits			% Passing		Natural Moisture %	Depth (ft)
	LL	PL	PI	#4	#200		
PZ-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PZ-12	29	NP	NP	100.0	43.1	25	25 - 26.5
PZ-12d	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PZ-21s	36	32	4	100	63.9	18.2	10 - 11.5
PZ-21d	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PZ-22	12	NP	NP	100	36	8.1	10 - 11.5
PZ-24	41	33	8	100	63.7	7.9	10 - 11.5
PZ-25s	13	NP	NP	100	35	11.5	20 - 21.5
PZ-25d	11	NP	NP	100	31.4	16.1	70 - 71.5
PZ-50	NA	NA	NA	NA	NA	NA	MA
PZ-51	25	24	1	99.9	29.7	20.2	10 - 14
PZ-52	28	20	8	99.5	29.3	5.5	20 - 22
PZ-57	31	26	5	98.8	25.3	19.1	15 - 18
PZ-58	32	25	7	99	53.8	16.4	30 - 32
PZ-59	41	35	6	100	36.1	25	15 - 20
PZ-62	42	33	9	99.8	40.1	29.4	20 - 25
PZ-63	31	26	5	100	59.2	26.1	20 - 23

N/A - soils not analyzed for these parameters.
NP - Soils are not plastic.

By: JAS
Date: 8/17/2011

Table 4
Bedrock data
Davidson County Landfill Phase 2

Piezometer Number	Core Depth	Run Length (feet)	Recovery (percent)	RQD (percent)
PZ-1	30 - 40	10	85.0%	12.5%
PZ-5d	65 - 75'	10	100.0%	60.8%
PZ-9	24 - 34'	10	87.0%	49.7%
PZ-12d	40 - 50'	10	56.6%	79.4%
PZ-13	40 - 50'	10	56.6%	79.4%
PZ-19	50 - 60'	10	100.0%	32.9%
PZ-21d	36 - 46'	10	100.0%	62.5%
PZ-29*	27 - 37'	10	30%	100.0%
PZ-31	27 - 37'	10	40%	30.5%
PZ-32d	43 - 53'	10	85%	58.4%
PZ-34	17 - 27'	10	85%	69.6%
PZ-37d	34 - 44'	10	95%	39.0%
PZ-38d	40 - 50'	10	100%	61.0%
PZ-39	21 - 36'	15	90%	24.0%
PZ-41d	29 - 39'	10	40%	**0.0%**
PZ-41d**	44 - 54'	10	75%	0.1%
PZ-42s	18 - 29'	11	23%	**0.0%**
PZ-42d	50 - 60'	10	85%	77.0%
PZ-43d	21 - 31'	10	62%	20.0%
PZ-44d	23 - 33'	10	100%	40.0%
PZ-45d	58 - 68'	10	15%	22.0%
PZ-46	NA	NA	NA	NA
PZ-47	NA	NA	NA	NA
PZ-48	NA	NA	NA	NA
PZ-49	43 - 53'	10	99.0%	99.0%
PZ-50	NA	NA	NA	NA
PZ-51	NA	NA	NA	NA
PZ-52	26' - 36'	10	0.0%	**0.0%**
PZ-53	NA	NA	NA	NA
PZ-54	NA	NA	NA	NA
PZ-55	NA	NA	NA	NA
PZ-56s	NA	NA	NA	NA
PZ-56d	21' - 31'	10	0.0%	**0.0%**
PZ-57	NA	NA	NA	NA
PZ-58	NA	NA	NA	NA
PZ-59	NA	NA	NA	NA
PZ-60	NA	NA	NA	NA
PZ-61	NA	NA	NA	NA
PZ-62	NA	NA	NA	NA
PZ-63	NA	NA	NA	NA

PZ-29 - rock that was cored was an isolated boulder. Unconsolidated Sediments were encountered below the rock.
PZ-41d - A 2nd rock core was performed after the first yielded no recovery.
Rock cores attempted in PZ-52 and PZ-56d yielded no recovery.
Below coring depth in these piezometers, unconsolidated sediments and partially weathered rock were encountered.

By: JAS
Date: 8/17/2011

Table 5
Hydrogeologic Properties Summary
Davidson County Landfill Phase 2

Well Name	Hydrologic Unit	Rock Type	Effective Porosity	Conductivity K (ft/day)	Grain Size Distribution			
					% Gravel	% Sand	% Silt	% Clay
PZ-11	2	Diorite	0.20	0.69	N/A	N/A	N/A	N/A
PZ-12*	1a	N/A	0.12	2.17	0	56.9	43.1	
PZ-12d	1a	N/A	0.20	1.64	N/A	N/A	N/A	N/A
PZ-21s	1b	N/A	0.14	1.86	0	36.1	45.7	18.2
PZ-21d	2	Diorite	N/A	1.33	N/A	N/A	N/A	N/A
PZ-22	2	Diorite	0.17	1.58	0	64	20.6	15.4
PZ-24	1a	N/A	0.04	2.74	0	36.3	31.2	32.5
PZ-25s	1a	N/A	0.17	1.10	0	65	21.1	13.9
PZ-25d	1b	N/A	0.20	0.46	0	68	18.6	13.4
PZ-50	1b	N/A	0.170	1.890	NA	NA	NA	NA
PZ-51	1b	N/A	0.250	0.207	3.23	73.92	18.35	4.49
PZ-52	1b	N/A	0.170	0.224	0	71	29	
PZ-57	1	N/A	0.220	0.224	2	72	26	
PZ-58	1b	N/A	0.140	0.741	4.99	48.14	39.54	7.34
PZ-59	1b	N/A	0.120	0.358	0	64	36	
PZ-62	1	N/A	0.220	0.675	3.49	62.3	30.01	4.2
PZ-63	1b	N/A	0.160	0.159	0.75	50.68	41.19	7.38

Unit 1 = unconsolidated sediments
Unit 1b = partially weathered rock
Unit 2 = bedrock formation
Effective Porosity from Textural Classification Triangle and grain size analysis or estimated from rock core RQD.
Conductivity Values from aquifer slug testing.
Where one number is given under %silt and %clay a hydrometer test was not performed.

RICHARDSON SMITH GARDNER & ASSOCIATES
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Table 6
Historical Precipitation Data
Davidson County Area
1975 - 2011

Date: 3/13/2012
By: MG

1975	
Month	Value (in)
1	6.22
2	3.77
3	7.95
4	1.63
5	6.18
6	3.02
7	9.02
8	1.7
9	7.19
10	2.76
11	3.03
12	3.76
Total	**56.23**

1976	
Month	Value (in)
1	2.72
2	1.66
3	3.21
4	0.36
5	5.7
6	5.19
7	1.64
8	2.92
9	4.11
10	6.51
11	2.22
12	4.76
Total	**41**

1977	
Month	Value (in)
1	2.68
2	1.66
3	5.77
4	2.16
5	2.24
6	2.15
7	1.49
8	4.79
9	5.91
10	5.32
11	3.76
12	3.09
Total	**41.02**

1978	
Month	Value (in)
1	7.99
2	1.03
3	4.76
4	4.63
5	4.6
6	3.96
7	4.75
8	4.01
9	2.01
10	1.33
11	3.51
12	3.76
Total	**46.34**

1979	
Month	Value (in)
1	5.74
2	5.5
3	3.7
4	3.99
5	5.26
6	5.1
7	4.6
8	3.19
9	8.3
10	2.22
11	5.26
12	1.19
Total	**54.05**

1980	
Month	Value (in)
1	4.52
2	1.61
3	6.46
4	2.5
5	3.62
6	3.72
7	3.63
8	1.72
9	4.85
10	3.21
11	2.9
12	1.56
Total	**40.3**

1981	
Month	Value (in)
1	0.86
2	3.6
3	2.46
4	0.91
5	3.65
6	4.87
7	4.65
8	4.16
9	3.94
10	3.97
11	0.85
12	5.09
Total	**39.01**

1982	
Month	Value (in)
1	4.41
2	5.06
3	2.35
4	3.79
5	4.64
6	7.12
7	4.03
8	2.58
9	1.98
10	4.52
11	2.58
12	4.16
Total	**47.22**

1983	
Month	Value (in)
1	1.86
2	5.66
3	6.61
4	4.25
5	4.11
6	3.76
7	1.18
8	2.32
9	2.54
10	3.69
11	4.35
12	6.65
Total	**46.98**

1984	
Month	Value (in)
1	4.36
2	6.5
3	6.13
4	4.94
5	6.45
6	2.99
7	8.24
8	1.77
9	1.02
10	1.75
11	1.88
12	2.23
Total	**48.26**

1985	
Month	Value (in)
1	4.06
2	5.17
3	1.2
4	1.18
5	4.35
6	4.3
7	5.66
8	6.55
9	0.2
10	3.23
11	8.07
12	1.13
Total	**45.1**

1986	
Month	Value (in)
1	1.37
2	1.54
3	2.36
4	0.84
5	2.12
6	1.33
7	3.29
8	8.61
9	0.96
10	2.6
11	3.69
12	3.57
Total	**32.28**

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Table 6
Historical Precipitation Data
Davidson County Area
1975 - 2011

Date: 3/13/2012
By: MG

1987	
Month	Value (in)
1	6.19
2	4.41
3	4.46
4	5.71
5	1.4
6	3.4
7	1.99
8	3.1
9	6.81
10	1.32
11	3.51
12	3.41
Total	**45.71**

1988	
Month	Value (in)
1	3.42
2	2.01
3	2.36
4	2.86
5	3.08
6	2.95
7	3.34
8	5.79
9	5.05
10	3.91
11	4.07
12	0.92
Total	**39.76**

1989	
Month	Value (in)
1	1.79
2	6.41
3	5.49
4	4.11
5	5.32
6	6.73
7	6.09
8	4.16
9	4.83
10	5.76
11	3.19
12	3.51
Total	**57.39**

1990	
Month	Value (in)
1	4.03
2	4.69
3	4.39
4	2.98
5	8.05
6	1.55
7	2.23
8	3.06
9	0.83
10	10.48
11	2.2
12	3.32
Total	**47.81**

1991	
Month	Value (in)
1	5.06
2	1.37
3	5.96
4	3.86
5	3.18
6	3.39
7	5.74
8	4.09
9	2.96
10	0.85
11	1.68
12	3.02
Total	**41.16**

1992	
Month	Value (in)
1	2.92
2	2.98
3	3.32
4	3.59
5	3.34
6	6.59
7	3.33
8	4.46
9	2.42
10	4.88
11	5.76
12	2.87
Total	**46.46**

1993	
Month	Value (in)
1	5.4
2	3.11
3	7.45
4	4.41
5	3.37
6	1.54
7	2.68
8	2.55
9	3.28
10	2.79
11	2.6
12	3.69
Total	**42.87**

1994	
Month	Value (in)
1	4.06
2	3.36
3	6.59
4	1.57
5	2.81
6	5.6
7	5.12
8	4.56
9	3.01
10	2.95
11	2.56
12	1.44
Total	**43.63**

1995	
Month	Value (in)
1	4.9
2	5.17
3	2.84
4	1.02
5	4
6	9.36
7	4.77
8	4.71
9	3.61
10	8.5
11	4.55
12	1.74
Total	**55.17**

1996	
Month	Value (in)
1	4.8
2	2.76
3	3.85
4	3.71
5	2.86
6	3.38
7	4.71
8	4.97
9	9.69
10	3.23
11	3.57
12	3.65
Total	**51.18**

1997	
Month	Value (in)
1	3.34
2	3.51
3	3.68
4	6.12
5	2.12
6	4.01
7	6.73
8	1.36
9	3.38
10	3.24
11	3.37
12	3.33
Total	**44.19**

1998	
Month	Value (in)
1	7.54
2	5.19
3	6.21
4	5.2
5	4.06
6	2.54
7	2.89
8	3.38
9	3.27
10	1.78
11	2.07
12	3.96
Total	**48.09**

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

Table 6
Historical Precipitation Data
Davidson County Area
1975 - 2011

Date: 3/13/2012
By: MG

1999	
Month	Value (in)
1	5.52
2	2.02
3	3.01
4	3.95
5	1.25
6	2.15
7	3.55
8	4.44
9	11.75
10	3.23
11	1.92
12	2.09
Total	**44.88**

2000	
Month	Value (in)
1	5.86
2	2.07
3	3.41
4	4.4
5	1.98
6	2.72
7	4.62
8	4.07
9	5.95
10	0.01
11	2.26
12	1.25
Total	**38.6**

2001	
Month	Value (in)
1	1.76
2	2.51
3	5.74
4	1.92
5	2.68
6	5.53
7	6.29
8	4.29
9	1.96
10	1.35
11	0.68
12	2.3
Total	**37.01**

2002	
Month	Value (in)
1	5.66
2	0.34
3	4.6
4	0.51
5	1.76
6	3.39
7	2.61
8	3.96
9	3.53
10	7.98
11	3.99
12	6.22
Total	**44.53**

2003	
Month	Value (in)
1	1.99
2	3.22
3	5.89
4	7.91
5	4.82
6	5.9
7	6.9
8	3.24
9	8.42
10	2.12
11	0.4
12	2.82
Total	**53.63**

2004	
Month	Value (in)
1	1.06
2	3.47
3	1.99
4	2.52
5	2.33*
6	4.93
7	5.42
8	1.88
9	8.14
10	0.84
11	3.21
12	3.08
Total	**38.87**

2005	
Month	Value (in)
1	2.12
2	3.02
3	4.66
4	3.17
5	1.91
6	3.15
7	6.78
8	2.65
9	0.17
10	3.03
11	3.35
12	4.84
Total	**38.85**

2006	
Month	Value (in)
1	2.91
2	1.7
3	1.63
4	4.11
5	1.2
6	9.01
7	3.28
8	6.5
9	5.31
10	4.01
11	7.46
12	2.14
Total	**49.26**

2007	
Month	Value (in)
1	5.01
2	2.98
3	3.12
4	3.89
5	0.22
6	10.93
7	4.22
8	1.45
9	0.76
10	4.24
11	0.81
12	3.35
Total	**40.98**

2008	
Month	Value (in)
1	1.15
2	3.4
3	3.47
4	4.29
5	2.39
6	1.51
7	4.48
8	9.19
9	8.19
10	1.95
11	2.35
12	3.09
Total	**45.46**

2009	
Month	Value (in)
1	2.88
2	1.79
3	6.13
4	2.86
5	6.3
6	5.83
7	4.64
8	4.57
9	3.44
10	2.71
11	6.96
12	5.43
Total	**53.54**

2010	
Month	Value (in)
1	5.66
2	3.89
3	5.32
4	0.74
5	4.42
6	2.03
7	7.47
8	0
9	3.56
10	2.09
11	0.96
12	1.92
Total	**38.06**

Table 6
Historical Precipitation Data
Davidson County Area
1975 - 2011

Date: 3/13/2012
By: MG

2011	
Month	Value (in)
1	1.35
2	2.78
3	3.83
4	3.58
5	4.14
6	1.88
7	5.86
8	2.12
9	6.82
10	3.97
11	6.93
12	3.66
Total	**46.92**

2012	
Month	Value (in)
1	1.80
2	0.57
Total*	**2.37**

* = incomplete data

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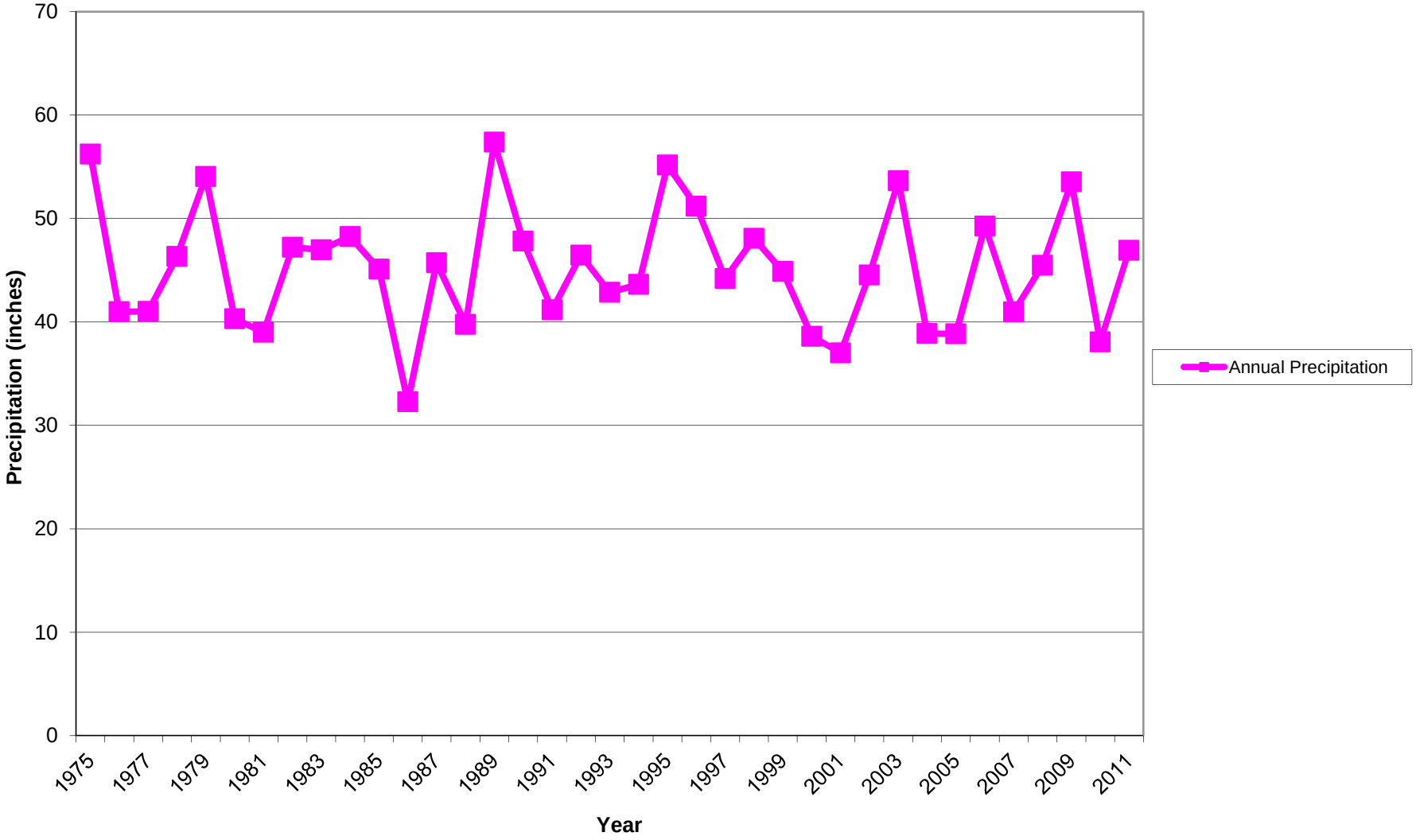
Table 6 Hydrograph
Annual Precipitation - Davidson County



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By: JAS
Date: 8/17/2011

Table 7
Gradients and Ground Water Velocities
Davidson County Landfill Phase 2

Well Name	K (ft/day)	I	n	Velocity (ft/day)
PZ-11	0.69	N/A	0.200	N/A
PZ-12	2.17	0.09	0.120	1.63
PZ-12d	1.64	N/A	0.010	N/A
PZ-21S	1.86	0.05	0.140	0.66
PZ-21D	1.33	N/A	N/A	N/A
PZ-22	1.58	N/A	0.170	N/A
PZ-24	2.74	0.05	0.040	3.43
PZ-25S	1.10	0.02	0.170	0.13
PZ-25D	0.46	N/A	0.200	N/A
PZ-50	1.890	0.02	0.170	0.22
PZ-51	0.207	0.02	0.250	0.02
PZ-52	0.224	0.02	0.170	0.03
PZ-57	0.224	0.02	0.220	0.02
PZ-58	0.741	0.03	0.140	0.16
PZ-59	0.358	0.02	0.120	0.06
PZ-62	0.675	0.04	0.220	0.12
PZ-63	0.159	0.05	0.160	0.05

N/A - no potentiometric data available as these wells are constructed in bedrock.
NST = No slug test performed due to low water in well.
Calculated using V = KI/n
Where: V = Velocity
K = Hydraulic Conductivity
I = Hydraulic Gradient - data from composite high water level map.
n- = Effective Porosity from Textural Classification Triangle
Evaluations using Textural Classification Triangle is in Appendix D.

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Table 8A
Vertical Gradient PZ-21S/PZ-21D
Davidson County Design, Phase 2 Area 2

Date: 3/13/2012
By: MG

Date	PZ-21s	PZ-21d	Gradient
03/28/2002	689.17	669.20	1.0272634
04/22/2002	689.04	669.11	1.0252058
05/10/2002	688.91	669.05	1.0216049
06/11/2002	688.73	668.89	1.0205761
07/09/2002	688.50	668.68	1.0195473
08/01/2002	688.41	668.55	1.0216049
09/03/2002	688.24	668.21	1.0303498
10/07/2002	688.00	667.82	1.0380658
11/14/2002	688.18	667.63	1.0570988
12/11/2002	688.82	667.64	1.0895062
01/03/2003	689.79	667.87	1.127572
02/04/2003	690.47	668.49	1.1306584
03/12/2003	677.89	680.63	-0.140947
04/03/2003	678.94	681.67	-0.140432
04/24/2003	680.02	682.99	-0.152778
05/09/2003	680.89	683.63	-0.140947
05/30/2003	681.59	684.39	-0.144033
06/10/2003	682.23	684.95	-0.139918
07/09/2003	682.68	685.46	-0.143004
08/07/2003	682.93	685.70	-0.14249
09/04/2003	683.31	686.11	-0.144033
10/14/2003	683.76	686.59	-0.145576
03/24/2004	685.09	687.99	-0.149177
04/07/2004	685.36	688.28	-0.150206
05/12/2004	685.48	688.38	-0.149177
06/11/2004	685.39	688.28	-0.148663
07/08/2004	685.45	688.36	-0.149691
08/17/2004	685.08	688.00	-0.150206
09/03/2004	684.81	687.73	-0.150206
10/28/2004	685.04	687.97	-0.15072
11/29/2004	685.07	687.64	-0.132202
12/14/2004	685.38	688.34	-0.152263
01/12/2005	685.38	688.34	-0.152263
02/08/2005	685.69	688.69	-0.154321
04/11/2005	686.84	689.80	-0.152263
05/05/2005	686.68	689.65	-0.152778
12/22/2010	673.59	679.59	-0.308642
01/31/2011	670.14	679.10	-0.460905
02/08/2011	673.19	679.15	-0.306584
03/14/2011	673.59	679.57	-0.307613
04/26/2011	677.72	677.61	0.0056584
05/31/2011	674.69	680.71	-0.309671
06/15/2011	674.55	680.59	-0.3107
07/25/2011	677.04	676.93	0.0056584
08/09/2011	676.81	676.71	0.0051986
09/12/2011	676.23	676.17	0.0031409
10/13/2011	676.05	675.99	0.0031409
11/30/2011	673.24	678.22	-0.256118
		Average	**0.1425693**

Table 8A
Vertical Gradient PZ-21S/PZ-21D
Davidson County Design, Phase 2 Area 2

Date: 3/13/2012
By: MG

	TOC Elevation	Ground Elevation	Top of Screen	Bottom of Screen	Midpoint of Screen
PZ-21s	695.64	692.94	668.94	658.94	663.94
PZ-21d	698.59	693.00	649.50	639.50	644.50

TOC = Top of Well Casing
Vertical Gradient calculated using the following equation:

$$\frac{\text{(WTE Shallow Well - WTE Deep Well)}}{\text{(Shallow Screen midpoint - Deep Screen midpoint)}}$$

Where:
WTE= Water Table Elevation

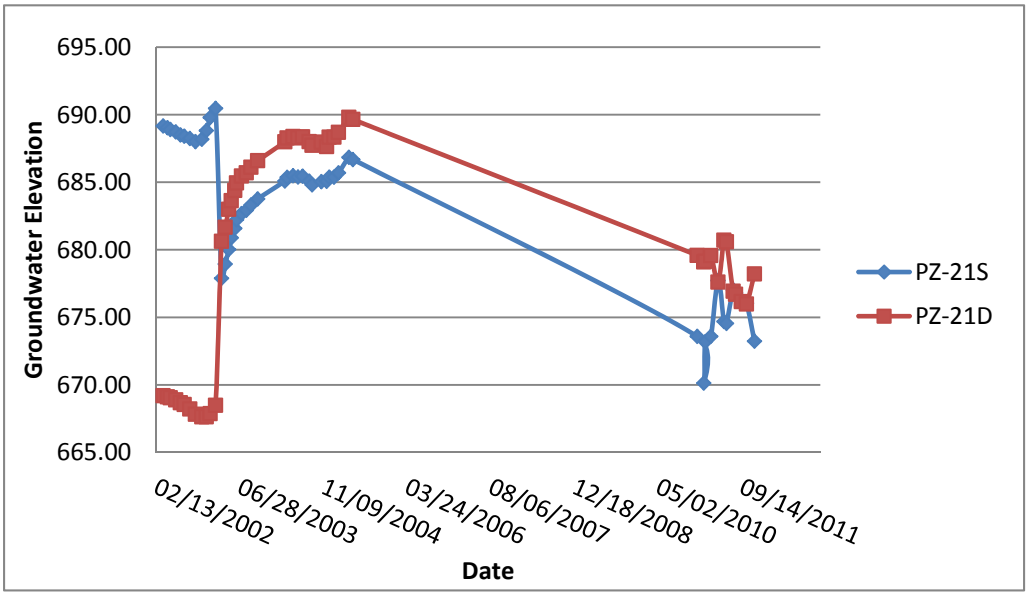

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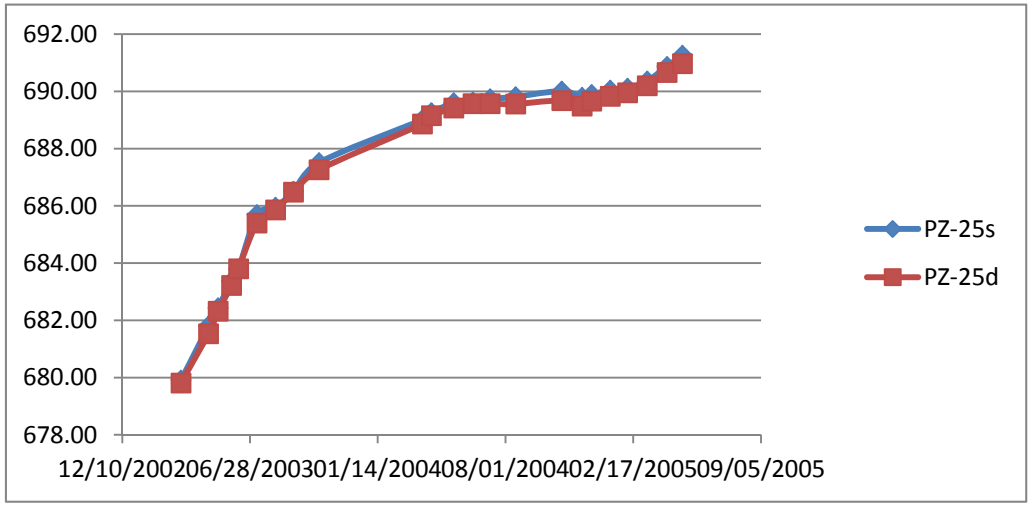
Table 8B
Vertical Gradient PZ-25S/PZ-25D
Davidson County Design, Phase 2 Area 2

Date: 3/13/2012
By: MG

Date	PZ-25s	PZ-25d	Gradient
03/12/2003	679.91	679.81	1.64606E-05
04/24/2003	681.80	681.53	4.44436E-05
05/09/2003	682.44	682.32	1.97527E-05
05/30/2003	683.36	683.22	2.30449E-05
06/10/2003	683.79	683.80	-1.64606E-06
07/09/2003	685.69	685.40	4.77358E-05
08/07/2003	685.95	685.86	1.48145E-05
09/04/2003	686.51	686.48	4.93818E-06
10/14/2003	687.51	687.26	4.11515E-05
03/24/2004	689.01	688.86	2.46909E-05
04/07/2004	689.25	689.15	1.64606E-05
05/12/2004	689.60	689.42	2.96291E-05
06/11/2004	689.63	689.57	9.87636E-06
07/08/2004	689.74	689.57	2.7983E-05
08/17/2004	689.81	689.56	4.11515E-05
10/28/2004	690.01	689.68	5.432E-05
11/29/2004	689.79	689.49	4.93818E-05
12/14/2004	689.89	689.66	3.78594E-05
01/12/2005	690.04	689.83	3.45673E-05
02/08/2005	690.11	689.95	2.6337E-05
03/11/2005	690.36	690.20	2.6337E-05
04/11/2005	690.87	690.66	3.45673E-05
05/05/2005	691.26	690.97	4.77358E-05
		Average	**2.91997E-05**



	TOC Elevation	Ground Elevation	Top of Screen	Bottom of Screen	Midpoint of Screen
PZ-25s	717.46	714.82	679.82	664.82	6725.32
PZ-25d	717.91	715.21	655.21	645.21	650.21

TOC = Top of Well Casing
Vertical Gradient calculated using the following equation:

$$\frac{\text{(WTE Shallow Well - WTE Deep Well)}}{\text{(Shallow Screen midpoint - Deep Screen midpoint)}}$$

Where:
WTE= Water Table Elevation

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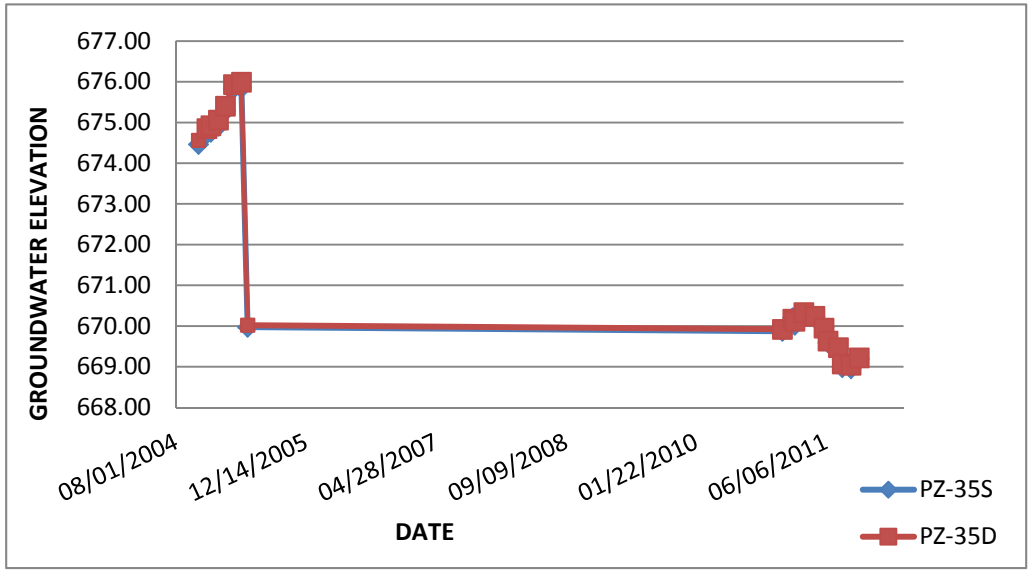
Table 8C
Vertical Gradient PZ-35S/PZ-35D
Davidson County Design, Phase 2 Area 2

Date: 3/13/2012
By: MG

Date	PZ-35S	PZ-35D	Gradient
10/28/2004	674.60	NR	-
11/29/2004	674.46	674.56	-0.00191
12/14/2004	674.72	674.85	-0.00248
01/12/2005	674.76	674.92	-0.00305
02/08/2005	674.91	675.06	-0.00286
03/11/2005	675.28	675.40	-0.00229
04/11/2005	675.83	675.93	-0.00191
05/05/2005	675.85	675.99	-0.00267
12/22/2010	669.97	670.02	-0.00095
01/31/2011	669.87	669.92	-0.00095
02/08/2011	670.20	670.17	0.000572
03/14/2011	670.02	670.12	-0.00191
04/26/2011	670.23	670.33	-0.00191
05/31/2011	670.22	670.24	-0.00038
06/15/2011	669.97	669.95	0.000381
07/25/2011	669.59	669.63	-0.00076
08/09/2011	669.44	669.47	-0.00057
09/12/2011	668.98	669.07	-0.00172
10/13/2011	668.95	669.04	-0.00172
11/30/2011	669.20	669.22	-0.00038
		Average	**-0.00144**



	TOC Elevation	Ground Elevation	Top of Screen	Bottom of Screen	Midpoint of Screen
PZ-35s	689.12	687.47	679.47	664.47	671.97
PZ-35d	689.17	687.52	624.52	614.52	619.52

TOC = Top of Well Casing
Vertical Gradient calculated using the following equation:

$$\frac{\text{(WTE Shallow Well - WTE Deep Well)}}{\text{(Shallow Screen midpoint - Deep Screen midp}}$$

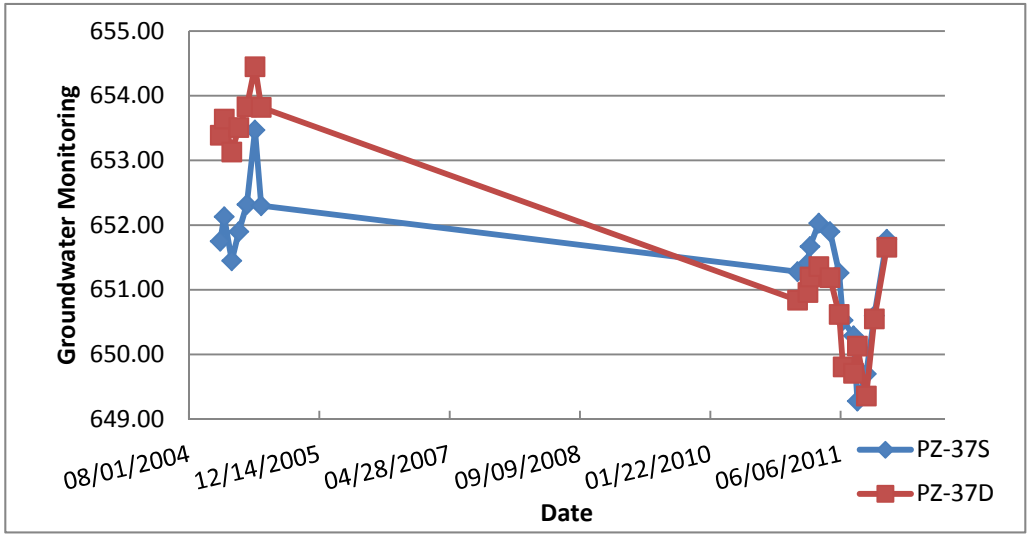
Where:
WTE= Water Table Elevation

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

Table 8D
Vertical Gradient PZ-37S/PZ-37D
Davidson County Design, Phase 2 Area 2

Date: 3/13/2012
By: MG

Date	PZ-37S	PZ-37D	Gradient
11/29/2004	651.75	653.39	-0.083461
12/14/2004	652.13	653.64	-0.076845
01/12/2005	651.45	653.13	-0.085496
02/08/2005	651.90	653.51	-0.081934
03/11/2005	652.32	653.83	-0.076845
04/11/2005	653.47	654.45	-0.049873
05/05/2005	652.30	653.82	-0.077354
12/22/2010	651.28	650.84	0.0223919
01/31/2011	651.41	650.96	0.0229008
02/08/2011	651.67	651.20	0.0239186
03/14/2011	652.03	651.36	0.0340967
04/26/2011	651.90	651.19	0.0361323
05/31/2011	651.26	650.62	0.03257
06/15/2011	650.53	649.81	0.0366412
07/25/2011	650.29	649.71	0.0295165
08/09/2011	649.28	650.13	-0.043257
09/12/2011	649.70	649.36	0.0173028
10/13/2011	650.60	650.55	0.0025445
11/30/2011	651.78	651.66	0.0061069
		Average:	**-0.016365**



	TOC Elevation	Ground Elevation	Top of Screen	Bottom of Screen	Midpoint of Screen
PZ-37s	668.58	665.17	653.17	638.17	645.67
PZ-37d	668.76	666.02	630.02	622.02	626.02

TOC = Top of Well Casing
Vertical Gradient calculated using the following equation:

$$\frac{\text{(WTE Shallow Well - WTE Deep Well)}}{\text{(Shallow Screen midpoint - Deep Screen midpoint)}}$$

Where:
WTE= Water Table Elevation

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Appendix 1

Boring Logs

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(919) 828-0577

FIELD BOREHOLE LOG

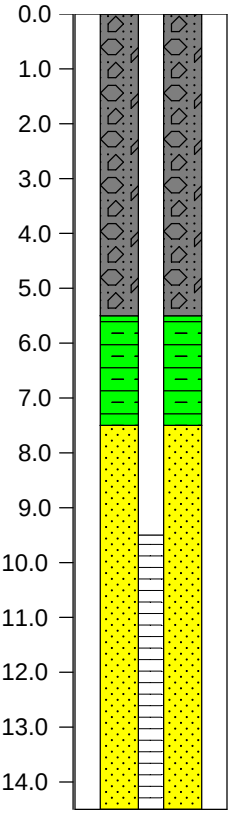
BOREHOLE NUMBER **MW-2**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/12/08** DATE COMPLETED: **8/12/08**

TOTAL DEPTH: **14.5**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)	13.06	
Time	11:00 am	
Date	8/12/08	

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY
0.0				HSA	SILT: Dry dark brown silt with samll quarz fragments and black mottles.	
1.0						
2.0						
3.0						
4.0						
5.0	10,12,15	SS	18"		SANDY SILT: Moist sandy silt with partially weathered andesite and Fe spotting.	
6.0						
7.0						
8.0						
9.0						
10.0	8,17,23	SS	18"			
11.0						
12.0						
13.0		Grab			GRANITE: Dry, partially weathered granite. B.T. @ 14.5 feet.	
14.0						



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FIELD BOREHOLE LOG

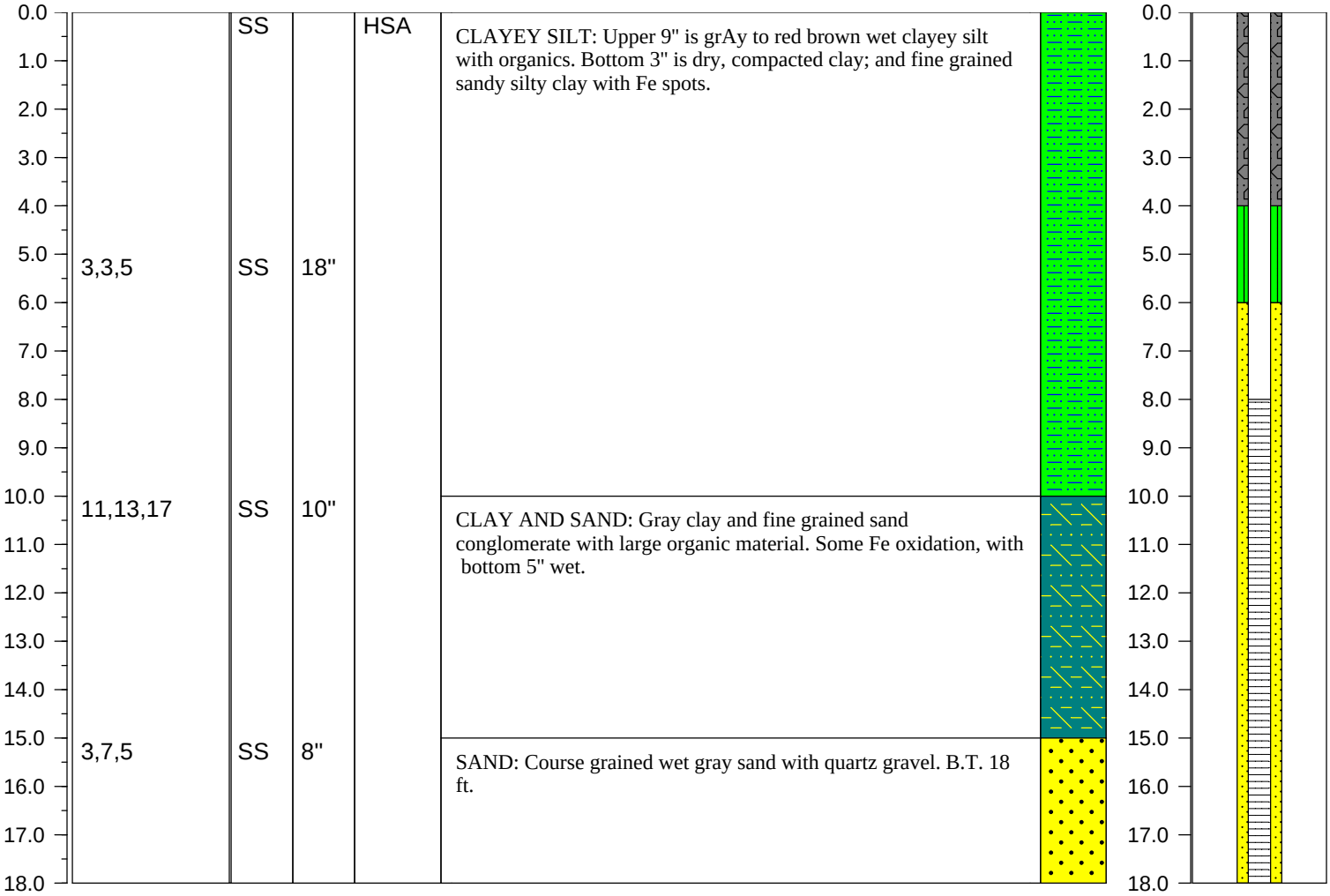
BOREHOLE NUMBER **MW-3s**

PROJECT NAME: **Davidson County**
LOCATION: **Davidson County Landfill**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **3/24/08** DATE COMPLETED: **3/24/08**

TOTAL DEPTH: **18 ft.**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)	6.21	
Time	1:10pm	
Date	3/27/08	

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY
0.0		SS		HSA	CLAYEY SILT: Upper 9" is grAy to red brown wet clayey silt with organics. Bottom 3" is dry, compacted clay; and fine grained sandy silty clay with Fe spots.	
5.0	3,3,5	SS	18"			
10.0	11,13,17	SS	10"		CLAY AND SAND: Gray clay and fine grained sand conglomerate with large organic material. Some Fe oxidation, with bottom 5" wet.	
15.0	3,7,5	SS	8"		SAND: Course grained wet gray sand with quartz gravel. B.T. 18 ft.	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **MW-3D**

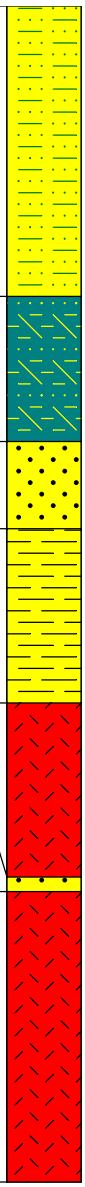
PROJECT NAME: **Davidson County Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **Daivd Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **3/26/08** DATE COMPLETED: **3/26/08**

TOTAL DEPTH: **40.5 ft.**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

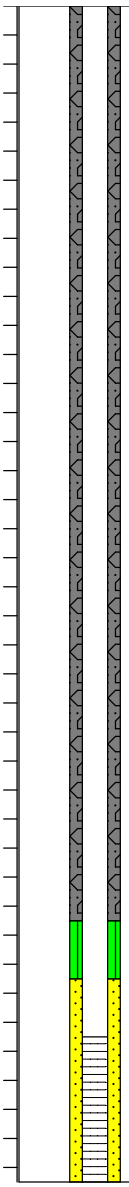
STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION
0.0–5.0				HSA	CLAYEY SAND: Upper 9" is gray to red brown wet clayey silt with organics. Bottom 3" is dry compacted clay with fine grained sandy silty clay with Fe spots.
5.0–6.0	3,3,5	SS	18"		
10.0–11.0	11,13,17	SS	10"		CLAY AND SAND: Gray clay and fine grained sand conglomerate, with large organic material. Some Fe oxidation with bottom 5" wet.
15.0–16.0	3,7,5	SS	8"		SAND: Course grained wet gray sand with quartz gravel.
19.0–21.0	50/3	SS	4"		SANDY SILT: Wet course grained sticky gray sandy silt. A.R. 24 ft.
24.0–29.0		SS		AH	GRANITE: Weathered boulder.
29.0–30.0					SAND: 6" thick fine to coarse sand layer.
30.0–40.0		Grab / Grab / Grab			GRANITE: Weathered granite, wet. B.T. 40.5 ft.

LITHOLOGY



WELL INSTALLATION



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-11**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **P. May**
DATE BEGUN: **11/8/00** COMPLETED: **11/20/00**

TOTAL DEPTH: **54**
GROUND SURFACE ELEVATION: **719.13**
TOP OF CASING ELEVATION: **720.48**

STATIC WATER LEVEL (BLS)		
Depth (ft)	49	38.41
Time	10:00	10:30
Date	11/20/00	11/21/00

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	GRAVEL AND SAND: Dry, gray & white medium to coarse sand & gravel with some small tan-orange clay bands.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	34-32-26	SS	10"				5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	50/0"	SS	0"	AH	DIORITE: Competent diorite.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0							15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0							20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	
26.0							26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	
30.0							30.0	
31.0							31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0					DIORITE: Competent diorite. Boring terminated at 54'.		35.0	
36.0							36.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-11**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **P. May**
DATE BEGUN: **11/8/00** COMPLETED: **11/20/00**

TOTAL DEPTH: **54**
GROUND SURFACE ELEVATION: **719.13**
TOP OF CASING ELEVATION: **720.48**

STATIC WATER LEVEL (BLS)		
Depth (ft)	49	38.41
Time	10:00	10:30
Date	11/20/00	11/21/00

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION

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FIELD BOREHOLE LOG

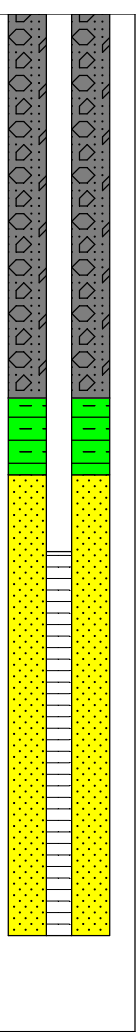
BOREHOLE NUMBER **PZ-12**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **P. May**
DATE BEGUN: **11/1/00** COMPLETED: **11/1/00**

TOTAL DEPTH: **25**
GROUND SURFACE ELEVATION: **680.48**
TOP OF CASING ELEVATION: **682.71**

STATIC WATER LEVEL (BLS)		
Depth (ft)	15.9	15.9
Time	10:00	10:30
Date	11/1/00	11/2/00

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILTY SAND: Slightly moist gray, white, & tan mottled silty fine sand with iron.		0.0	
5.0	8-10-11	SS	12"				5.0	
10.0	8-7-7	SS	12"		CLAYEY SANDY SILT: Moist gray-white & rust mottled slightly clayey fine sandy silt, large quartz fragments.		10.0	
15.0	9-12-15	SS	14"		CLAYEY SAND: Wet tan & white & gray medium to coarse micaceous clayey sand (trace silt), quartz fragments, water at 15.0'.		15.0	
20.0	11-19-24	SS	12"		SAND: Wet white, brown, & gray mottled medium to coarse sand with quartz fragments.		20.0	
25.0	5-9-43	SS	12"		SILTY SAND: Wet gray & white silty fine sand with brown mottles. Boring terminated at 25'. Bottom of well set at 24'.		25.0	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-12d** Page 1 of 1

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **P. May**
DATE BEGUN: **11/17/00** COMPLETED: **11/20/00**

TOTAL DEPTH: **45**
GROUND SURFACE ELEVATION: **679.81**
TOP OF CASING ELEVATION: **682.56**

STATIC WATER LEVEL (BLS)		
Depth (ft)	16	16.1
Time	10:00	10:30
Date	11/20/00	11/21/00

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILTY SAND: Slightly moist gray, white, & tan mottled silty fine sand with iron.		0.0	
6.0	8-10-11	SS	12"				6.0	
11.0	8-7-7	SS	12"		CLAYEY SANDY SILT: Moist gray-white & rust mottled slightly clayey fine sandy silt, large quartz fragments.		11.0	
16.0	9-12-15	SS	14"		CLAYEY SAND: Wet tan & white & gray medium to coarse micaceous clayey sand (trace silt), quartz fragments, water at 15.0'.		16.0	
21.0	11-19-24	SS	12"		SAND: Wet white, brown, & gray mottled medium to coarse sand with quartz fragments.		21.0	
26.0	5-9-43	SS	12"		SILTY SAND: Wet gray & white silty fine sand with brown mottles.		26.0	
31.0	26-50/6"	SS	10"		CLAYEY SILTY SAND: Wet dark gray & white salt & peppered clayey silty fine sand with iron streaks, some manganese, large (1mm) quartz grains at 31.5'.		31.0	
36.0	18-22-26	SS	14"		CLAYEY SAND: Wet brown medium to coarse clayey sand followed by gray & white salt & peppered fine silty sand/sandy silt with iron streaks and some quartz & manganese.		36.0	
41.0	23-36-45	SS	10"		SILTY SAND: Wet gray & white salt & peppered fine silty sand & partially weathered rock; large quartz grains; coarse sand. Boring terminated at 45'.		41.0	
45.0							45.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-20**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/21/02** COMPLETED: **2/22/02**

TOTAL DEPTH: **58**
GROUND SURFACE ELEVATION: **717.57**
TOP OF CASING ELEVATION: **719.74**

STATIC WATER LEVEL (BLS)		
Depth (ft)	54	NA
Time	NA	NA
Date	2/22/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILTY SAND: Tan black silty sand with some mica.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	6,10,12	SS					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	5,7,8	SS			SANDY SILT: Tan brown gray sandy silt. dry.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0	6,8,12	SS			SILT: White, tan and brown micaceous silt with rock fragments, dry.		15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	21,22,35	SS			SANDY SILT: White tan sandy silt with quartz. Auger refusal at 25 feet.		20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0	50/1"	SS			DIORITE: Competent diorite bedrock.		25.0	
26.0							26.0	
27.0							27.0	
28.0				AH			28.0	
29.0							29.0	
30.0							30.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-20**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/21/02** COMPLETED: **2/22/02**

TOTAL DEPTH: **58**
GROUND SURFACE ELEVATION: **717.57**
TOP OF CASING ELEVATION: **719.74**

STATIC WATER LEVEL (BLS)		
Depth (ft)	54	NA
Time	NA	NA
Date	2/22/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
30.0							30.0	
31.0							31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0							35.0	
36.0					DIORITE: Competent diorite bedrock. Drilled with air hammer to 58 feet.		36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	
40.0							40.0	
41.0							41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0							45.0	
46.0							46.0	
47.0							47.0	
48.0							48.0	
49.0							49.0	
50.0							50.0	
51.0							51.0	
52.0							52.0	
53.0							53.0	
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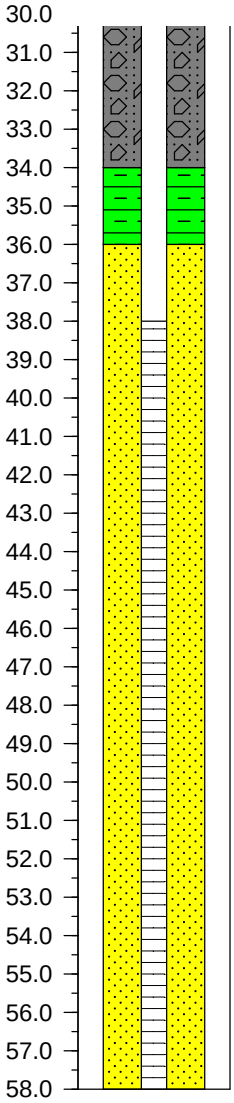
56.0							56.0	
57.0							57.0	
58.0							58.0	



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FIELD BOREHOLE LOG

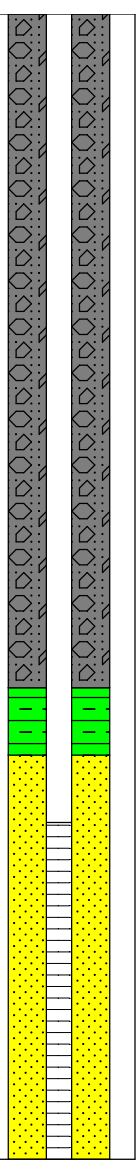
BOREHOLE NUMBER **PZ-21**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/18/02** COMPLETED: **2/18/02**

TOTAL DEPTH: **34**
GROUND SURFACE ELEVATION: **692.94**
TOP OF CASING ELEVATION: **695.64**

STATIC WATER LEVEL (BLS)		
Depth (ft)	16.37	16.7
Time	16:30	16:00
Date	2/19/02	2/21/02

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY CLAY: Wet brown sandy clay with quartz pebbles and Mn staining.		0.0	
5.0	5,7,15	SS	12"				5.0	
10.0	8,15,15	SS	8"		CLAYEY SILT: Moist, brown clayey silt with some Mn staining.		10.0	
15.0	9,20,28	SS	8"		SANDY SILT: Black and white mottled sandy silt with iron staining and relict rock texture. Auger refusal at 34'		15.0	
20.0	16,23,44	SS	8"				20.0	
25.0	50/4"	SS	4"				25.0	
30.0	50/2"	SS	2"				30.0	
34.0							34.0	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-21d**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/RC/AH**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/20/02** COMPLETED: **2/21/02**

TOTAL DEPTH: **53.5**
GROUND SURFACE ELEVATION: **695**
TOP OF CASING ELEVATION: **698.59**

STATIC WATER LEVEL (BLS)		
Depth (ft)	25.6	NA
Time	16:30	NA
Date	2/21/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY CLAY: Wet brown sandy clay with quartz pebbles and Mn staining.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	5,7,15	SS	12"				5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	8,15,15	SS	8"		CLAYEY SILT: Moist, brown clayey silt with some Mn staining.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0	9,20,28	SS	8"		SANDY SILT: Black and white mottled sandy silt with iron staining and relict rock texture. Auger refusal at 36'. Set 4" outer casing.		15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	16,23,44	SS	8"				20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0	50/4"	SS	4"				25.0	
26.0							26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	
30.0	50/2"	SS	2"				30.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-21d**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/RC/AH**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/20/02** COMPLETED: **2/21/02**

TOTAL DEPTH: **53.5**
GROUND SURFACE ELEVATION: **695**
TOP OF CASING ELEVATION: **698.59**

STATIC WATER LEVEL (BLS)		
Depth (ft)	25.6	NA
Time	16:30	NA
Date	2/21/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
30.0							30.0	
31.0							31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0	50/0.5"	SS	0"				35.0	
36.0				RC/AH	DIORITE: Competent Diorite. Rock Core to 46' then drilled with air hammer to 53.5 feet where water bearing fractures were encountered. Recovery=100%, RQD= 62.5%.		36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	
40.0							40.0	
41.0							41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0							45.0	
46.0							46.0	
47.0							47.0	
48.0							48.0	
49.0							49.0	
50.0							50.0	
51.0							51.0	
52.0							52.0	
53.0							53.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-22**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/AH**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/18/02** COMPLETED: **2/19/02**

TOTAL DEPTH: **43**
GROUND SURFACE ELEVATION: **712.04**
TOP OF CASING ELEVATION: **714.47**

STATIC WATER LEVEL (BLS)		
Depth (ft)	36.2	36.2
Time	16:30	16:00
Date	2/20/02	2/21/02

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Tan and black and white mottled sandy silt. Dry.		0.0	
5.0	14,16,20	SS	NA				5.0	
10.0	31,33,43	SS	7"				10.0	
15.0	41,50/3"	SS	5"				15.0	
20.0	50/6"	SS	6"				20.0	
25.0	50/2"	SS	2"		SANDY SILT: Moist black and white mottled sandy silt with quartz.		25.0	
30.0	50/1"	SS	1"				30.0	
33.0				AH	DIORITE: Diorite bedrock.		33.0	
35.0					DIORITE: Dioite bedrock.		35.0	
43.0							43.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-24**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/20/02** COMPLETED: **2/20/02**

TOTAL DEPTH: **50**
GROUND SURFACE ELEVATION: **711.55**
TOP OF CASING ELEVATION: **714.55**

STATIC WATER LEVEL (BLS)		
Depth (ft)	45.35	NA
Time	16:30	NA
Date	2/21/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILTY CLAY: Tan, brown reddish sandy silty clay. Dry.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	6,14,22	SS	8"				5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	9,15,18	SS	8"		SILTY CLAY: Tan and red mottled silty clay. Moist.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0	9,13,19	SS	9"		SILTY SAND: White and black mottled silty sand. Dry.		15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	11,16,21	SS	9"				20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0	14,25,34	SS	9"				25.0	
26.0							26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	
30.0	15,25,40	SS	8"				30.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-24**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/20/02** COMPLETED: **2/20/02**

TOTAL DEPTH: **50**
GROUND SURFACE ELEVATION: **711.55**
TOP OF CASING ELEVATION: **714.55**

STATIC WATER LEVEL (BLS)		
Depth (ft)	45.35	NA
Time	16:30	NA
Date	2/21/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
30.0							30.0	
31.0							31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0	21,37,44	SS	8"		SILTY SAND: White and black mottled silty sand. Dry. Auger refusal @ 50'		35.0	
36.0							36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	
40.0	26,40,38	SS	5"				40.0	
41.0							41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0	23,39,42	SS	6"				45.0	
46.0							46.0	
47.0							47.0	
48.0							48.0	
49.0							49.0	
50.0							50.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-25s**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/19/02** COMPLETED: **2/19/02**

TOTAL DEPTH: **50**
GROUND SURFACE ELEVATION: **714.82**
TOP OF CASING ELEVATION: **717.46**

STATIC WATER LEVEL (BLS)		
Depth (ft)	39.85	40
Time	16:30	16:00
Date	2/20/02	2/21/02

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILT: Tan black and white mottled silt with trace clay. Dry.		0.0	
5.0	7,10,16	SS	NA				5.0	
10.0	8,9,14	SS	NA				10.0	
15.0	11,16,20	SS	NA		SANDY SILT: Tan black and white mottled silt with trace clay and some sand. Dry.		15.0	
20.0	13,20,20	SS	NA				20.0	
25.0	12,18,21	SS	NA		SANDY SILT: Black and white mottled silt with trace clay and some sand. Some iron staining. Dry.		25.0	
30.0	23,25,21	SS	9"		CLAYEY SILT: Black and white mottled clayey silt with more iron staining in various directions. Dry.		30.0	
35.0							35.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-25s**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/19/02** COMPLETED: **2/19/02**

TOTAL DEPTH: **50**
GROUND SURFACE ELEVATION: **714.82**
TOP OF CASING ELEVATION: **717.46**

STATIC WATER LEVEL (BLS)		
Depth (ft)	39.85	40
Time	16:30	16:00
Date	2/20/02	2/21/02

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
35.0	12,21,24	SS	9"		GRAVELLY SILT: Black and white mottled gravelly silt with iron and Mn staining. Moist.		35.0	
36.0							36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	
40.0	14,26,31	SS	9"		SILTY SAND: Black and white mottled silty sand with quartz and iron staining. Moist. Water at 35' 7" after 1 hour. Boring Terminated. Hole caved to 45 feet when well was set.		40.0	
41.0							41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0	22,43,50/5	SS	10"				45.0	
46.0							46.0	
47.0							47.0	
48.0							48.0	
49.0							49.0	
50.0							50.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-25d**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/20/02** COMPLETED: **2/20/02**

TOTAL DEPTH: **70**
GROUND SURFACE ELEVATION: **715.21**
TOP OF CASING ELEVATION: **717.91**

STATIC WATER LEVEL (BLS)		
Depth (ft)	37.15	NA
Time	16:30	NA
Date	2/21/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILT: Tan black and white mottled silt with trace clay. Dry.		0.0	
5.0	7,10,16	SS	NA				5.0	
10.0	8,9,14	SS	NA				10.0	
15.0	11,16,20	SS	NA		SANDY SILT: Tan black and white mottled silt with trace clay and some sand. Dry.		15.0	
20.0	13,20,20	SS	NA				20.0	
25.0	12,18,21	SS	NA		SANDY SILT: Black and white mottled silt with trace clay and some sand. Some iron staining. Dry.		25.0	
30.0	23,25,21	SS	9"		CLAYEY SILT: Black and white mottled clayey silt with more iron staining in various directions. Dry.		30.0	
35.0	12,21,24	SS	9"		GRAVELLY SILT: Black and white mottled gravelly silt with iron and Mn staining. Moist.		35.0	

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FIELD BOREHOLE LOG

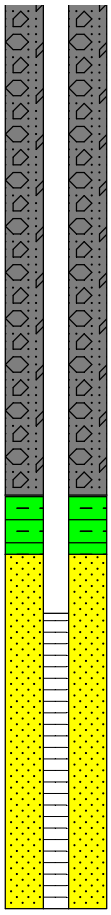
BOREHOLE NUMBER **PZ-25d**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **D. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **2/20/02** COMPLETED: **2/20/02**

TOTAL DEPTH: **70**
GROUND SURFACE ELEVATION: **715.21**
TOP OF CASING ELEVATION: **717.91**

STATIC WATER LEVEL (BLS)		
Depth (ft)	37.15	NA
Time	16:30	NA
Date	2/21/02	NA

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
39.0							39.0	
40.0	14,26,31	SS	9"		SILTY SAND: Gray and white mottled silty sand. Wet below 40 feet. Boring terminated at 70 feet.		40.0	
41.0							41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0							45.0	
46.0	22,43,50/5	SS	10"				46.0	
47.0							47.0	
48.0							48.0	
49.0							49.0	
50.0							50.0	
51.0	27,35,50/5	SS	9"				51.0	
52.0							52.0	
53.0							53.0	
54.0							54.0	
55.0							55.0	
56.0							56.0	
57.0							57.0	
58.0							58.0	
59.0							59.0	
60.0							60.0	
61.0							61.0	
62.0							62.0	
63.0							63.0	
64.0							64.0	
65.0							65.0	
66.0							66.0	
67.0							67.0	
68.0							68.0	
69.0							69.0	
70.0	50/6	SS					70.0	
71.0							71.0	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-29**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/RC/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **4/16/03** COMPLETED: **4/23/03**

TOTAL DEPTH: **56**
GROUND SURFACE ELEVATION: **709.63**
TOP OF CASING ELEVATION: **712.53**

STATIC WATER LEVEL (BLS)		
Depth (ft)	55.3	48.00
Time	3:00 PM	8:00 am
Date	4/23/03	4/24/03

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Dry dark green to gray and white mottled sandy silt.		0.0	
5.0	6,7,10	SS	10"				5.0	
10.0	10,20,35	SS	10"		CLAYEY SILT: Dry, dark green to gray and white mottled clayey silt with trace mica around 15 feet.		10.0	
15.0	50/6	SS	6"				15.0	
20.0	50/2	SS	1"				20.0	
25.0	50/2	SS	0.5"				25.0	
27.0				RC/AH	DIORITE: Cored from 27 to 37 feet below grade, and recovered one solid 3 ft long piece of diorite.		27.0	
30.0					SANDY CLAY: No recovery from core to 37 feet. Split spoon sample taken at 37 feet had gray sandy clay with trace iron staining.		30.0	
33.0							33.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-29**

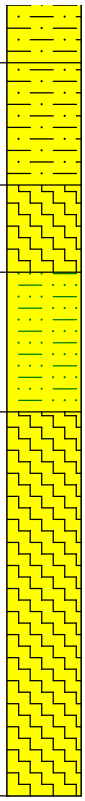
PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA/RC/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **4/16/03** COMPLETED: **4/23/03**

TOTAL DEPTH: **56**
GROUND SURFACE ELEVATION: **709.63**
TOP OF CASING ELEVATION: **712.53**

STATIC WATER LEVEL (BLS)		
Depth (ft)	55.3	48.00
Time	3:00 PM	8:00 am
Date	4/23/03	4/24/03

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION
33.0					
34.0					
35.0					SANDY CLAY: No recovery from core to 37 feet. Split spoon sample taken at 37 feet had gray sandy clay with trace iron staining.
36.0					
37.0	50/6	SS	6"	AH	
38.0					
39.0					DIORITE: Drilled with air hammer.
40.0					
41.0	50/5	SS	5"		CLAYEY SAND: Split spoon sample taken when air hammer indicated no rock. Gray clayey sand.
42.0					
43.0					
44.0					
45.0					DIORITE: Drilled with air hammer. Seams indicated at 49-50 ft, (no water indicated) and 55-56 feet. The second seam had water. Boring terminated at 56 feet.
46.0					
47.0					
48.0					
49.0					
50.0					
51.0					
52.0					
53.0					
54.0					
55.0					
56.0					

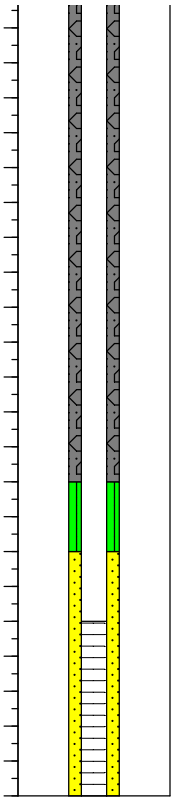
LITHOLOGY



DEPTH

33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0 41.0 42.0 43.0 44.0 45.0 46.0 47.0 48.0 49.0 50.0 51.0 52.0 53.0 54.0 55.0 56.0

WELL INSTALLATION



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FIELD BOREHOLE LOG

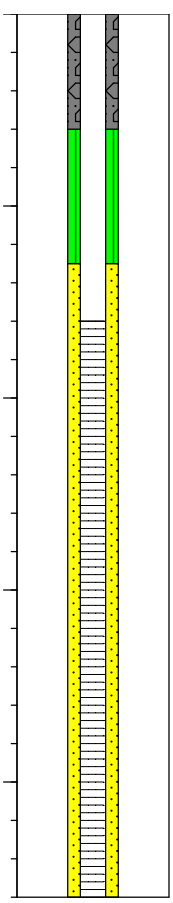
BOREHOLE NUMBER **PZ-35s** Page 1 of 1

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/20/04** COMPLETED: **9/20/04**

TOTAL DEPTH: **23**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (BLS)		
Depth (ft)	18	14.21
Time	3 pm	4:07
Date	9/20/04	10/12/04

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				HSA	SILTY CLAY: Slightly moist granitic saprolitic silty clay. Sample has cast but no ribbon. Iron stained.		0.0	
	5,6,9	SS	18"					
5.0							5.0	
	3,3,4	SS	15"					
10.0							10.0	
	2,3,4	SS	16"					
15.0							15.0	
	3,6,9	SS	14"		SILTY CLAY: Wet granitici saprolitic silty clay with iron staining at a 60 degree angle. Boring terminated at 23 feet.			
20.0							20.0	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-35d**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/15/04** COMPLETED: **9/16/04**

TOTAL DEPTH: **73**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (BLS)		
Depth (ft)		14.02
Time		4:10
Date		10/12/04

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				HSA	SILTY CLAY: Slightly moist granitic saprolitic silty clay. Sample has cast but no ribbon. Iron stained.		0.0	
5.0	5,6,9	SS					5.0	
10.0	3,3,4	SS					10.0	
15.0	2,3,4	SS					15.0	
20.0	3,6,9	SS			SILTY CLAY: Wet granitici saprolitic silty clay with iron staining at a 60 degree angle.		20.0	
25.0	7,7,10	SS			SILTY CLAY: Wet granitic saprolitic silty clay.		25.0	
30.0	6,9,15	SS					30.0	
35.0	11,16,22	SS					35.0	
40.0	15,21,29	SS					40.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-35d**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/15/04** COMPLETED: **9/16/04**

TOTAL DEPTH: **73**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (BLS)		
Depth (ft)		14.02
Time		4:10
Date		10/12/04

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
45.0							45.0	
	9,14,29	SS			SILTY CLAY: Wet granitic saprolitic silty clay to clayey silt. Iron and manganese staining. Could not take split spoons past 48' due to excessive water. BT @ 73 feet.			
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-36**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/20/04** COMPLETED: **9/20/04**

TOTAL DEPTH: **68**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (BLS)		
Depth (ft)	43.	40.12
Time	5 pm	4:03
Date	9/20/04	10/12/04

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				HSA	CLAYEY SILT: Dry to moist , red, clayey silt white clay bands.		0.0	
	16,33,50	SS						
5.0							5.0	
	13,13,30	SS						
10.0							10.0	
	30,30,41	SS			CLAYEY SANDY SILT: Dry red clayey sandy silt to silty sand.			
15.0							15.0	
	30,50/3	SS			SANDY CLAYEY SILT: Dry red sandy clayey silt.			
20.0							20.0	
	27,30,32	SS			CLAYEY SILTY SAND: Moist, red, clayey silty sand to sandy silt with some Mn staining.			
25.0							25.0	
	12,15,21	SS			SANDY SILT: Moist, red, pink and white granitic saprolite that is sandy silt with Mn staining.			
30.0							30.0	
	27,35,40	SS						
35.0							35.0	
	31,39,42	SS						
40.0							40.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-36**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/20/04** COMPLETED: **9/20/04**

TOTAL DEPTH: **68**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (BLS)		
Depth (ft)	43.	40.12
Time	5 pm	4:03
Date	9/20/04	10/12/04

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
45.0	36,50/6	SS			SILTY SAND: Moist to wet coarse grained red, and white granitic saprolite with Mn staining.		45.0	
50.0	50/6	SS					50.0	
55.0	50/3	SS					55.0	
60.0	50/1	SS			SAND: Wet sand. Split spoon empty upon removal so cuttings sampled. Boring terminated at 68 feet.		60.0	
65.0		SS					65.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-37** Page 1 of 1

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/21/04** COMPLETED: **9/21/04**

TOTAL DEPTH: **27**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)	19	16.98
Time	2 pm	4:15
Date	9/21/04	10/12/04

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILTY SAND: Dry to moist, tan and black, silty sand granitic sarprolite with Mn staining.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0	11,21,37	SS	18"				4.0	
5.0							5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0	6,9,15	SS	10"				9.0	
10.0							10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0	4,8,28	SS	8"		CLAYEY SANDY GRAVEL: Moist red brown clayey sandy gravel sarprolite.		14.0	
15.0							15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0	50/3	SS	3"		CLAYEY GRAVEL: Wet clayey gravel saprolite with large quartz grains. Boring terminated at 27 feet below grade.		19.0	
20.0							20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0	50/2	SS	2"				24.0	
25.0							25.0	
26.0							26.0	
27.0							27.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-37d**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/21/04** COMPLETED: **10/14/06**

TOTAL DEPTH: **44**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILTY SAND: Dry to moist, tan and black, silty sand granitic sarprolite with Mn staining.		0.0	
4.0	11,21,37	SS	18"				4.0	
9.0	6,9,15	SS	10"				9.0	
14.0	4,8,28	SS	8"		CLAYEY SANDY GRAVEL: Moist red brown clayey sandy gravel sarprolite.		14.0	
19.0	50/3	SS	3"		CLAYEY GRAVEL: Wet clayey gravel saprolite with large quartz grains. AR at 30'. Air hammer to 34' to set outer casing in rock.		19.0	
24.0	50/2	SS	2"				24.0	
30.0				AH/RC	DIABASE: Rock cored from 34' to 44' REC=95%, RQD=39%. Weathered diabase. Boring terminated at 44 feet.		30.0	
44.0							44.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-40**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/22/04** COMPLETED: **9/23/04**

TOTAL DEPTH: **64**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)	--	9.61
Time	--	3:20 pm
Date	--	10/12/04

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILTY CLAY: Moist red, tan and gray silty clay with iron staining and trace of granitic saprolite.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0	4,6,7	SS	8"				4.0	
5.0							5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0	3,4,5	SS	10"				9.0	
10.0							10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0	5,7,9	SS	10"		SILT: Moist to wet, black and white mottled silt with iron staining.		14.0	
15.0							15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0	7,10,18	SS	9"		CLAYEY SILT: Moist to wet, black and white clayey silt with iron staining with some coarse grained sand.		19.0	
20.0							20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0	10,12,16	SS	10"		SANDY SILT: Moist to wet, black and white sandy silt with iron staining. Dry from 28.5 to 33.5 feet.		24.0	
25.0							25.0	
26.0							26.0	
27.0							27.0	
28.0							28.0	
29.0	50/3	SS	3"				29.0	
30.0							30.0	
31.0							31.0	
32.0							32.0	
33.0							33.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-40**

PROJECT NAME: **Davidson County - Phase 2**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **9/22/04** COMPLETED: **9/23/04**

TOTAL DEPTH: **64**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)	--	9.61
Time	--	3:20 pm
Date	--	10/12/04

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
33.0							33.0	
34.0	50/3	SS	3"		SANDY SILT: Alternating dry and wet layers of black and white mottled sandy silt with granitic saprolite.		34.0	
35.0							35.0	
36.0							36.0	
37.0							37.0	
38.0							38.0	
39.0	35,50/6	SS	6"				39.0	
40.0							40.0	
41.0							41.0	
42.0							42.0	
43.0							43.0	
44.0	50/3	SS	3"				44.0	
45.0							45.0	
46.0							46.0	
47.0							47.0	
48.0		Grab			GRAVEL: Split spoon refulsal, however augers still cut. Cuttings are quartz gravel ranging from dry to moist and finally wet at 64'. Some silt noted at 60 feet also. Boring terminated at 64 feet.		48.0	
49.0							49.0	
50.0							50.0	
51.0							51.0	
52.0		Grab					52.0	
53.0							53.0	
54.0							54.0	
55.0							55.0	
56.0		Grab					56.0	
57.0							57.0	
58.0							58.0	
59.0							59.0	
60.0		Grab					60.0	
61.0							61.0	
62.0							62.0	
63.0							63.0	
64.0							64.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-50**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **Geoprobe/AH**
FIELD PARTY: **John Burr**
GEOLOGIST: **L. Quant**
DATE BEGUN: **11/8/10** COMPLETED: **11/8/10**

TOTAL DEPTH: **40**
TOP OF CASING ELEV. **704.36** GROUND ELEV.: **701.46**
NORTHING: **766525.827** EASTING: **1650994.643**

STATIC WATER LEVEL (BLS)		
Depth (ft)	26.45	
Time	11:15 am	
Date	12/22/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP	SAND: Dry, brown, gray medium sand partially weathered rock.		0.0	
5.0		MC					5.0	
10.0		MC					10.0	
					SILT: Dry, brown, tan gray silt - partially weathered rock.			
15.0		MC					15.0	
20.0		MC		RC/AH	SANDY CLAY: Dry, brown sandy clay. Geoprobe refusal at 21 feet. Outer casing (for coring) set to 25'.		20.0	
25.0					PWR: Highly weathered granite. Rock core from 25' to 35' yielded no recovery. Boring air hammered from 25' - 40'. Water encountered at approximately 40 feet. BT @ 40'.		25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-51**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **Johnny Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/11/10** COMPLETED: **11/11/10**

TOTAL DEPTH: **18**
TOP OF CASING ELEV. **683.35** GROUND ELEV.: **681.34**
NORTHING: **765890.517** EASTING: **1650491.315**

STATIC WATER LEVEL (BLS)		
Depth (ft)	11.52	
Time	4:15	
Date	11/15/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	SILTY CLAY: Dry gray red silty clay.		0.0	
5.0		MC					5.0	
					CLAY: Very wet brown clay with ribbon and cast.			
10.0		MC			SANDY SILT: Dry to moist gray red sandy silt. Geoprobe refusal at 14 feet.		10.0	
15.0					PWR: Moist to wet partially weathered granitic rock (PWR). Air hammer drilled to 18 feet, then boring terminated.		15.0	

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FIELD BOREHOLE LOG

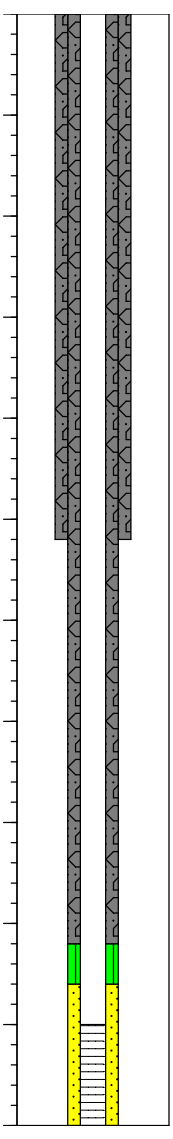
BOREHOLE NUMBER **PZ-52**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **Johnny Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/10/10** COMPLETED: **11/30/10**

TOTAL DEPTH: **55**
TOP OF CASING ELEV.**707.52** GROUND ELEV.: **704.71**
NORTHING: **765890.578** EASTING: **1650232.025**

STATIC WATER LEVEL (BLS)		
Depth (ft)	34.35	
Time	11:30 am	
Date	12/22/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	SAND: Dry red gray medium sand.		0.0	
5.0		MC					5.0	
10.0		MC			SANDY CLAY: Dry gray sandy clay.		10.0	
15.0		MC			SAND: Dry gray white sand and partially weathered rock (PWR),		15.0	
20.0		MC			SAND: Dry red gray and tan sand and PWR. Geoprobe refusal at 22 feet. 6-inch casing set at 26'.		20.0	
25.0					PWR: Rock core from 26' to 36' below grade. No core recovery.		25.0	
30.0							30.0	
35.0					PWR: Dry to wet partially weathered granitic rock. Drilled by air hammer with no competent bedrock encountered. Water encountered at ~52 feet. Boring terminated at 55 feet.		35.0	
40.0							40.0	
45.0							45.0	
50.0							50.0	
55.0							55.0	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-57**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **John Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/11/10** COMPLETED: **11/11/10**

TOTAL DEPTH: **23**
TOP OF CASING ELEV. **676.54** GROUND ELEV.: **674.24**
NORTHING: **765259.132** EASTING: **1649737.255**

STATIC WATER LEVEL (BLS)		
Depth (ft)	17.27	
Time	4:25	
Date	11/15/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	SILTY CLAY: Dry gray brown silty clay.		0.0	
5.0		MC			CLAY: Dry red clay and partially weathered rock (PWR).		5.0	
					SANDY CLAY: Dry brown sandy clay and PWR.			
10.0		MC			SAND: Dry white to brown/red sand and PWR.		10.0	
15.0		MC			SANDY CLAY: Moist, sandy clay and PWR.		15.0	
20.0		MC			SAND: Dry white sand. Geoprobe refusal at 18 feet. Drilled with air hamme to 23 feet, only PWR encountered, no competent bedrock. Boring terminated at 23 feet.		20.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-58**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **John Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/11/10** COMPLETED: **11/11/10**

TOTAL DEPTH: **36**
TOP OF CASING ELEV. **697.4** GROUND ELEV.: **695.16**
NORTHING: **765715.824** EASTING: **1649546.003**

STATIC WATER LEVEL (BLS)		
Depth (ft)	25.85	
Time	4:35	
Date	11/15/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	SANDY SILT: Dry, red sandy silt.		0.0	
					CLAY: Dry red and orange clay.			
5.0		MC					5.0	
					SANDY CLAY: Dry red sandy clay and partially weathered rock (PWR). Trace silt and quartz rock fragments with the sandy clay between 10- 15 feet.			
10.0		MC					10.0	
15.0		MC			SAND: Dry white, red, brown coarse sand and gravel with trace clay. Sample contained manganese staining and partially weathered rock (PWR).		15.0	
20.0		MC			SANDY SILT: Dry white tan sandy silt with quartz fragments.		20.0	
					CLAY: Dry red brown clay.			
25.0		MC			SAND: Dry white and red coarse sand with quartz fragments and silty patches. Geoprobe refusal at 32 feet.		25.0	
30.0		MC					30.0	
35.0		MC			PWR: Dry to wet white to tan sandy partially weathered rock (PWR). No competent bedrock encountered. Boring terminated at 36 feet.		35.0	

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FIELD BOREHOLE LOG

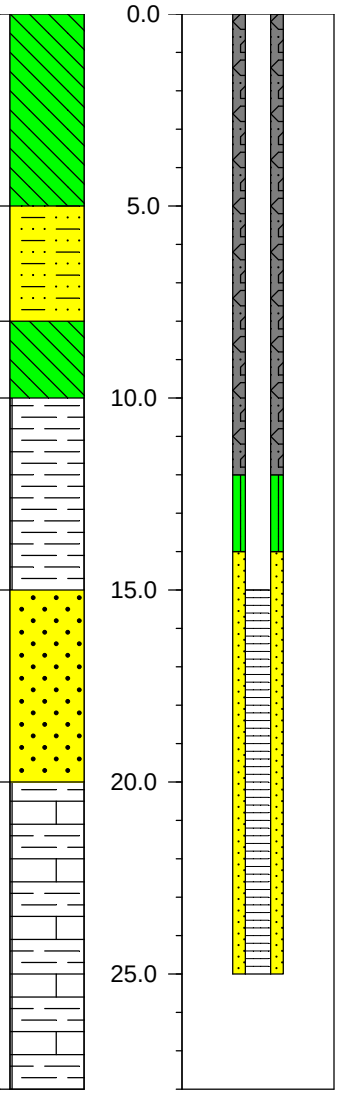
BOREHOLE NUMBER **PZ-59**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **John Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/11/10** COMPLETED: **11/11/10**

TOTAL DEPTH: **25**
TOP OF CASING ELEV. **691.34** GROUND ELEV.: **688.88**
NORTHING: **765984.48** EASTING: **1649687.842**

STATIC WATER LEVEL (BLS)		
Depth (ft)	19.32	
Time	4:45	
Date	11/15/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	CLAY: Dry red clay.		0.0	
5.0		MC			SANDY SILT: Dry red brown sandy silty with partially weathered rock (PWR).		5.0	
					CLAY: Moist to wet dark brown clay.			
10.0		MC			SILTY CLAY: Moist brown to red silty clay with PWR.		10.0	
15.0		MC			SAND: Moist white tan to gray sand with PWR.		15.0	
20.0		MC			PWR: Moist to wet sand with PWR. Very small sample recovered from 20 - 23 feet due to quartz fragement stuck in the sampler. Augers were very wet near bottom of the hole. Geoprobe refusal at 28 feet.		20.0	
25.0		MC					25.0	



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-62**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **John Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/15/10** COMPLETED: **11/15/10**

TOTAL DEPTH: **25**
TOP OF CASING ELEV. **679.56** GROUND ELEV.: **676.76**
NORTHING: **766153.985** EASTING: **1649462.167**

STATIC WATER LEVEL (BLS)		
Depth (ft)	16.37	
Time	1:40 pm	
Date	12/22/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	SANDY SILT: Dry tan to gray sandy silt.		0.0	
					SILTY CLAY: Dry, brown red and gray silty clay with relict rock texture.			
5.0		MC			SILTY SAND: Moist brown, gray, and tan silty sand. Sand fraction coarsening iwith depth.		5.0	
10.0		MC					10.0	
15.0		MC					15.0	
20.0		MC			CLAYEY SILTY SAND: Wet gray clayey silty fine to medium sand.		20.0	
					SILTY SAND: Moist to wet silty fine to coarse sand and partially weathered rock (PWR). Boring terminated at 25 feet.			
25.0							25.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **PZ-63**

PROJECT NAME: **Davidson Co Phase 2 Landfill**
LOCATION: **Davidson County**
DRILLING CO: **Geologic Explorations**
DRILLING METHOD: **GP/AH**
FIELD PARTY: **John Burr**
GEOLOGIST: **Lindsay Quant**
DATE BEGUN: **11/11/10** COMPLETED: **11/23/10**

TOTAL DEPTH: **40**
TOP OF CASING ELEV.: **700.05** GROUND ELEV.: **697.20**
NORTHING: **766442.808** EASTING: **1649546.08**

STATIC WATER LEVEL (BLS)		
Depth (ft)	36.05	
Time	2:00	
Date	12/22/10	

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				GP/AH	CLAYEY SILT: Moist brown red clayey silt and partially weathered rock (PWR).		0.0	
5.0		MC			CLAYEY SAND: Moist gray tan claeye fine sand with manganese sstaining.		5.0	
10.0		MC			SILT: Moist to wet silt with trace clay. 6-inch clay lens from 10 to 10.5 feet. Sample also contains partially weathered rock (PWR) with relict rock texture.		10.0	
15.0		MC			SILTY CLAY: Moist tan gray and black silty clay with partially weathered rock (PWR). Geoprobe refusal at 23 feet. Well initially set at 25 feet below grade.		15.0	
20.0		MC					20.0	
25.0					PWR: Moist to wet partially weatherred rock (PWR). Monitoring of well set at 25 indicated it was dry. Drillers removed well casing and advanced the borehole through a hard layer and then through layers of PWR. Boring terminated at 40 feet.		25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	

Appendix 2

Geotechnical Laboratory Data

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INTEGRITY IN TESTING

December 8, 2010

Project No. 2010-774-01

Ms. Joan Smyth
Richardson Smith Gardner & Associates
14 N. Boylan Avenue
Raleigh, NC 27603

jsmythr@rsgengineers.com

Transmittal
Laboratory Test Results
Davidson County Landfill

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was faxed to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

Michael P. Smith
Regional Manager

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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MOISTURE CONTENT

ASTM D 2216-05 (SOP-S1)

Client	R.S.G. & ASSOCIATES
Client Reference	DAVIDSON CO. LF.
Project No.	2010-774-01

Lab ID	1	2	3	4	5
Boring No.	PZ-46	PZ-47	PZ-48	PZ-51	PZ-52
Depth (ft)	27.5-30.0	15.0-18.0	25.0-30.0	10.0-14.0	20.0-22.0
Sample No.	NA	NA	NA	NA	NA
Tare Number	818	820	816	824	842
Wt. of Tare & WS (gm)	223.96	171.65	171.09	151.85	962.37
Wt. of Tare & DS (gm)	204.60	169.47	164.58	149.06	925.51
Wt. of Tare (gm)	137.32	136.07	135.98	135.28	255.85
Wt. of Water (gm)	19.36	2.18	6.51	2.79	36.86
Wt. of DS (gm)	67.28	33.4	28.6	13.78	669.66
Water Content (%)	**28.8**	**6.5**	**22.8**	**20.2**	**5.5**

Lab ID	6	7	8	9	10
Boring No.	PZ-53	PZ-54	PZ-55	PZ-56	PZ-57
Depth (ft)	15.0-18.0	10.0-13.0	5.0-6.0	7.5-9.0	15.0-18.0
Sample No.	NA	NA	NA	NA	NA
Tare Number	827	826	215	819	8010
Wt. of Tare & WS (gm)	160.55	169.67	454.56	156.92	199.95
Wt. of Tare & DS (gm)	156.58	167.51	428.88	155.02	189.70
Wt. of Tare (gm)	136.29	139.19	172.30	135.56	135.92
Wt. of Water (gm)	3.97	2.16	25.68	1.9	10.25
Wt. of DS (gm)	20.29	28.32	256.58	19.46	53.78
Water Content (%)	**19.6**	**7.6**	**10.0**	**9.8**	**19.1**

Notes : *NA*

Tested By *TMS* *Date* *12/1/2010* *Checked By* JBD *Date* 12.6.10

 DCN: CT-S1 DATE 6-30-98 REVISION: 2 *\\SERVER\Data Drive\Data Sheets\[Limit-(NP).xls]Sheet1*

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MOISTURE CONTENT

ASTM D 2216-05 (SOP-S1)

Client	R.S.G. & ASSOCIATES
Client Reference	DAVIDSON CO. LF.
Project No.	2010-774-01

Lab ID	11	12	13	14	15
Boring No.	PZ-58	PZ-59	PZ-60	PZ-61a	PZ-62
Depth (ft)	30.0-32.0	15.0-20.0	5.0-7.0	15.0-20.0	20.0-25.0
Sample No.	NA	NA	NA	NA	NA
Tare Number	822	216	200	209	815
Wt. of Tare & WS (gm)	251.66	725.49	887.03	663.72	178.52
Wt. of Tare & DS (gm)	235.50	614.41	832.67	570.17	168.88
Wt. of Tare (gm)	136.98	170.76	171.76	171.63	136.08
Wt. of Water (gm)	16.16	111.08	54.36	93.55	9.64
Wt. of DS (gm)	98.52	443.65	660.91	398.54	32.8
Water Content (%)	**16.4**	**25.0**	**8.2**	**23.5**	**29.4**

Lab ID	16	17	18	19	20
Boring No.	PZ-63	CDSB-1	CDSB-2	SB-1	CDMW-6
Depth (ft)	20.0-23.0	0.0-4.0	10.0-12.0	10.0-13.0	5.0-7.0
Sample No.	NA	NA	NA	NA	NA
Tare Number	817	213	823	843	838
Wt. of Tare & WS (gm)	221.83	997.86	154.37	821.08	827.48
Wt. of Tare & DS (gm)	203.96	964.34	152.56	776.85	798.94
Wt. of Tare (gm)	135.62	173.30	136.95	262.05	261.61
Wt. of Water (gm)	17.87	33.52	1.81	44.23	28.54
Wt. of DS (gm)	68.34	791.04	15.61	514.8	537.33
Water Content (%)	**26.1**	**4.2**	**11.6**	**8.6**	**5.3**

Notes : *NA*

Tested By *TMS* *Date* *12/1/2010* *Checked By* JBO *Date* 12-6-10

DCN: CT-S1 DATE 6-30-98 REVISION: 2

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MOISTURE CONTENT

ASTM D 2216-05 (SOP-S1)

Client	R.S.G. & ASSOCIATES
Client Reference	DAVIDSON CO. LF.
Project No.	2010-774-01

Lab ID	21
Boring No.	CDMW-7
Depth (ft)	5.0-7.0
Sample No.	NA
Tare Number	834
Wt. of Tare & WS (gm)	847.65
Wt. of Tare & DS (gm)	824.58
Wt. of Tare (gm)	259.44
Wt. of Water (gm)	23.07
Wt. of DS (gm)	565.14
Water Content (%)	**4.1**

Notes : *NA*

Tested By *TMS* *Date* *12/1/2010* *Checked By* TBD *Date* 12-6-10

DCN: CT-S1 DATE 6-30-98 REVISION: 2

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G & ASSOCIATES	Boring No.	PZ-46
Client Reference	DAVIDSON CO. LF.	Depth (ft)	27.5-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-01	Soil Description	**GRAY SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

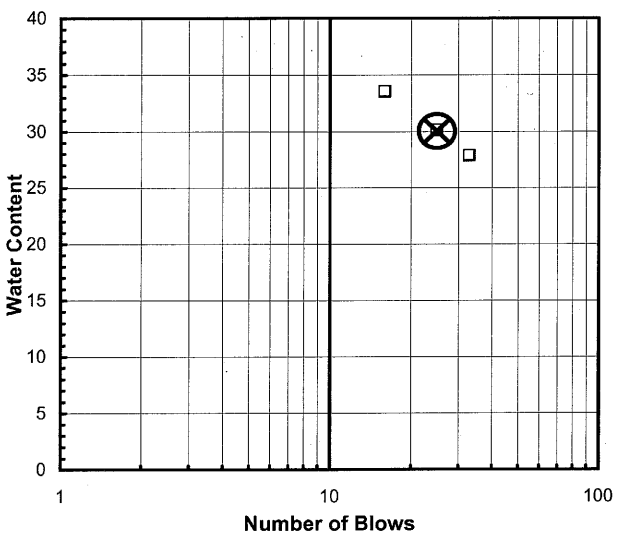
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	K	L	A	MULTIPOINT
Wt. of Tare & WS (gm)	26.42	25.02	25.26	
Wt. of Tare & DS (gm)	23.98	22.75	22.74	
Wt. of Tare (gm)	15.21	15.21	15.22	
Wt. of Water (gm)	2.4	2.3	2.5	
Wt. of DS (gm)	8.8	7.5	7.5	
Moisture Content (%)	**27.8**	**30.1**	**33.5**	
Number of Blows	**33**	**25**	**16**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	N	U	
Wt. of Tare & WS (gm)	22.23	21.64	
Wt. of Tare & DS (gm)	20.71	20.21	
Wt. of Tare (gm)	15.25	15.14	
Wt. of Water (gm)	1.5	1.4	
Wt. of DS (gm)	5.5	5.1	
Moisture Content (%)	**27.8**	**28.2**	**-0.4**

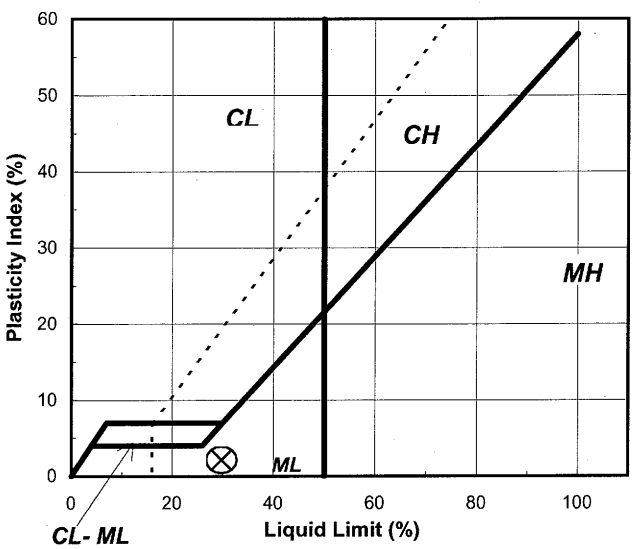
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**30**
Plastic Limit (%)	**28**
Plasticity Index (%)	**2**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-47
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-02	Soil Description	**GRAY SILTY CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

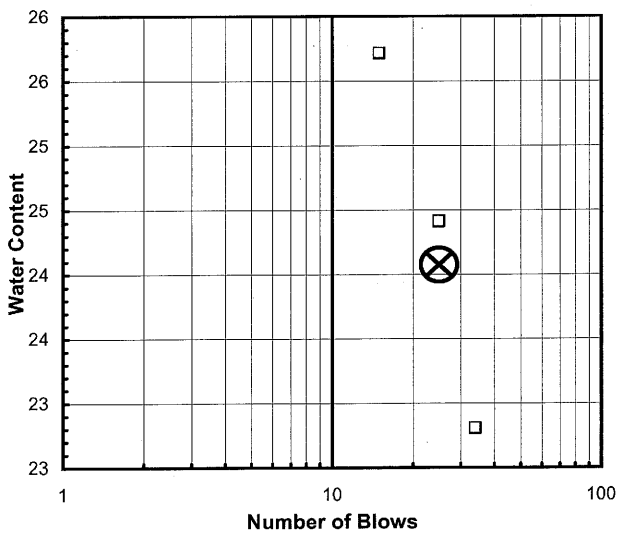
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	K-A	A-B	A-C	MULTIPOINT
Wt. of Tare & WS (gm)	24.12	24.55	25.27	
Wt. of Tare & DS (gm)	22.51	22.79	23.29	
Wt. of Tare (gm)	15.45	15.58	15.59	
Wt. of Water (gm)	1.6	1.8	2.0	
Wt. of DS (gm)	7.1	7.2	7.7	
Moisture Content (%)	**22.8**	**24.4**	**25.7**	
Number of Blows	**34**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	V	A-D	
Wt. of Tare & WS (gm)	21.93	22.48	
Wt. of Tare & DS (gm)	20.82	21.27	
Wt. of Tare (gm)	15.26	15.36	
Wt. of Water (gm)	1.1	1.2	
Wt. of DS (gm)	5.6	5.9	
Moisture Content (%)	**20.0**	**20.5**	**-0.5**

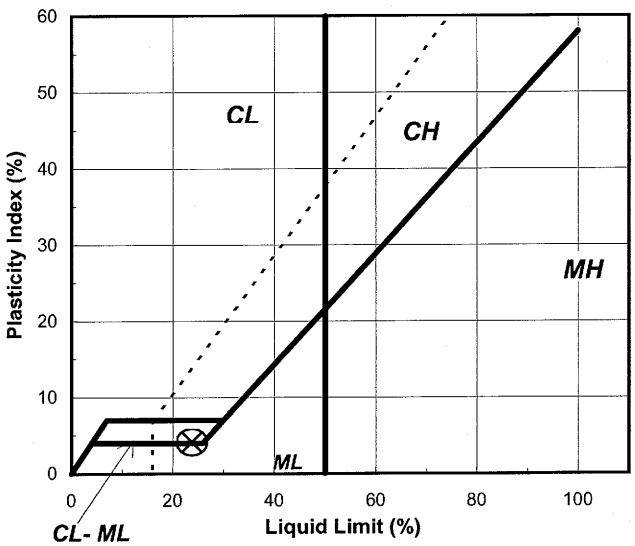
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**24**
Plastic Limit (%)	**20**
Plasticity Index (%)	**4**
USCS Symbol	**CL-ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G & ASSOCIATES	Boring No.	PZ-48
Client Reference	DAVIDSON CO. LF.	Depth (ft)	25.0-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-03	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

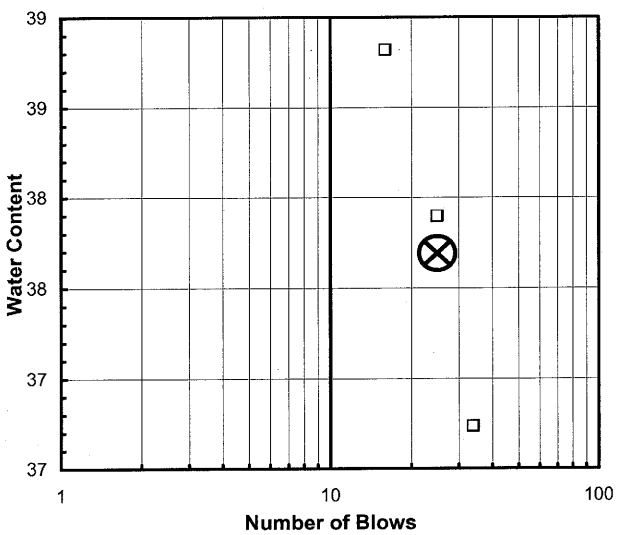
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	C	R	A-N	MULTIPOINT
Wt. of Tare & WS (gm)	27.30	23.02	25.01	
Wt. of Tare & DS (gm)	24.06	20.86	22.32	
Wt. of Tare (gm)	15.24	15.16	15.39	
Wt. of Water (gm)	3.2	2.2	2.7	
Wt. of DS (gm)	8.8	5.7	6.9	
Moisture Content (%)	**36.7**	**37.9**	**38.8**	
Number of Blows	**34**	**25**	**16**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-K	A-F	
Wt. of Tare & WS (gm)	21.98	21.91	
Wt. of Tare & DS (gm)	20.54	20.47	
Wt. of Tare (gm)	15.50	15.42	
Wt. of Water (gm)	1.4	1.4	
Wt. of DS (gm)	5.0	5.1	
Moisture Content (%)	**28.6**	**28.5**	**0.1**

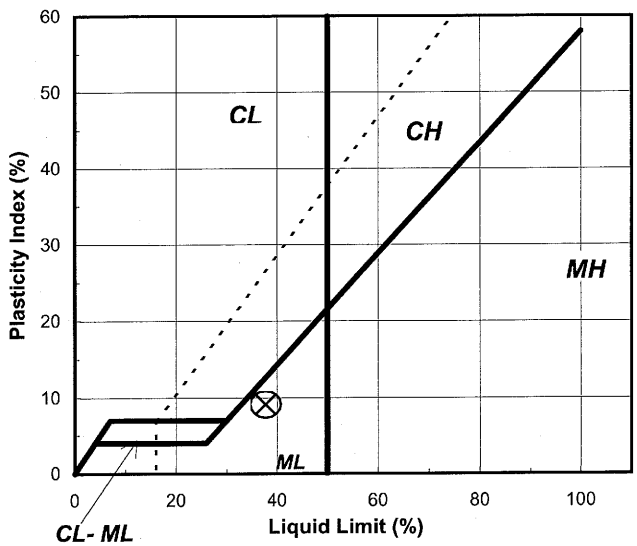
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**38**
Plastic Limit (%)	**29**
Plasticity Index (%)	**9**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-51
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-14.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-04	Soil Description	**GRAY BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

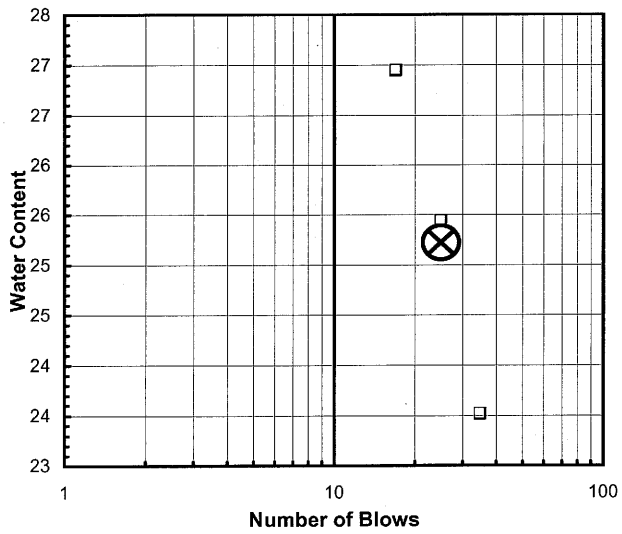
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	D-2	B-B	A-H	MULTIPOINT
Wt. of Tare & WS (gm)	24.77	25.52	23.34	
Wt. of Tare & DS (gm)	22.95	23.49	21.68	
Wt. of Tare (gm)	15.21	15.51	15.52	
Wt. of Water (gm)	1.8	2.0	1.7	
Wt. of DS (gm)	7.7	8.0	6.2	
Moisture Content (%)	**23.5**	**25.4**	**26.9**	
Number of Blows	**35**	**25**	**17**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-I	A-P	
Wt. of Tare & WS (gm)	21.68	22.94	
Wt. of Tare & DS (gm)	20.49	21.49	
Wt. of Tare (gm)	15.42	15.55	
Wt. of Water (gm)	1.2	1.5	
Wt. of DS (gm)	5.1	5.9	
Moisture Content (%)	**23.5**	**24.4**	**-0.9**

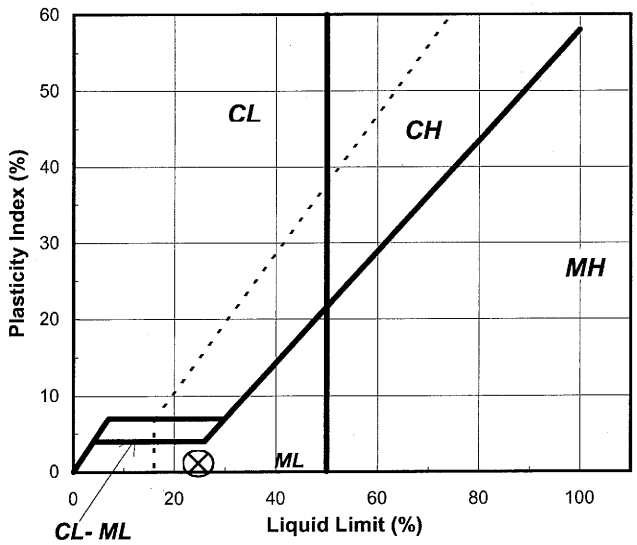
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**25**
Plastic Limit (%)	**24**
Plasticity Index (%)	**1**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-52
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-22.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-05	Soil Description	**BROWN TAN LEAN CLAY**

Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

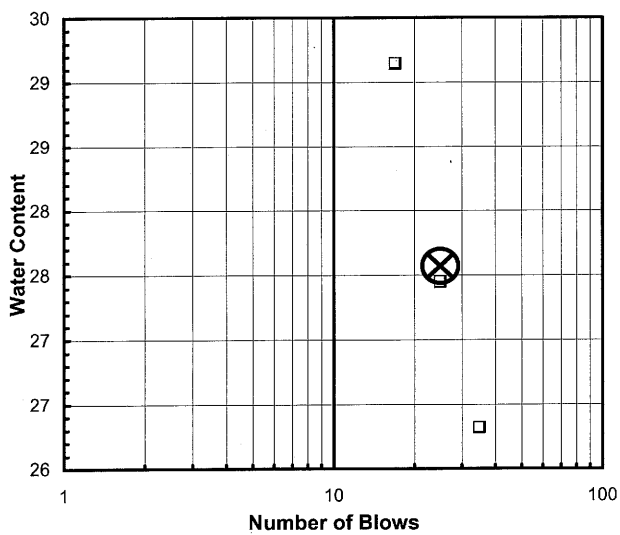
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Y	F	M	MULTIPOINT
Wt. of Tare & WS (gm)	23.25	25.11	24.45	
Wt. of Tare & DS (gm)	21.65	22.95	22.34	
Wt. of Tare (gm)	15.57	15.08	15.10	
Wt. of Water (gm)	1.6	2.2	2.1	
Wt. of DS (gm)	6.1	7.9	7.2	
Moisture Content (%)	**26.3**	**27.4**	**29.1**	
Number of Blows	**35**	**25**	**17**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	Q	R	
Wt. of Tare & WS (gm)	22.45	21.62	
Wt. of Tare & DS (gm)	21.25	20.57	
Wt. of Tare (gm)	15.15	15.16	
Wt. of Water (gm)	1.2	1.1	
Wt. of DS (gm)	6.1	5.4	
Moisture Content (%)	**19.7**	**19.4**	**0.3**

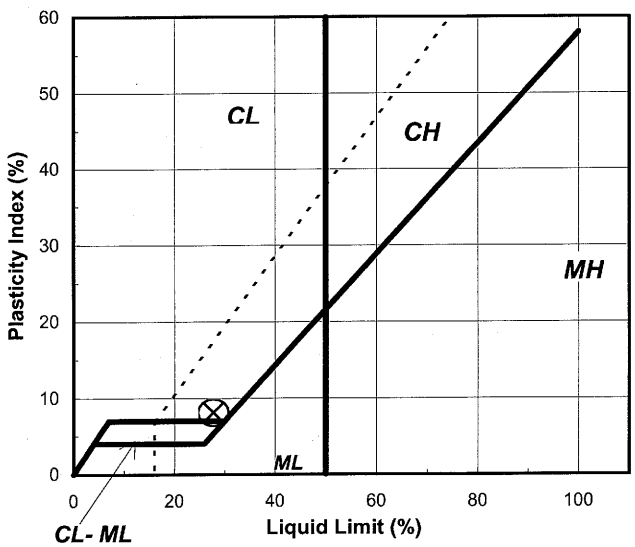
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**28**
Plastic Limit (%)	**20**
Plasticity Index (%)	**8**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-53
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-06	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

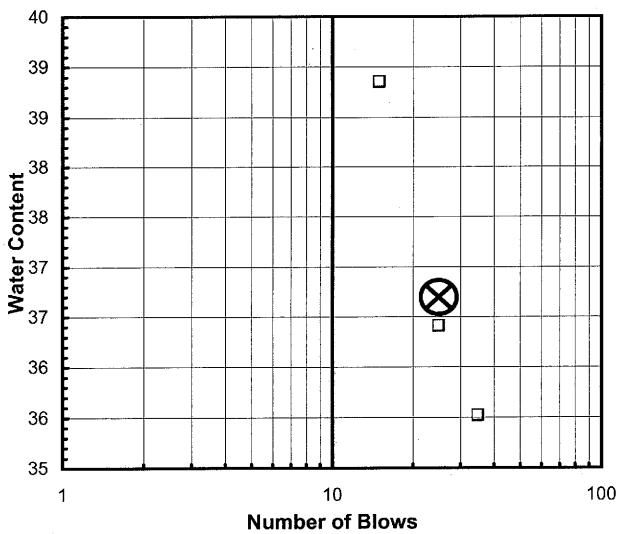
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A	U	L	MULTIPOINT
Wt. of Tare & WS (gm)	24.71	23.27	23.43	
Wt. of Tare & DS (gm)	22.22	21.10	21.13	
Wt. of Tare (gm)	15.21	15.14	15.21	
Wt. of Water (gm)	2.5	2.2	2.3	
Wt. of DS (gm)	7.0	6.0	5.9	
Moisture Content (%)	**35.5**	**36.4**	**38.9**	
Number of Blows	**35**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	K	N	
Wt. of Tare & WS (gm)	21.26	21.84	
Wt. of Tare & DS (gm)	19.93	20.38	
Wt. of Tare (gm)	15.20	15.24	
Wt. of Water (gm)	1.3	1.5	
Wt. of DS (gm)	4.7	5.1	
Moisture Content (%)	**28.1**	**28.4**	**-0.3**

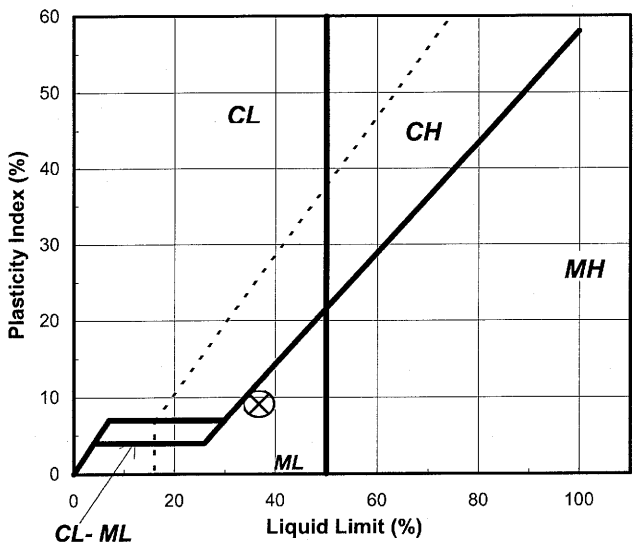
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**37**
Plastic Limit (%)	**28**
Plasticity Index (%)	**9**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-54
Client Reference	DAVIDSON CO. LF.	Depth (ft)	10.0-13.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-07	Soil Description	**GRAY/BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

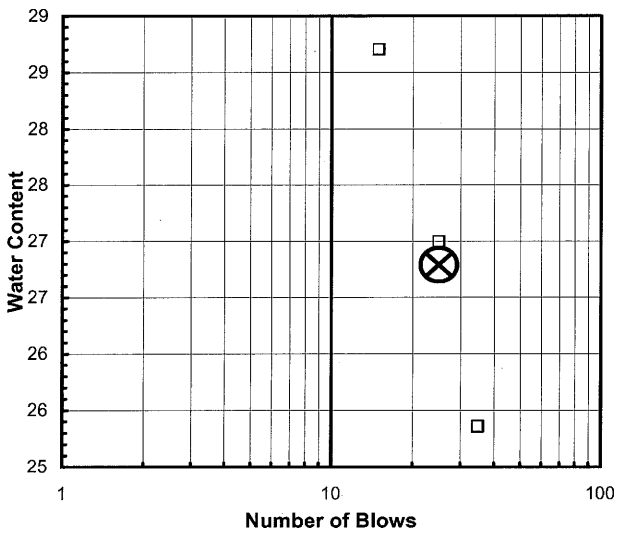
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	H	S	E	**MULTIPOINT**
Wt. of Tare & WS (gm)	31.07	31.12	30.32	
Wt. of Tare & DS (gm)	27.52	27.73	27.27	
Wt. of Tare (gm)	15.15	15.17	15.24	
Wt. of Water (gm)	3.6	3.4	3.1	
Wt. of DS (gm)	12.4	12.6	12.0	
Moisture Content (%)	**28.7**	**27.0**	**25.4**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	W	O	
Wt. of Tare & WS (gm)	24.84	26.25	
Wt. of Tare & DS (gm)	22.95	24.13	
Wt. of Tare (gm)	15.14	15.20	
Wt. of Water (gm)	1.9	2.1	
Wt. of DS (gm)	7.8	8.9	
Moisture Content (%)	**24.2**	**23.7**	**0.5**

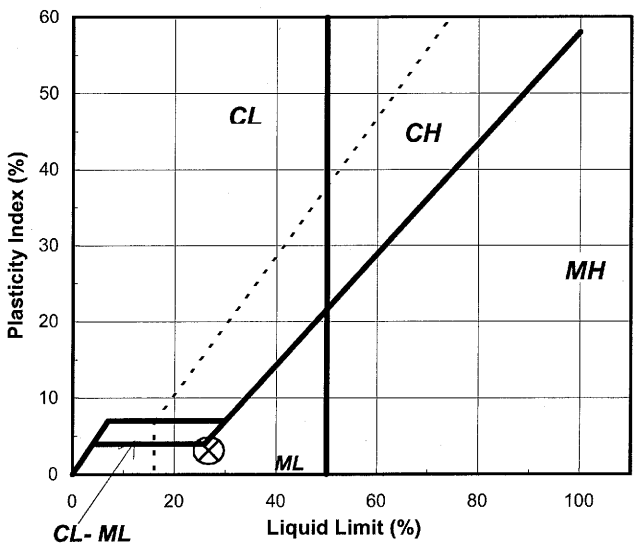
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**27**
Plastic Limit (%)	**24**
Plasticity Index (%)	**3**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-55
Client Reference	DAVIDSON CO. LF.	Depth (ft)	5.0-6.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-08	Soil Description	**BROWN SILTY CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

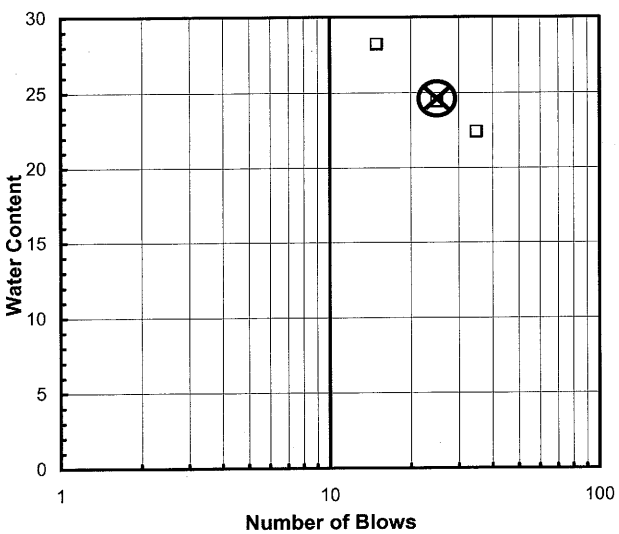
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	I	B	T	MULTIPOINT
Wt. of Tare & WS (gm)	25.65	27.04	25.05	
Wt. of Tare & DS (gm)	23.35	24.71	23.24	
Wt. of Tare (gm)	15.19	15.16	15.16	
Wt. of Water (gm)	2.3	2.3	1.8	
Wt. of DS (gm)	8.2	9.6	8.1	
Moisture Content (%)	**28.2**	**24.4**	**22.4**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	J	G	
Wt. of Tare & WS (gm)	21.80	21.02	
Wt. of Tare & DS (gm)	20.63	19.98	
Wt. of Tare (gm)	15.11	15.00	
Wt. of Water (gm)	1.2	1.0	
Wt. of DS (gm)	5.5	5.0	
Moisture Content (%)	**21.2**	**20.9**	**0.3**

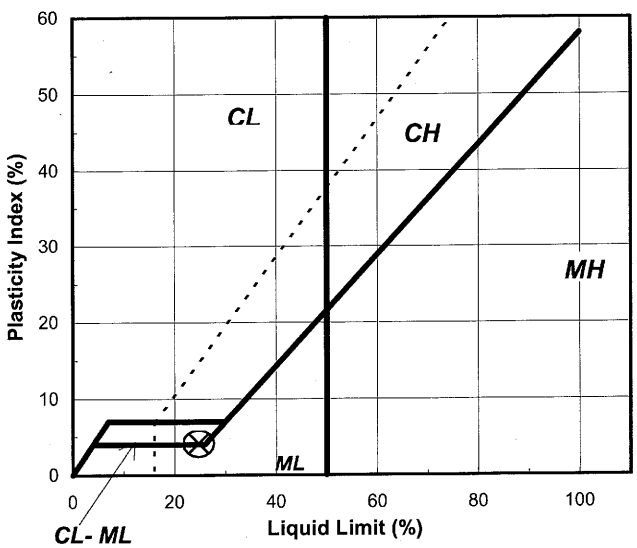
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**25**
Plastic Limit (%)	**21**
Plasticity Index (%)	**4**
USCS Symbol	**CL-ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 (SOP - S4)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-56
Client Reference	DAVIDSON CO. LF.	Depth (ft)	7.5-9.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-09	Visual Description	**GRAY**

(MInus No. 40 sieve material, Wet Method)

NON - PLASTIC MATERIAL

Tested By *JBD* *Date* *12/6/2010* *Checked By* GEM *Date* 12-8-10

DCN: CT-S4C DATE: 7-11-97 REVISION : 2

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-09 Limit-(NP).xls]Sheet1

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G & ASSOCIATES	Boring No.	PZ-57
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-10	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

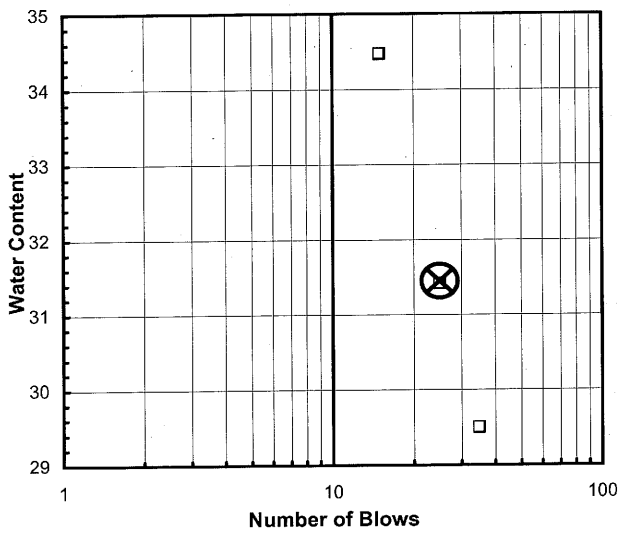
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	H	S	E	MULTIPOINT
Wt. of Tare & WS (gm)	29.34	33.01	33.33	
Wt. of Tare & DS (gm)	25.70	28.75	29.21	
Wt. of Tare (gm)	15.14	15.19	15.24	
Wt. of Water (gm)	3.6	4.3	4.1	
Wt. of DS (gm)	10.6	13.6	14.0	
Moisture Content (%)	**34.5**	**31.4**	**29.5**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	W	O	
Wt. of Tare & WS (gm)	23.54	24.27	
Wt. of Tare & DS (gm)	21.78	22.43	
Wt. of Tare (gm)	15.14	15.20	
Wt. of Water (gm)	1.8	1.8	
Wt. of DS (gm)	6.6	7.2	
Moisture Content (%)	**26.5**	**25.4**	**1.1**

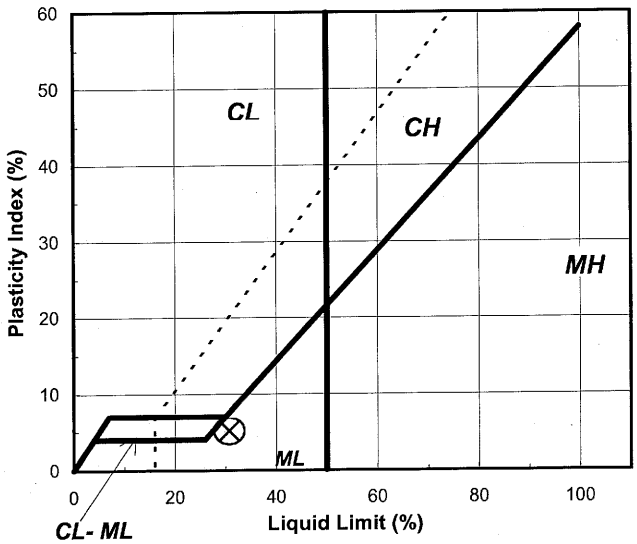
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**31**
Plastic Limit (%)	**26**
Plasticity Index (%)	**5**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-58
Client Reference	DAVIDSON CO. LF	Depth (ft)	30-32
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-11	Soil Description	**TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

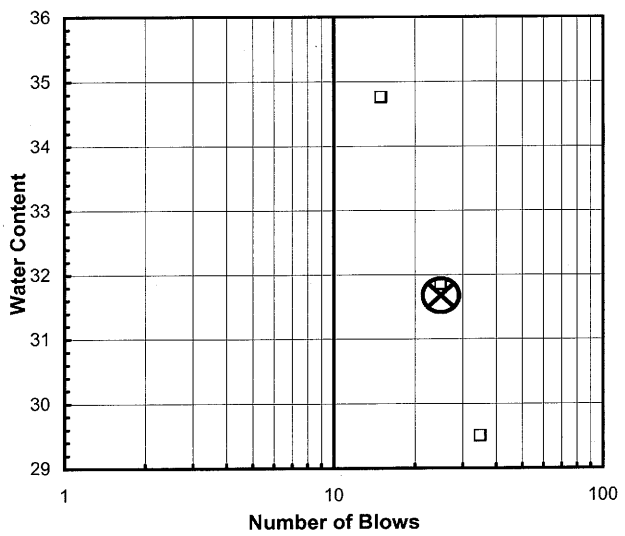
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	S	B	H	MULTIPOINT
Wt. of Tare & WS (gm)	31.82	30.86	30.64	
Wt. of Tare & DS (gm)	28.03	27.08	26.64	
Wt. of Tare (gm)	15.18	15.21	15.13	
Wt. of Water (gm)	3.8	3.8	4.0	
Wt. of DS (gm)	12.9	11.9	11.5	
Moisture Content (%)	**29.5**	**31.8**	**34.8**	
Number of Blows	**35**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	E	W	
Wt. of Tare & WS (gm)	23.19	22.33	
Wt. of Tare & DS (gm)	21.58	20.92	
Wt. of Tare (gm)	15.27	15.14	
Wt. of Water (gm)	1.6	1.4	
Wt. of DS (gm)	6.3	5.8	
Moisture Content (%)	**25.5**	**24.4**	**1.1**

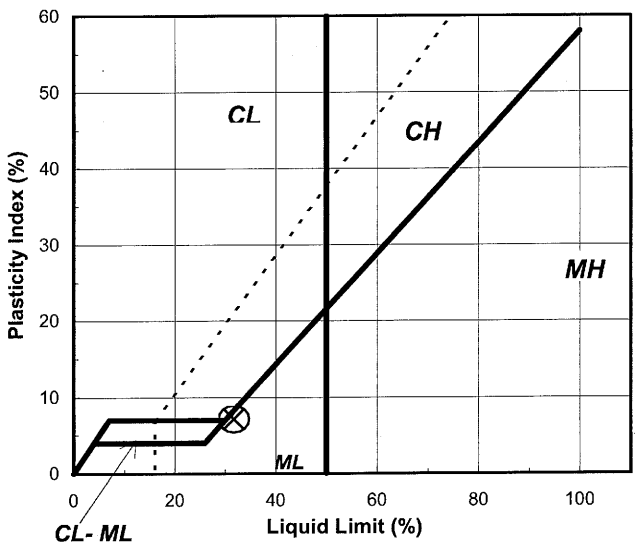
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**25**
Plasticity Index (%)	**7**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-59
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-20.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-12	Soil Description	**BROWN SILT**

Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

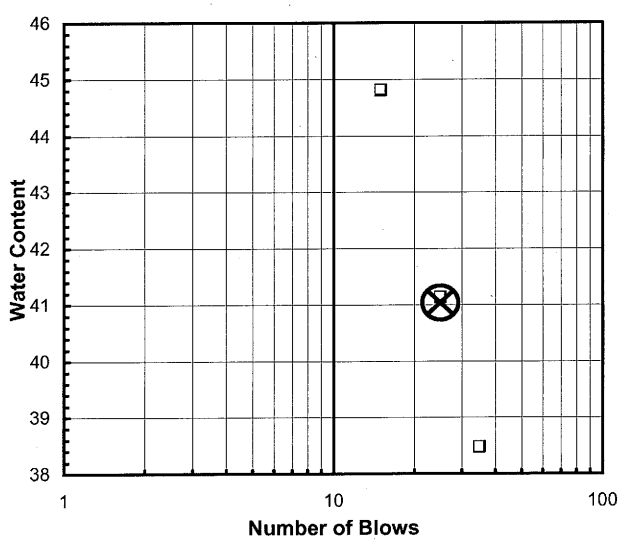
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-U	B-B	A-H	MULTIPOINT
Wt. of Tare & WS (gm)	30.68	30.78	29.45	
Wt. of Tare & DS (gm)	25.89	26.33	25.58	
Wt. of Tare (gm)	15.20	15.51	15.52	
Wt. of Water (gm)	4.8	4.5	3.9	
Wt. of DS (gm)	10.7	10.8	10.1	
Moisture Content (%)	**44.8**	**41.1**	**38.5**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-I	A-P	
Wt. of Tare & WS (gm)	23.06	22.60	
Wt. of Tare & DS (gm)	21.11	20.76	
Wt. of Tare (gm)	15.42	15.54	
Wt. of Water (gm)	2.0	1.8	
Wt. of DS (gm)	5.7	5.2	
Moisture Content (%)	**34.3**	**35.2**	**-1.0**

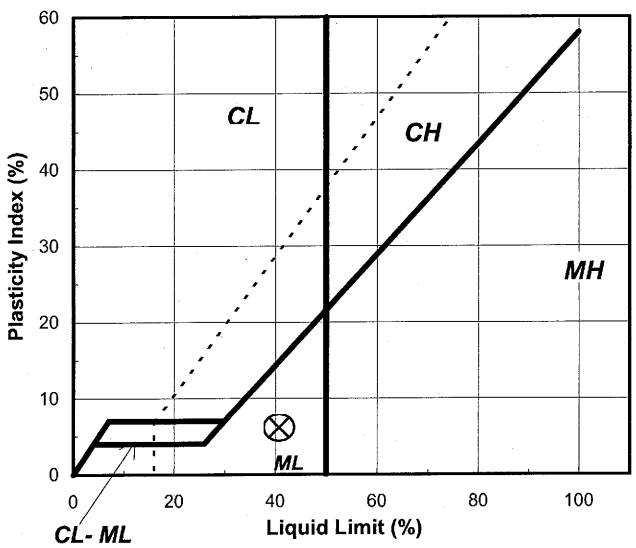
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**41**
Plastic Limit (%)	**35**
Plasticity Index (%)	**6**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-60
Client Reference	DAVIDSON CO. LF.	Depth (ft)	5.0-7.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-13	Soil Description	**GRAY SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

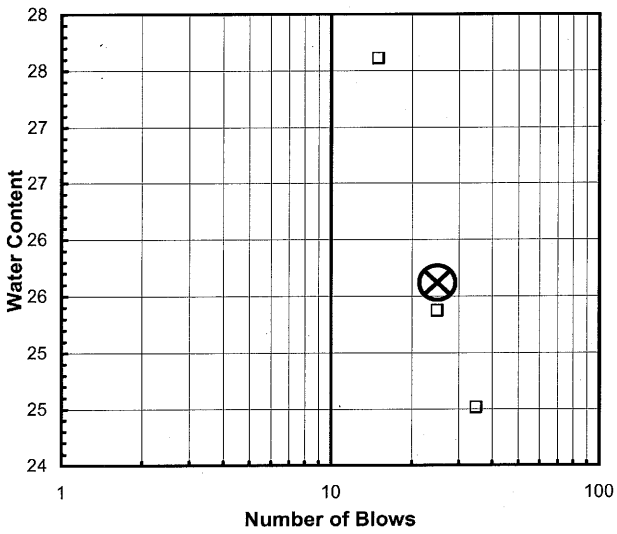
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-B	A-C	A-D	MULTIPOINT
Wt. of Tare & WS (gm)	33.94	30.80	37.71	
Wt. of Tare & DS (gm)	29.97	27.72	33.31	
Wt. of Tare (gm)	15.59	15.58	15.36	
Wt. of Water (gm)	4.0	3.1	4.4	
Wt. of DS (gm)	14.4	12.1	18.0	
Moisture Content (%)	**27.6**	**25.4**	**24.5**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	V	X	
Wt. of Tare & WS (gm)	24.33	22.85	
Wt. of Tare & DS (gm)	22.68	21.52	
Wt. of Tare (gm)	15.25	15.47	
Wt. of Water (gm)	1.7	1.3	
Wt. of DS (gm)	7.4	6.1	
Moisture Content (%)	**22.2**	**22.0**	**0.2**

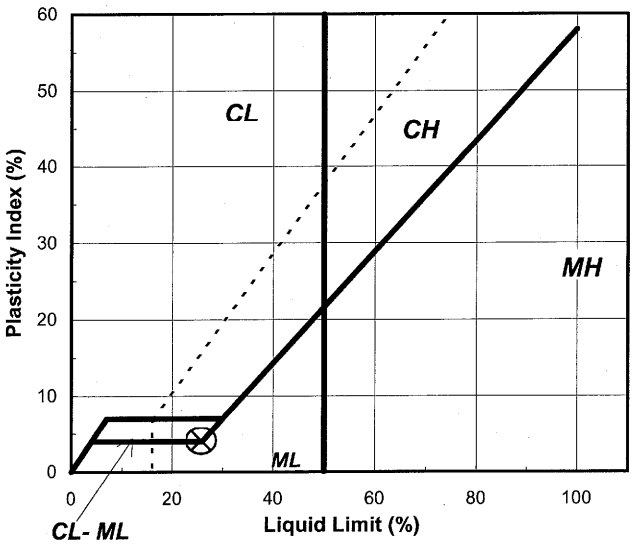
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**26**
Plastic Limit (%)	**22**
Plasticity Index (%)	**4**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G & ASSOCIATES	Boring No.	PZ-61a
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-20.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-14	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

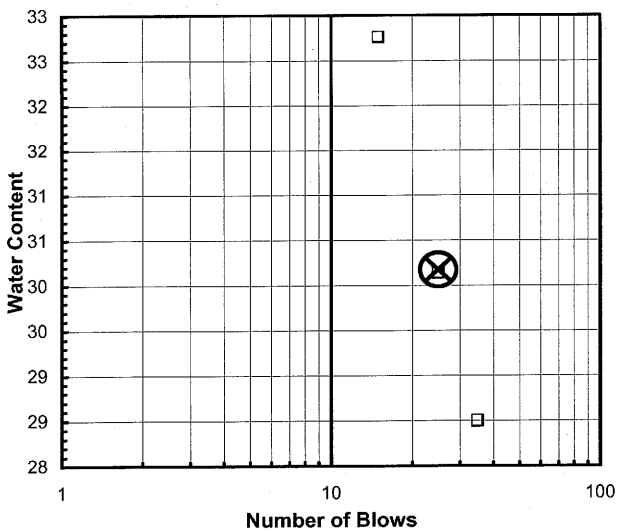
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Q	Y	F	MULTIPOINT
Wt. of Tare & WS (gm)	31.29	33.62	30.14	
Wt. of Tare & DS (gm)	27.31	29.44	26.80	
Wt. of Tare (gm)	15.16	15.57	15.08	
Wt. of Water (gm)	4.0	4.2	3.3	
Wt. of DS (gm)	12.2	13.9	11.7	
Moisture Content (%)	**32.8**	**30.1**	**28.5**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	P	M	
Wt. of Tare & WS (gm)	23.01	22.53	
Wt. of Tare & DS (gm)	21.38	20.99	
Wt. of Tare (gm)	15.16	15.10	
Wt. of Water (gm)	1.6	1.5	
Wt. of DS (gm)	6.2	5.9	
Moisture Content (%)	**26.2**	**26.1**	**0.1**

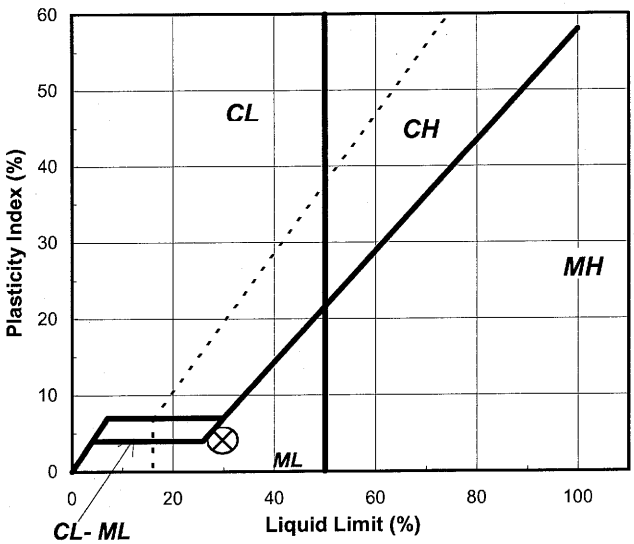
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**30**
Plastic Limit (%)	**26**
Plasticity Index (%)	**4**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By *JBD* *Date* *12/6/2010* *Checked By* TMS *Date* 12-7-10

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-62
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-25.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-15	Soil Description	**BROWN GRAY SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

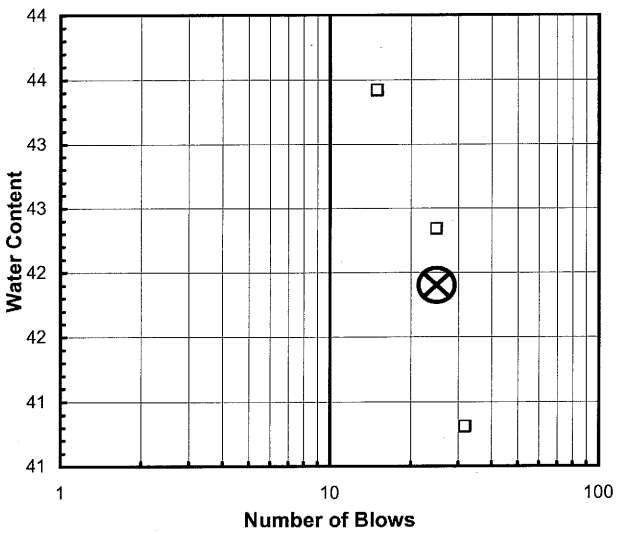
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	K-A	A-D	A-C	MULTIPOINT
Wt. of Tare & WS (gm)	24.19	23.15	23.64	
Wt. of Tare & DS (gm)	21.66	20.83	21.20	
Wt. of Tare (gm)	15.46	15.35	15.58	
Wt. of Water (gm)	2.5	2.3	2.4	
Wt. of DS (gm)	6.2	5.5	5.6	
Moisture Content (%)	**40.8**	**42.3**	**43.4**	
Number of Blows	**32**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	V	A-B	
Wt. of Tare & WS (gm)	21.68	21.65	
Wt. of Tare & DS (gm)	20.08	20.17	
Wt. of Tare (gm)	15.23	15.58	
Wt. of Water (gm)	1.6	1.5	
Wt. of DS (gm)	4.9	4.6	
Moisture Content (%)	**33.0**	**32.2**	**0.7**

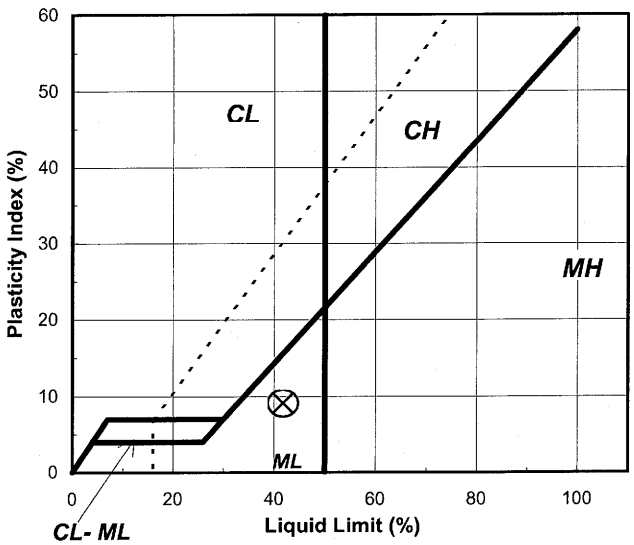
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**42**
Plastic Limit (%)	**33**
Plasticity Index (%)	**9**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-63
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-23.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-16	Soil Description	**GRAY SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

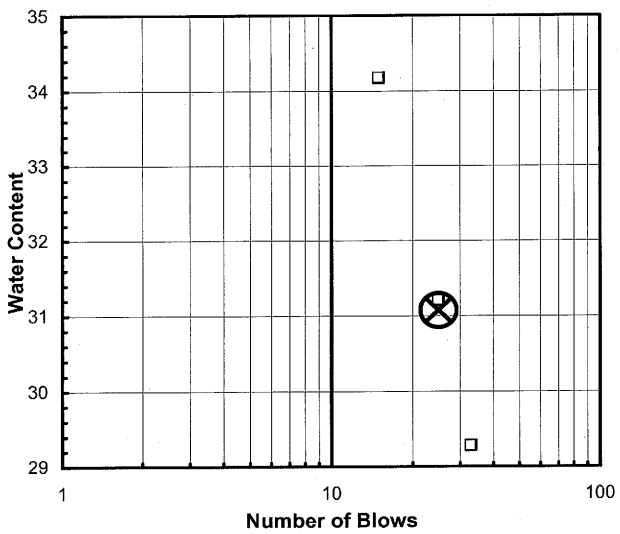
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	D-1	B-B	A-H	MULTIPOINT
Wt. of Tare & WS (gm)	25.18	25.17	24.64	
Wt. of Tare & DS (gm)	22.92	22.87	22.32	
Wt. of Tare (gm)	15.20	15.50	15.53	
Wt. of Water (gm)	2.3	2.3	2.3	
Wt. of DS (gm)	7.7	7.4	6.8	
Moisture Content (%)	**29.3**	**31.2**	**34.2**	
Number of Blows	**33**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-I	A-P	
Wt. of Tare & WS (gm)	22.13	21.86	
Wt. of Tare & DS (gm)	20.73	20.57	
Wt. of Tare (gm)	15.42	15.56	
Wt. of Water (gm)	1.4	1.3	
Wt. of DS (gm)	5.3	5.0	
Moisture Content (%)	**26.4**	**25.7**	**0.6**

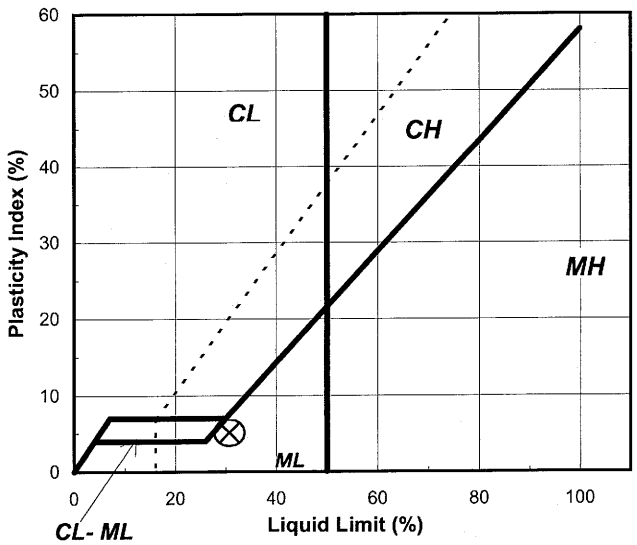
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**31**
Plastic Limit (%)	**26**
Plasticity Index (%)	**5**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	CDSB-1
Client Reference	DAVIDSON CO. LF	Depth (ft)	0.0-4.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-17	Soil Description	**BROWN TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

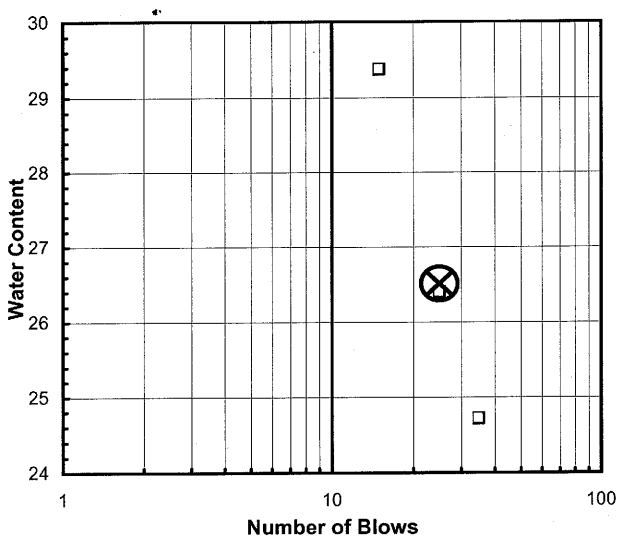
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	T	I	B	MULTIPOINT
Wt. of Tare & WS (gm)	29.41	36.90	30.85	
Wt. of Tare & DS (gm)	26.59	32.37	27.29	
Wt. of Tare (gm)	15.18	15.21	15.17	
Wt. of Water (gm)	2.8	4.5	3.6	
Wt. of DS (gm)	11.4	17.2	12.1	
Moisture Content (%)	**24.7**	**26.4**	**29.4**	
Number of Blows	**35**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	J	G	
Wt. of Tare & WS (gm)	23.04	23.61	
Wt. of Tare & DS (gm)	21.59	22.06	
Wt. of Tare (gm)	15.12	15.01	
Wt. of Water (gm)	1.5	1.6	
Wt. of DS (gm)	6.5	7.1	
Moisture Content (%)	**22.4**	**22.0**	**0.4**

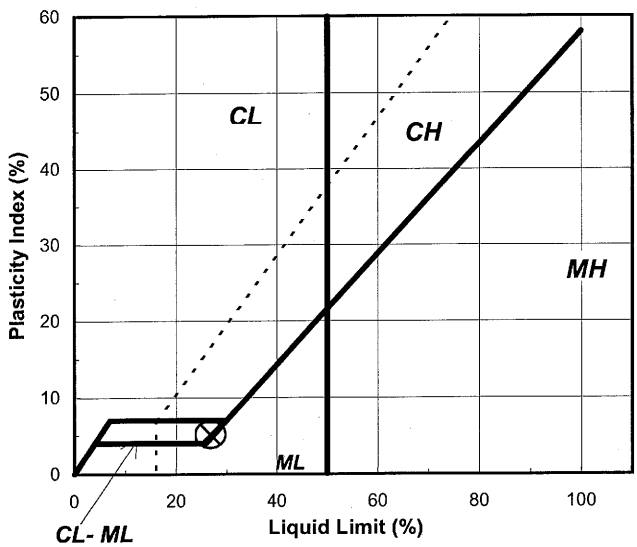
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**27**
Plastic Limit (%)	**22**
Plasticity Index (%)	**5**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	CDSB-2
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-12.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-18	Soil Description	**GRAY TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

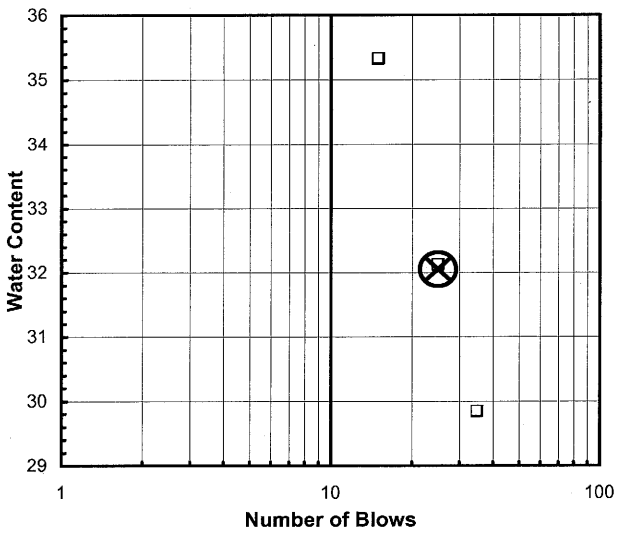
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Q	P	Y	M U L T I P O I N T
Wt. of Tare & WS (gm)	29.06	33.62	30.96	
Wt. of Tare & DS (gm)	25.87	29.13	26.94	
Wt. of Tare (gm)	15.18	15.15	15.56	
Wt. of Water (gm)	3.2	4.5	4.0	
Wt. of DS (gm)	10.7	14.0	11.4	
Moisture Content (%)	**29.8**	**32.1**	**35.3**	
Number of Blows	**35**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	F	M	
Wt. of Tare & WS (gm)	22.53	23.17	
Wt. of Tare & DS (gm)	20.87	21.35	
Wt. of Tare (gm)	15.06	15.13	
Wt. of Water (gm)	1.7	1.8	
Wt. of DS (gm)	5.8	6.2	
Moisture Content (%)	**28.6**	**29.3**	**-0.7**

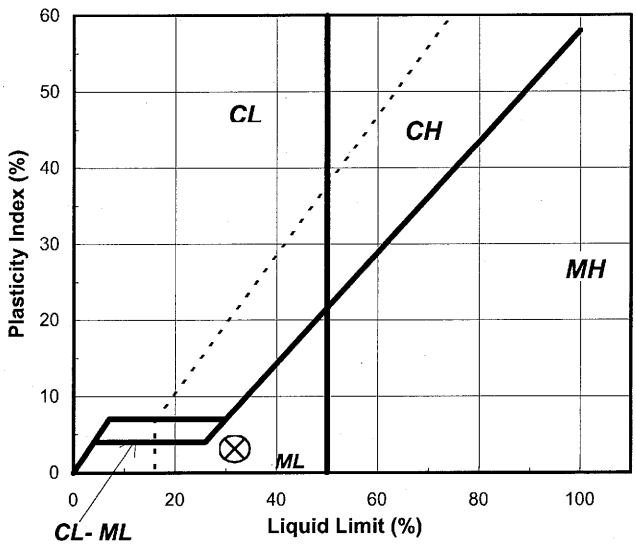
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**29**
Plasticity Index (%)	**3**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	SB-1
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-13.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-19	Soil Description	**ORANGE BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

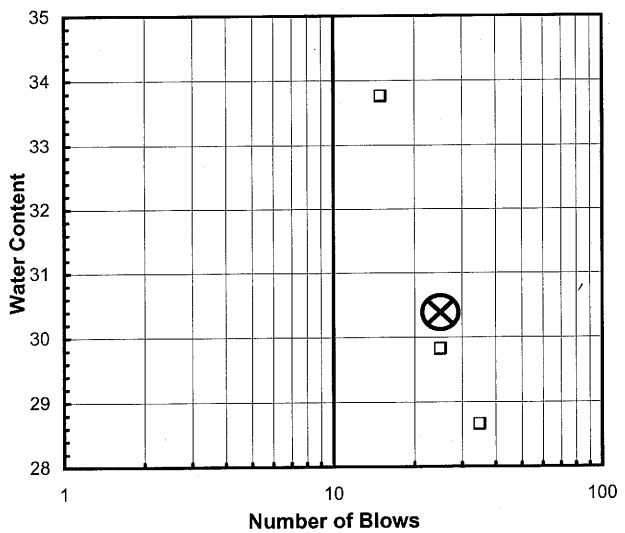
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A	N	L	MULTIPOINT
Wt. of Tare & WS (gm)	26.39	26.09	24.76	
Wt. of Tare & DS (gm)	23.90	23.60	22.35	
Wt. of Tare (gm)	15.21	15.25	15.21	
Wt. of Water (gm)	2.5	2.5	2.4	
Wt. of DS (gm)	8.7	8.4	7.1	
Moisture Content (%)	**28.7**	**29.8**	**33.8**	
Number of Blows	**35**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	K	U	
Wt. of Tare & WS (gm)	21.93	22.24	
Wt. of Tare & DS (gm)	20.64	20.87	
Wt. of Tare (gm)	15.20	15.14	
Wt. of Water (gm)	1.3	1.4	
Wt. of DS (gm)	5.4	5.7	
Moisture Content (%)	**23.7**	**23.9**	**-0.2**

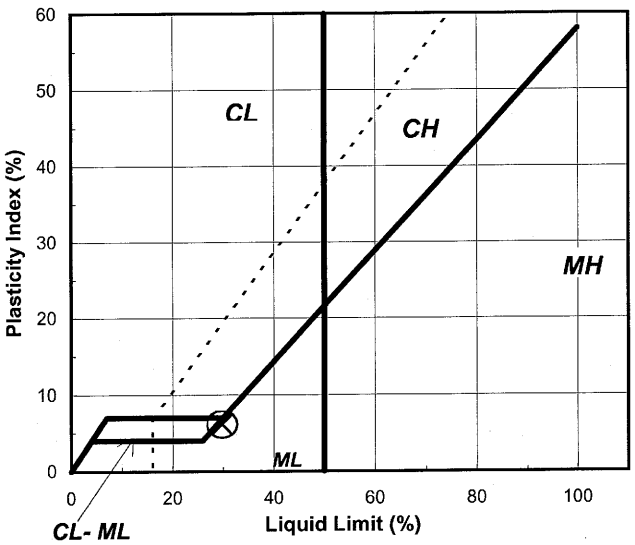
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**30**
Plastic Limit (%)	**24**
Plasticity Index (%)	**6**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	CDMW-6
Client Reference	DAVIDSON CO. LF	Depth (ft)	5.0-7.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-20	Soil Description	**LIGHT BROWN TAN SILT**

Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

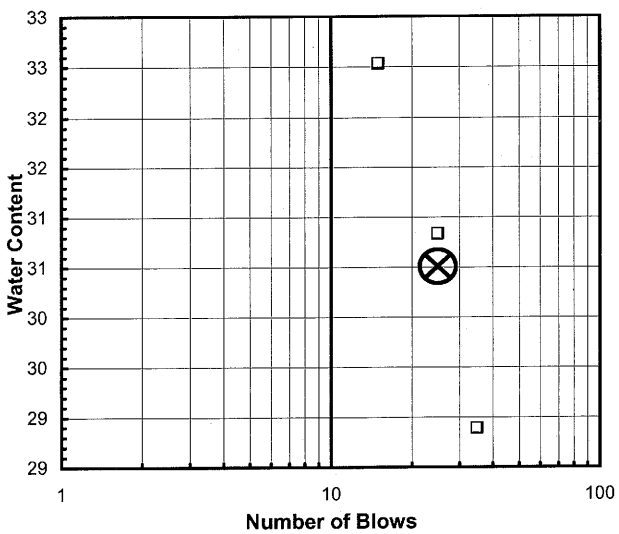
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-N	A-P	A-K	MULTIPOINT
Wt. of Tare & WS (gm)	30.47	28.15	31.43	
Wt. of Tare & DS (gm)	27.09	25.15	27.52	
Wt. of Tare (gm)	15.39	15.42	15.50	
Wt. of Water (gm)	3.4	3.0	3.9	
Wt. of DS (gm)	11.7	9.7	12.0	
Moisture Content (%)	**28.9**	**30.8**	**32.5**	
Number of Blows	**35**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	C	R	
Wt. of Tare & WS (gm)	23.66	23.76	
Wt. of Tare & DS (gm)	21.96	22.05	
Wt. of Tare (gm)	15.25	15.16	
Wt. of Water (gm)	1.7	1.7	
Wt. of DS (gm)	6.7	6.9	
Moisture Content (%)	**25.3**	**24.8**	**0.5**

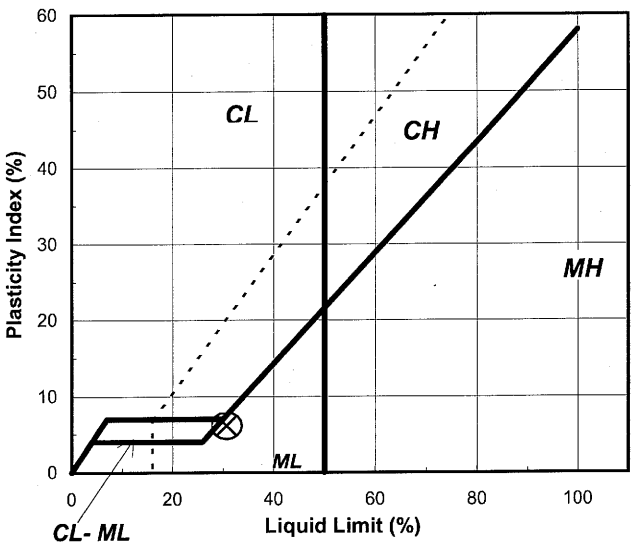
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**31**
Plastic Limit (%)	**25**
Plasticity Index (%)	**6**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	R.S.G. & ASSOCIATES	Boring No.	CDMW-7
Client Reference	DAVIDSON CO. LF	Depth (ft)	5.0-7.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-21	Soil Description	**TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

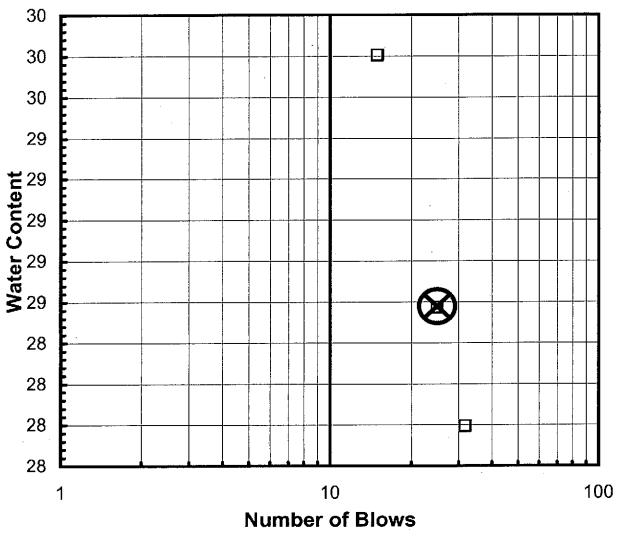
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	T	I	G	MULTIPOINT
Wt. of Tare & WS (gm)	26.83	24.58	23.57	
Wt. of Tare & DS (gm)	24.28	22.50	21.60	
Wt. of Tare (gm)	15.17	15.22	14.99	
Wt. of Water (gm)	2.6	2.1	2.0	
Wt. of DS (gm)	9.1	7.3	6.6	
Moisture Content (%)	**28.0**	**28.6**	**29.8**	
Number of Blows	**32**	**25**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	B	J	
Wt. of Tare & WS (gm)	22.15	22.04	
Wt. of Tare & DS (gm)	20.74	20.83	
Wt. of Tare (gm)	15.17	15.11	
Wt. of Water (gm)	1.4	1.2	
Wt. of DS (gm)	5.6	5.7	
Moisture Content (%)	**25.3**	**21.2**	**4.2**

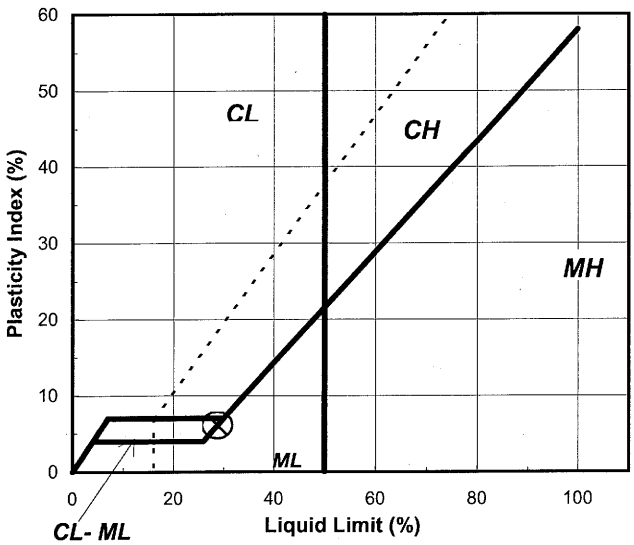
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**29**
Plastic Limit (%)	**23**
Plasticity Index (%)	**6**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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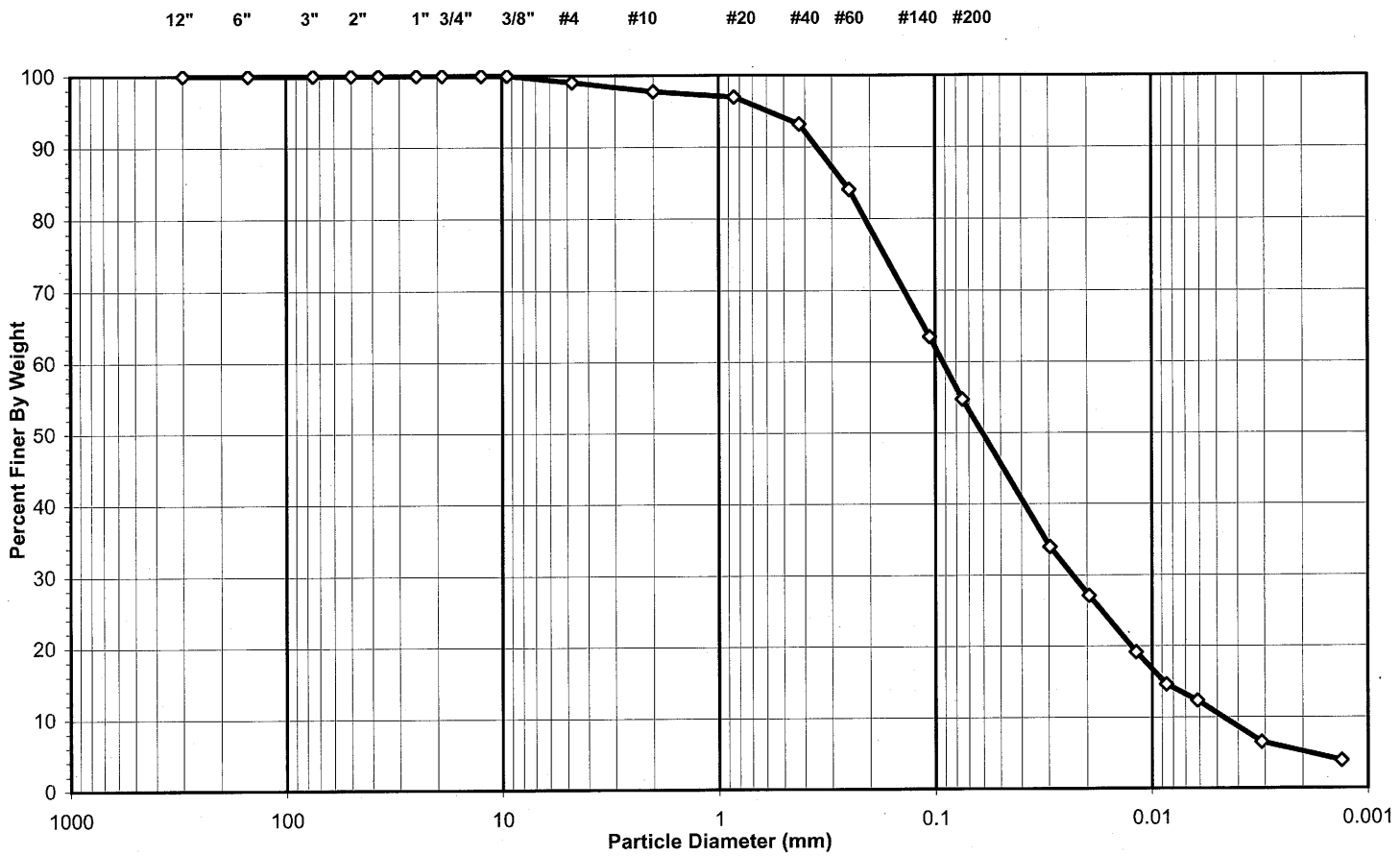
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-46
Client Reference	DAVIDSON CO. LF	Depth (ft)	27.5-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-01	Soil Color	**GRAY**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.94
#4 To #200	*Sand*	44.35
Finer Than #200	*Silt & Clay*	54.71

USCS Symbol ***ML, TESTED***

USCS Classification ***SANDY SILT***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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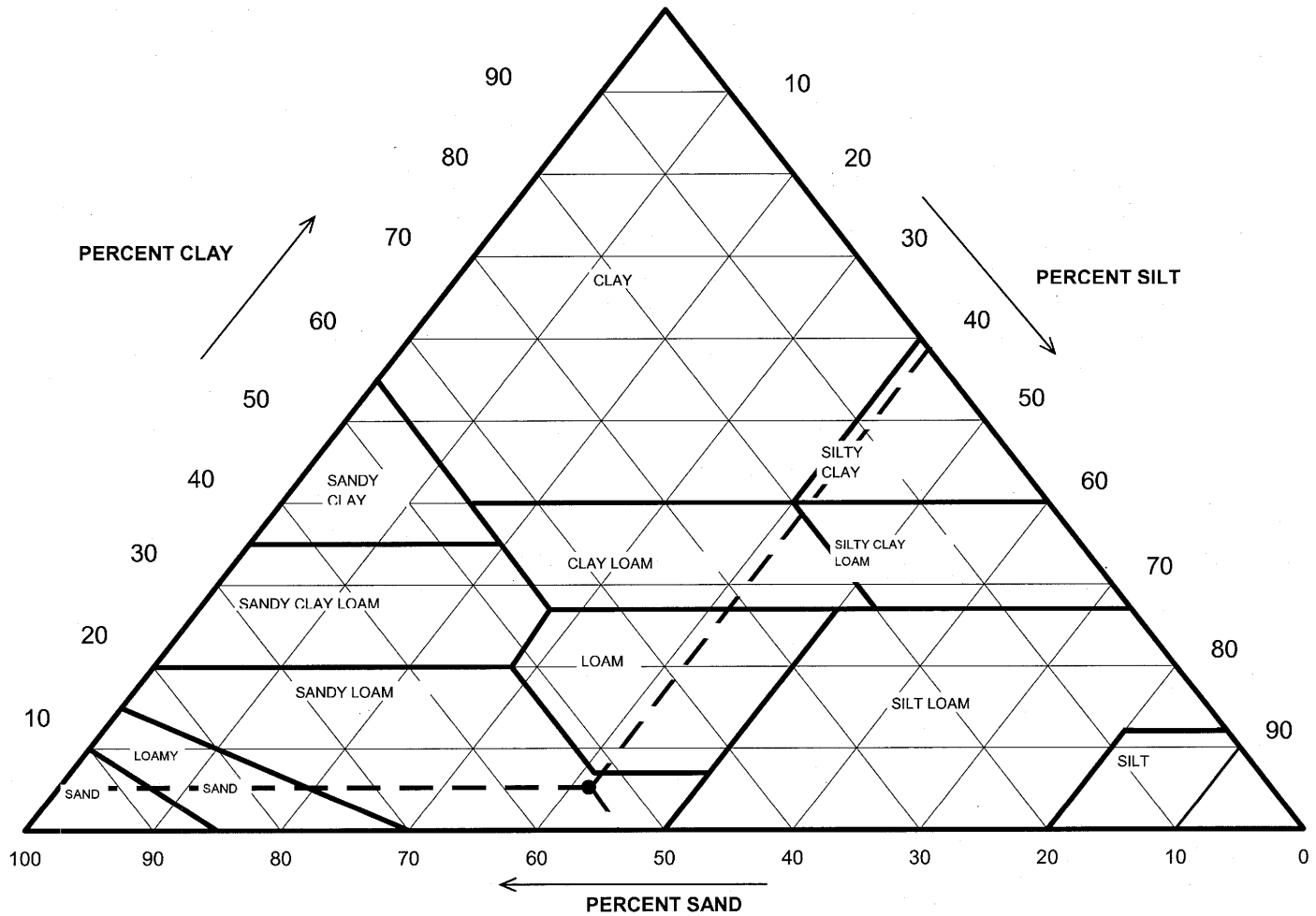
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-46
Client Reference	DAVIDSON CO. LF	Depth (ft)	27.5-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-01	Soil Color	GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	2.24	**0.00**
2	97.76	*Sand*	52.11	**53.31**
0.05	45.65	*Silt*	40.50	**41.43**
0.002	5.15	*Clay*	5.15	**5.27**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-01 SIEVEHYD10.xls]Sheet1

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-46
Client Reference	DAVIDSON CO. LF	Depth (ft)	27.5-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-01	Soil Color	**GRAY**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	E-2	Air Dried - #10 Hydrometer Material (gm)	100.02
Wgt.Tare + Wet Soil (gm)	32.71	Corrected Dry Wt. of - #10 Material (gm)	84.85
Wgt.Tare + Dry Soil (gm)	30.12		
Weight of Tare (gm)	15.63	Weight of - #200 Material (gm)	47.48
Weight of Water (gm)	2.59	Weight of - #10 ; + #200 Material (gm)	37.37
Weight of Dry Soil (gm)	14.49		
Moisture Content (%)	**17.9**	**J-FACTOR (%FINER THAN #10)**	**0.9776**
Soil Specimen Data			
Tare No.	833		
Wgt.Tare + Air Dry Soil (gm)	444.06		
Weight of Tare (gm)	259.35		
Air Dried Wgt. Total Sample (gm)	184.71	Dry Weight of Material Retained on #10 (gm)	3.52
Total Dry Sample Weight (gm)	157.23	Corrected Dry Sample Wt - #10 (gm)	153.71

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	1.48	0.9	0.9	99.1	**99.1**
#10	2.00	2.04	1.3	2.2	97.8	**97.8**
#20	0.85	0.67	0.8	0.8	99.2	**97.0**
#40	0.425	3.31	3.9	4.7	95.3	**93.2**
#60	0.250	7.92	9.3	14.0	86.0	**84.1**
#140	0.106	17.85	21.0	35.1	64.9	**63.5**
#200	0.075	7.62	9.0	44.0	56.0	**54.7**
Pan	-	47.48	56.0	100.0	-	**-**

Notes :

Tested By SD Date 12/8/2010 Checked By GEM Date 12-8-10

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-46
Client Reference	DAVIDSON CO. LF	Depth (ft)	27.5-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-01	Soil Color	**GRAY**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	35.0	23.6	5.25	29.8	34.7	0.01288	0.0296	**33.9**
5	29.0	23.6	5.25	23.8	27.7	0.01288	0.0196	**27.1**
15	22.0	23.6	5.25	16.8	19.5	0.01288	0.0118	**19.1**
30	18.0	23.7	5.20	12.8	14.9	0.01287	0.0086	**14.6**
60	16.0	23.7	5.20	10.8	12.6	0.01287	0.0061	**12.3**
250	11.0	23.5	5.29	5.7	6.7	0.01290	0.0031	**6.5**
1440	9.0	22.8	5.61	3.4	4.0	0.01300	0.0013	**3.9**

Soil Specimen Data		Other Corrections	
Wgt. of Dry Material (gm)	84.85	Hygroscopic Moisture Factor	0.848
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	97.76
		Specific Gravity	2.70 Assumed

Notes:

Tested By TMS Date 12/6/2010 Checked By GEM Date 12-8-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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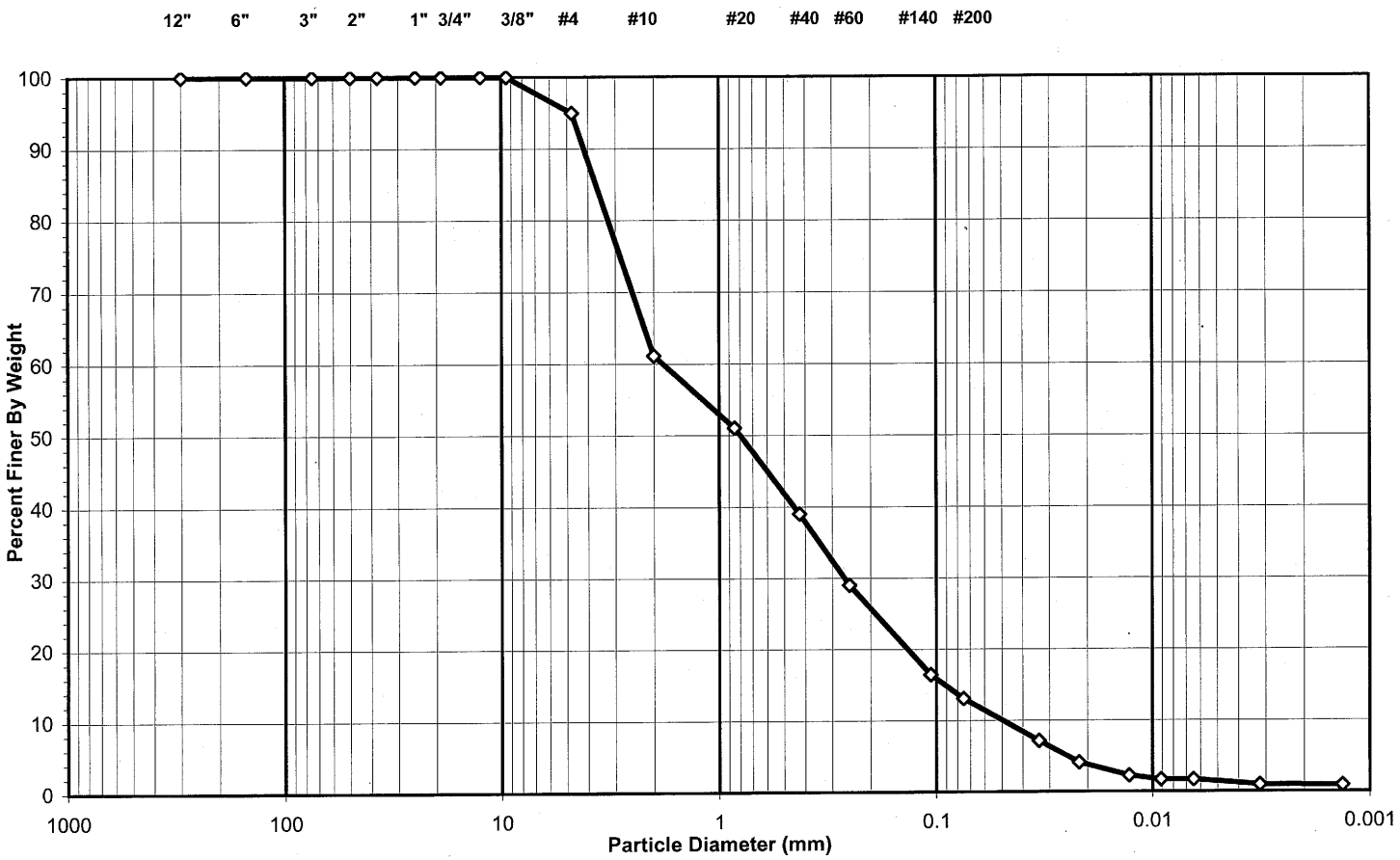
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-47
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-02	Soil Color	**GRAY**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	5.05
#4 To #200	*Sand*	81.89
Finer Than #200	*Silt & Clay*	13.05

USCS Symbol ***SC-SM, TESTED***

USCS Classification ***SILTY, CLAYEY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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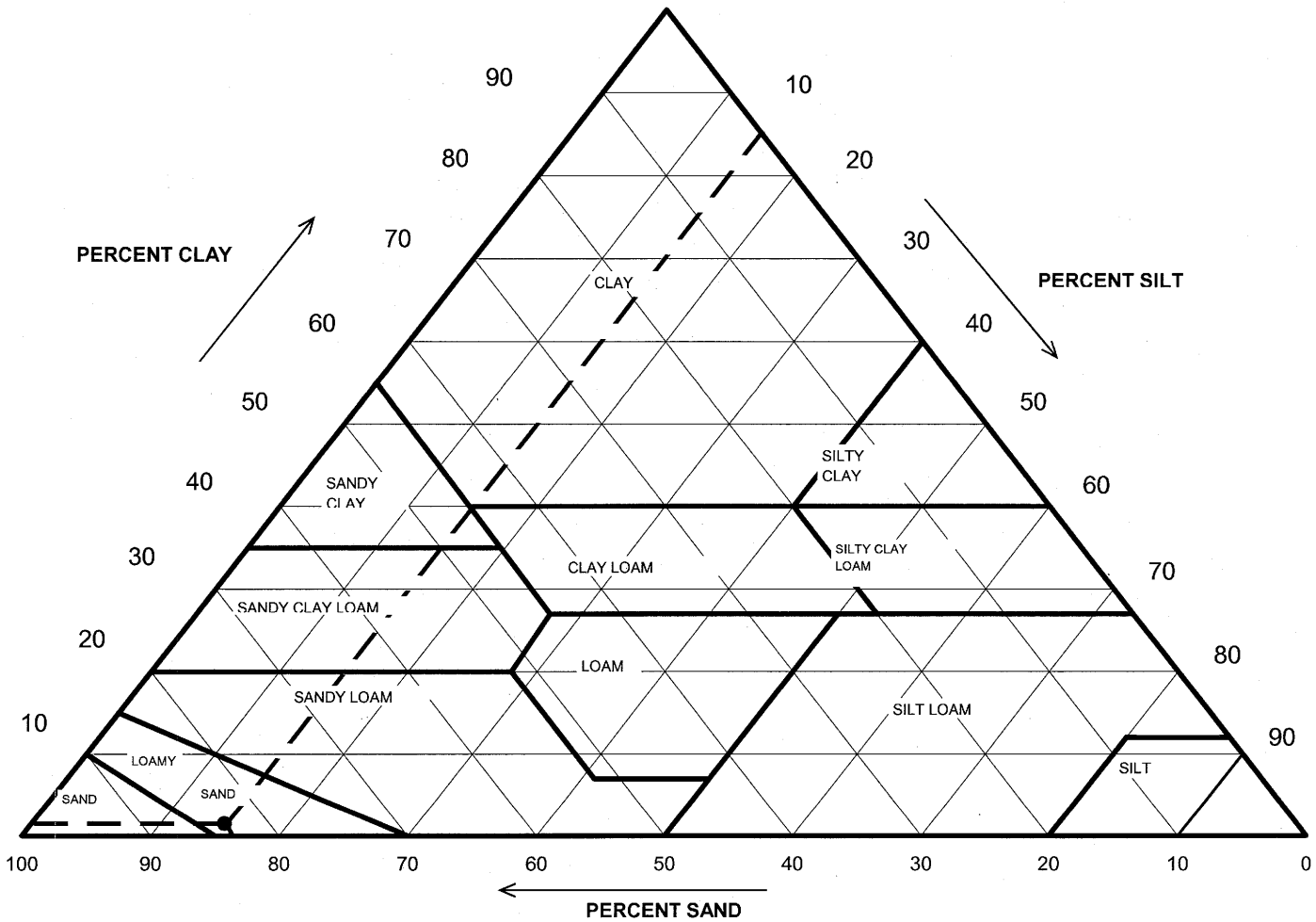
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-47
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-02	Soil Color	GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	38.84	**0.00**
2	61.16	*Sand*	51.08	**83.51**
0.05	10.08	*Silt*	9.18	**15.00**
0.002	0.91	*Clay*	0.91	**1.48**

USDA Classification: ***LOAMY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-47
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-02	Soil Color	**GRAY**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	R-1	Air Dried - #10 Hydrometer Material (gm)	100.00
Wgt.Tare + Wet Soil (gm)	45.93	Corrected Dry Wt. of - #10 Material (gm)	98.57
Wgt.Tare + Dry Soil (gm)	45.59		
Weight of Tare (gm)	22.08	Weight of - #200 Material (gm)	21.03
Weight of Water (gm)	0.34	Weight of - #10 ; + #200 Material (gm)	77.54
Weight of Dry Soil (gm)	23.51		
Moisture Content (%)	**1.4**	**J-FACTOR (%FINER THAN #10)**	**0.6116**
	Soil Specimen Data		
Tare No.	841		
Wgt.Tare + Air Dry Soil (gm)	369.12		
Weight of Tare (gm)	259.15		
Air Dried Wgt. Total Sample (gm)	109.97	Dry Weight of Material Retained on #10 (gm)	42.34
Total Dry Sample Weight (gm)	109.01	Corrected Dry Sample Wt - #10 (gm)	66.67

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	5.51	5.1	5.1	94.9	**94.9**
#10	2.00	36.83	33.8	38.8	61.2	**61.2**
#20	0.85	16.28	16.5	16.5	83.5	**51.1**
#40	0.425	19.46	19.7	36.3	63.7	**39.0**
#60	0.250	16.08	16.3	52.6	47.4	**29.0**
#140	0.106	20.27	20.6	73.1	26.9	**16.4**
#200	0.075	5.45	5.5	78.7	21.3	**13.1**
Pan	-	21.03	21.3	100.0	-	-

Notes :

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-47
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-02	Soil Color	**GRAY**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	17.0	23.4	5.34	11.7	11.7	0.01291	0.0336	**7.2**
5	12.0	23.4	5.34	6.7	6.7	0.01291	0.0219	**4.1**
15	9.0	23.4	5.34	3.7	3.7	0.01291	0.0128	**2.3**
30	8.0	23.5	5.29	2.7	2.7	0.01290	0.0091	**1.7**
60	8.0	23.5	5.29	2.7	2.7	0.01290	0.0064	**1.7**
250	7.0	23.1	5.47	1.5	1.5	0.01296	0.0032	**0.9**
1440	7.0	22.9	5.57	1.4	1.4	0.01299	0.0013	**0.9**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	98.57	Hygroscopic Moisture Factor	0.986
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	61.16
		Specific Gravity	2.70 Assumed

Notes:

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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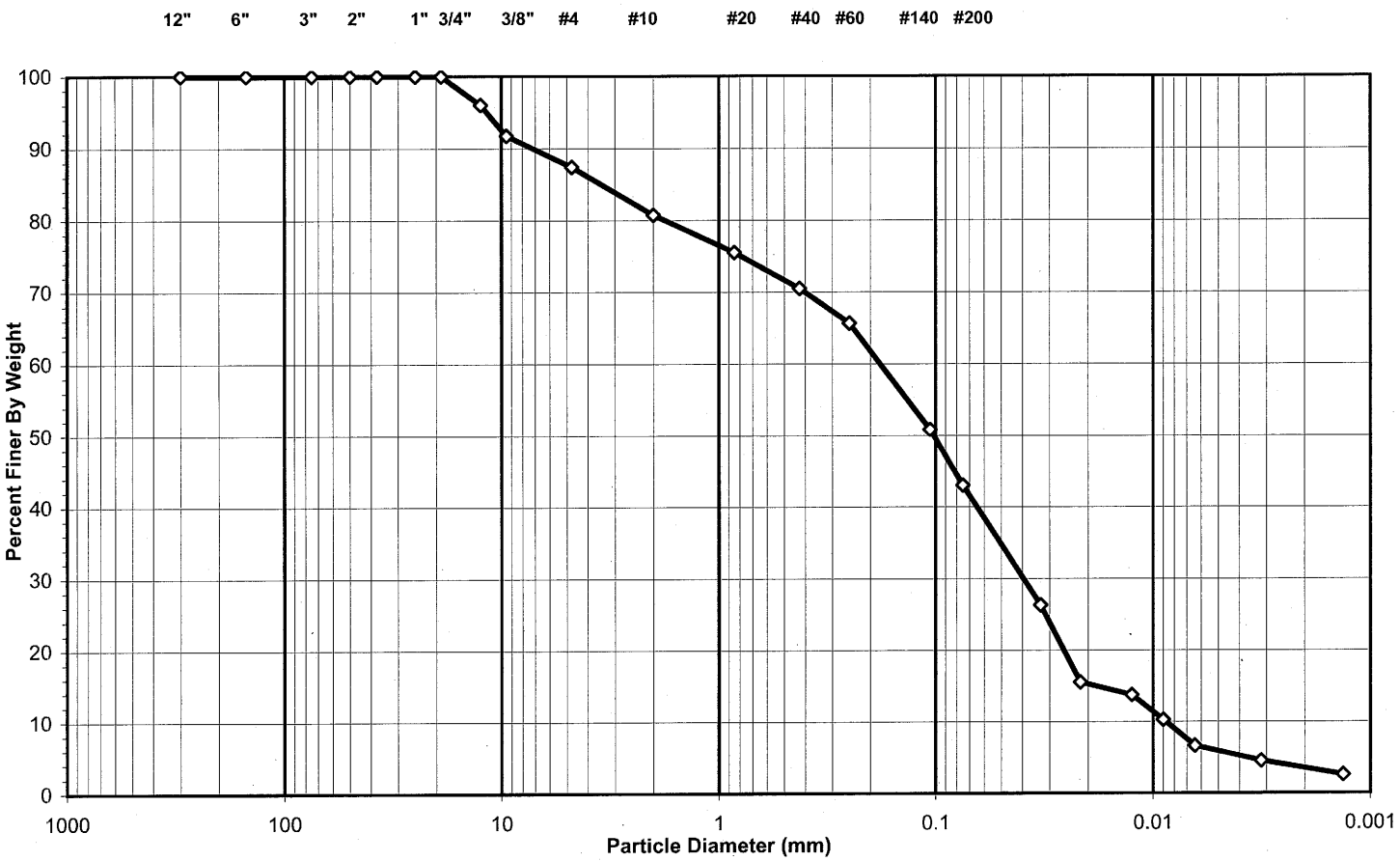
Client	R.S.G. & ASSOCIATES	Boring No.	PZ-48
Client Reference	DAVIDSON CO. LF	Depth (ft)	25.0-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-03	Soil Color	**BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	12.57
#4 To #200	*Sand*	44.42
Finer Than #200	*Silt & Clay*	43.01

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-03 SIEVEHYD10.xls]Sheet1

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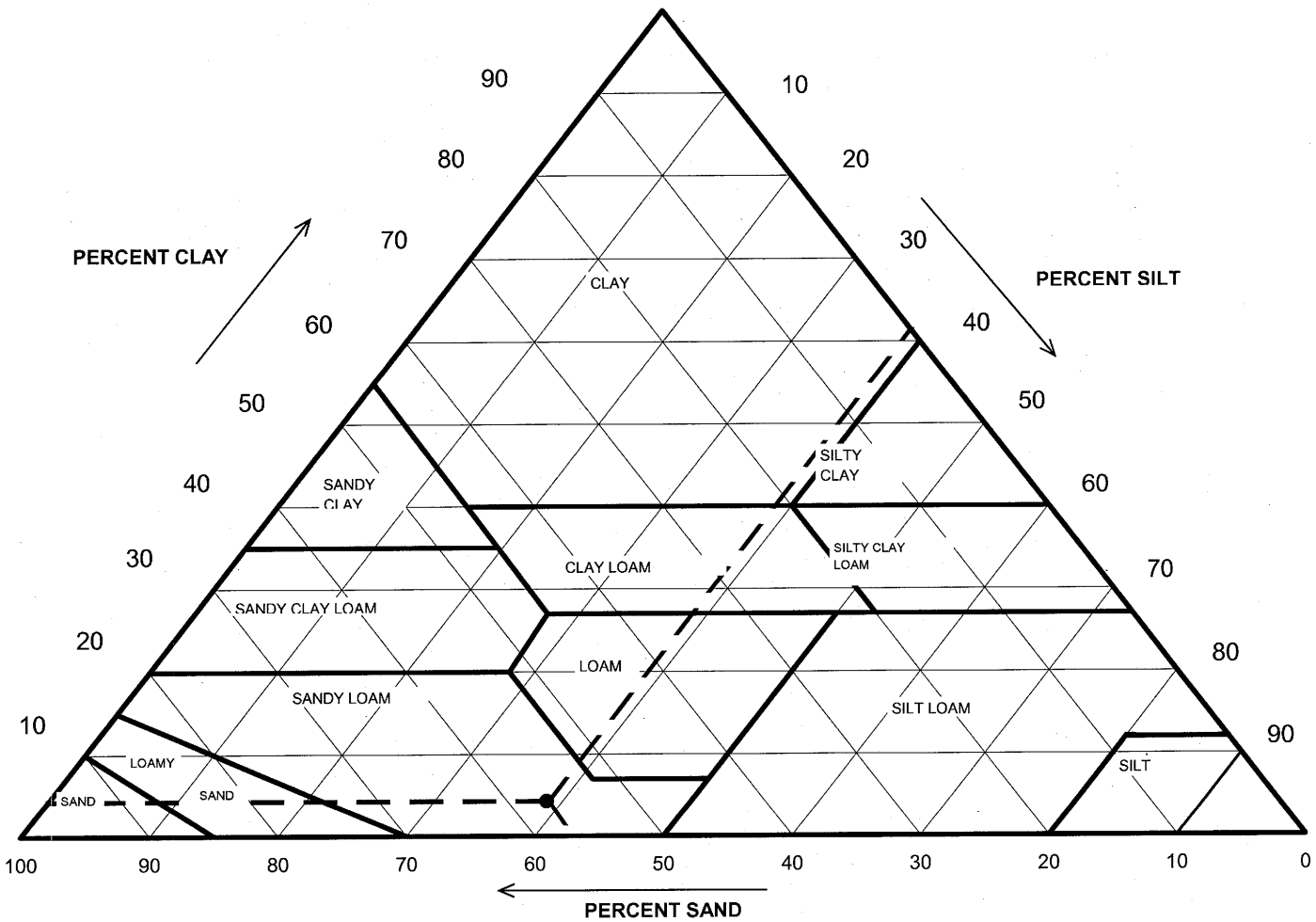
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-48
Client Reference	DAVIDSON CO. LF	Depth (ft)	25.0-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-03	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	19.26	**0.00**
2	80.74	*Sand*	45.98	**56.94**
0.05	34.77	*Silt*	31.28	**38.74**
0.002	3.49	*Clay*	3.49	**4.32**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-48
Client Reference	DAVIDSON CO. LF	Depth (ft)	25.0-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-03	Soil Color	**BROWN**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	M-1	Air Dried - #10 Hydrometer Material (gm)	50.00
Wgt.Tare + Wet Soil (gm)	43.12	Corrected Dry Wt. of - #10 Material (gm)	44.59
Wgt.Tare + Dry Soil (gm)	40.18		
Weight of Tare (gm)	15.93	Weight of - #200 Material (gm)	23.75
Weight of Water (gm)	2.94	Weight of - #10 ; + #200 Material (gm)	20.84
Weight of Dry Soil (gm)	24.25		
Moisture Content (%)	**12.1**	**J-FACTOR (%FINER THAN #10)**	**0.8074**
Soil Specimen Data			
Tare No.	202		
Wgt.Tare + Air Dry Soil (gm)	669.50		
Weight of Tare (gm)	197.39		
Air Dried Wgt. Total Sample (gm)	472.11	Dry Weight of Material Retained on #10 (gm)	82.81
Total Dry Sample Weight (gm)	430.02	Corrected Dry Sample Wt - #10 (gm)	347.21

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	16.98	3.9	3.9	96.1	**96.1**
3/8"	9.50	18.48	4.3	8.2	91.8	**91.8**
#4	4.75	18.61	4.3	12.6	87.4	**87.4**
#10	2.00	28.74	6.7	19.3	80.7	**80.7**
#20	0.85	2.89	6.5	6.5	93.5	**75.5**
#40	0.425	2.77	6.2	12.7	87.3	**70.5**
#60	0.250	2.66	6.0	18.7	81.3	**65.7**
#140	0.106	8.20	18.4	37.0	63.0	**50.8**
#200	0.075	4.32	9.7	46.7	53.3	**43.0**
Pan	-	23.75	53.3	100.0	-	**-**

Notes :

Tested By SD Date 12/9/2010 Checked By GEM Date 12-9-10

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-48
Client Reference	DAVIDSON CO. LF	Depth (ft)	25.0-30.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-03	Soil Color	**BROWN**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	20.0	23.4	5.34	14.7	32.6	0.01291	0.0329	**26.3**
5	14.0	23.4	5.34	8.7	19.2	0.01291	0.0216	**15.5**
15	13.0	23.4	5.34	7.7	17.0	0.01291	0.0125	**13.7**
30	11.0	23.5	5.29	5.7	12.7	0.01290	0.0090	**10.2**
60	9.0	23.5	5.29	3.7	8.2	0.01290	0.0064	**6.6**
250	8.0	23.1	5.47	2.5	5.6	0.01296	0.0032	**4.5**
1440	7.0	22.9	5.57	1.4	3.2	0.01299	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	44.59	Hygroscopic Moisture Factor	0.892
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	80.74
		Specific Gravity	2.70 Assumed

Notes:

Tested By JBD Date 12/7/2010 Checked By GEM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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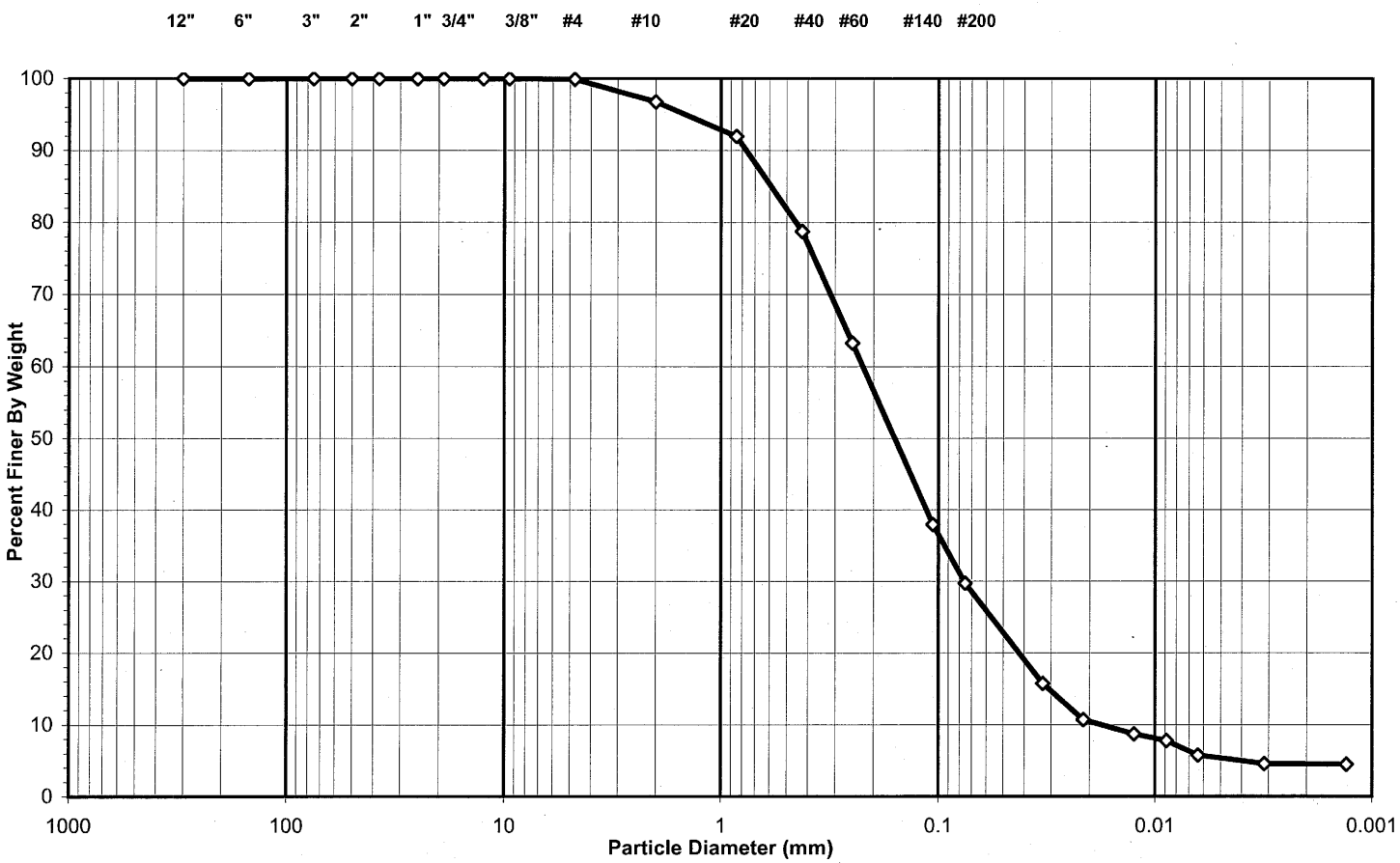
Client	R.S.G. & ASSOCIATES	Boring No.	PZ-51
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-14.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-04	Soil Color	**GRAY BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.09
#4 To #200	*Sand*	70.24
Finer Than #200	*Silt & Clay*	29.68

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-04 SIEVEHYD10.xls]Sheet1

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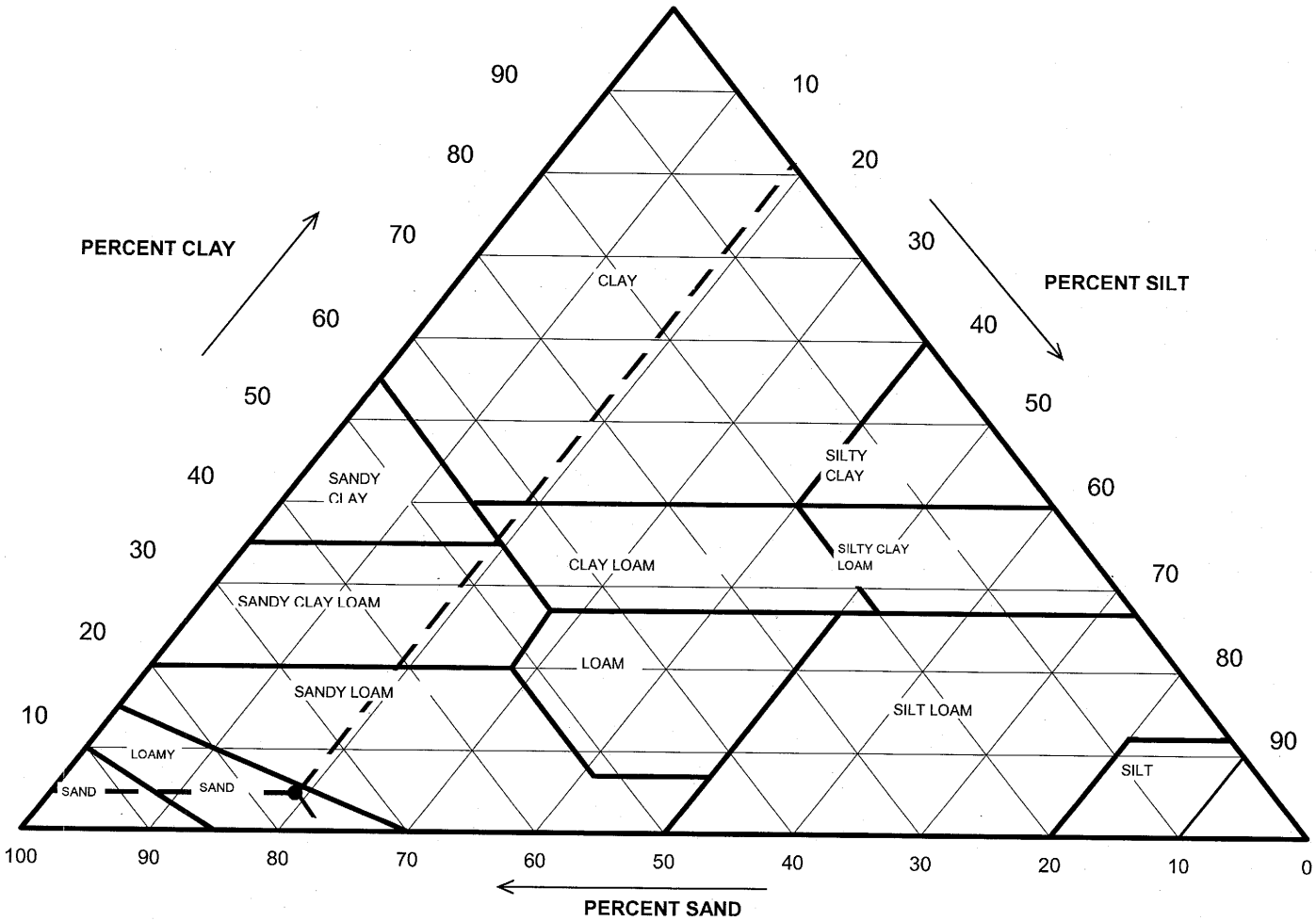
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-51
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-14.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-04	Soil Color	GRAY BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	3.23	**0.00**
2	96.77	*Sand*	73.92	**76.39**
0.05	22.85	*Silt*	18.35	**18.97**
0.002	4.49	*Clay*	4.49	**4.64**

USDA Classification: ***LOAMY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-04 SIEVEHYD10.xls]Sheet1

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-51
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-14.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-04	Soil Color	**GRAY BROWN**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	S-1	Air Dried - #10 Hydrometer Material (gm)	100.03
Wgt.Tare + Wet Soil (gm)	37.72	Corrected Dry Wt. of - #10 Material (gm)	95.47
Wgt.Tare + Dry Soil (gm)	36.71		
Weight of Tare (gm)	15.58	Weight of - #200 Material (gm)	29.28
Weight of Water (gm)	1.01	Weight of - #10 ; + #200 Material (gm)	66.19
Weight of Dry Soil (gm)	21.13		
Moisture Content (%)	**4.8**	**J-FACTOR (%FINER THAN #10)**	**0.9677**
	Soil Specimen Data		
Tare No.	832		
Wgt.Tare + Air Dry Soil (gm)	536.64		
Weight of Tare (gm)	259.10		
Air Dried Wgt. Total Sample (gm)	277.54	Dry Weight of Material Retained on #10 (gm)	8.58
Total Dry Sample Weight (gm)	265.27	Corrected Dry Sample Wt - #10 (gm)	256.69

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.23	0.1	0.1	99.9	**99.9**
#10	2.00	8.35	3.1	3.2	96.8	**96.8**
#20	0.85	4.77	5.0	5.0	95.0	**91.9**
#40	0.425	12.98	13.6	18.6	81.4	**78.8**
#60	0.250	15.31	16.0	34.6	65.4	**63.3**
#140	0.106	24.99	26.2	60.8	39.2	**37.9**
#200	0.075	8.14	8.5	69.3	30.7	**29.7**
Pan	-	29.28	30.7	100.0	-	-

Notes :

Tested By SD Date 12/9/2010 Checked By GEM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-04 SIEVEHYD10.xls]Sheet1

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-51
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-14.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-04	Soil Color	**GRAY BROWN**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	21.0	23.4	5.34	15.7	16.2	0.01291	0.0327	**15.7**
5	16.0	23.4	5.34	10.7	11.1	0.01291	0.0214	**10.7**
15	14.0	23.4	5.34	8.7	9.0	0.01291	0.0125	**8.7**
30	13.0	23.5	5.29	7.7	8.0	0.01290	0.0089	**7.7**
60	11.0	23.5	5.29	5.7	5.9	0.01290	0.0063	**5.7**
250	10.0	23.1	5.47	4.5	4.7	0.01296	0.0031	**4.5**
1440	10.0	22.9	5.57	4.4	4.6	0.01299	0.0013	**4.5**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	95.47	Hygroscopic Moisture Factor	0.954
Weight of Deflocculant (gm)	5.0		
		a - Factor	0.99
		Percent Finer than # 10	96.77
		Specific Gravity	2.70 Assumed

Notes:

Tested By JBD Date 12/7/2010 Checked By GEM Date 12-9-10

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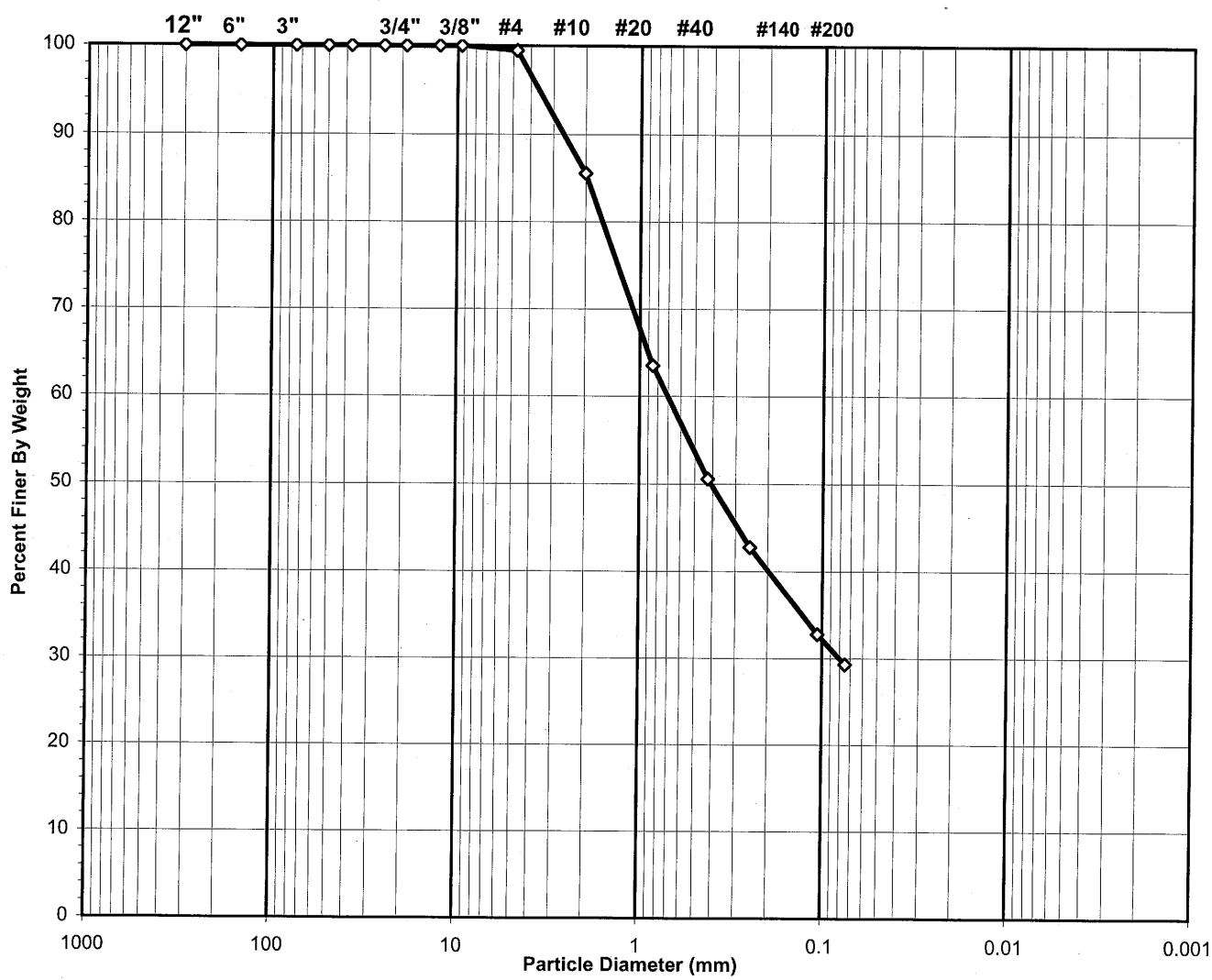
SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-52
Client Reference	DAVIDSON CO. LF.	Depth (ft)	20.0-22.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-05	Soil Color	**BROWN/TAN**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***SC, TESTED***

USCS Classification ***CLAYEY SAND***

Tested By TMS Date 12/3/2010 Checked By GEM Date 12-8-10

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-05 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-52
Client Reference	DAVIDSON CO. LF.	Depth (ft)	20.0-22.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-05	Soil Color	**BROWN/TAN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	842	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	962.37	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	925.51	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	255.85	Weight of Tare (gm)	NA
Weight of Water (gm)	36.86	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	669.66	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**5.5**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	669.66
Dry Weight - 3/4" Sample (gm)	473.5	Weight of minus #200 material (gm)	196.13
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	473.53
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	3.62	0.5	0.5	99.5	**99.5**
#10	2.00	93.28	13.9	14.5	85.5	**85.5**
#20	0.850	147.53	22.0	36.5	63.5	**63.5**
#40	0.425	86.58	12.9	49.4	50.6	**50.6**
#60	0.250	52.41	7.8	57.3	42.7	**42.7**
#140	0.106	67.06	10.0	67.3	32.7	**32.7**
#200	0.075	23.05	3.4	70.7	29.3	**29.3**
Pan	-	196.13	29.3	100.0	-	**-**

Tested By TMS Date 12/3/2010 Checked By GEM Date 12-8-10

DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-05 SIEVON REV 4.XLS]Sheet1*

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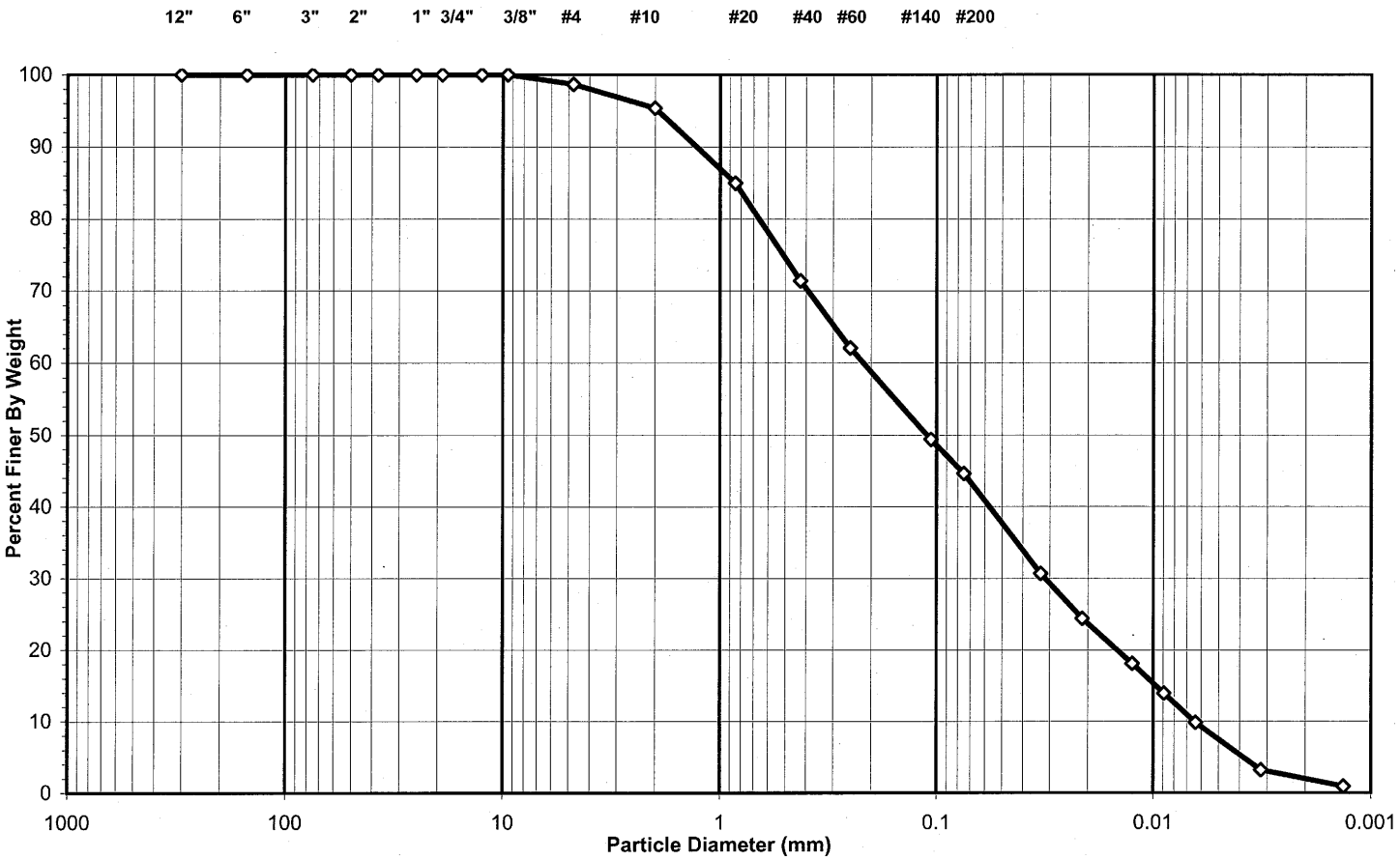
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-53
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-06	Soil Color	**BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	1.34
#4 To #200	*Sand*	54.07
Finer Than #200	*Silt & Clay*	44.59

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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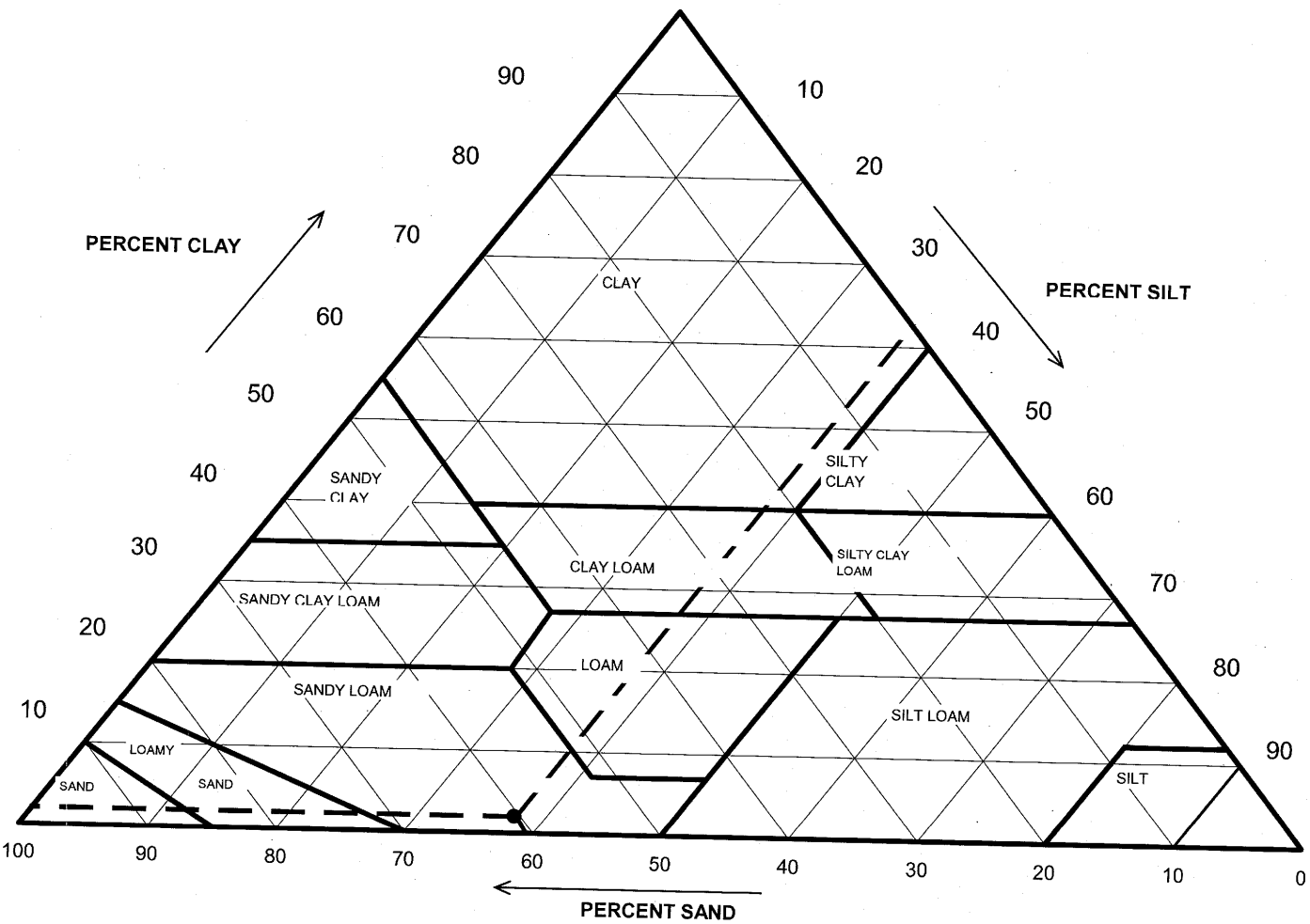
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-53
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-06	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.63	**0.00**
2	95.37	*Sand*	57.65	**60.45**
0.05	37.72	*Silt*	35.76	**37.49**
0.002	1.96	*Clay*	1.96	**2.06**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-53
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-06	Soil Color	**BROWN**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	C-2	Air Dried - #10 Hydrometer Material (gm)	50.02
Wgt.Tare + Wet Soil (gm)	35.05	Corrected Dry Wt. of - #10 Material (gm)	45.17
Wgt.Tare + Dry Soil (gm)	33.17		
Weight of Tare (gm)	15.67	Weight of - #200 Material (gm)	21.12
Weight of Water (gm)	1.88	Weight of - #10 ; + #200 Material (gm)	24.05
Weight of Dry Soil (gm)	17.50		
Moisture Content (%)	**10.7**	**J-FACTOR (%FINER THAN #10)**	**0.9537**
	Soil Specimen Data		
Tare No.	836		
Wgt.Tare + Air Dry Soil (gm)	706.94		
Weight of Tare (gm)	260.35		
Air Dried Wgt. Total Sample (gm)	446.59	Dry Weight of Material Retained on #10 (gm)	18.77
Total Dry Sample Weight (gm)	405.09	Corrected Dry Sample Wt - #10 (gm)	386.32

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	5.43	1.3	1.3	98.7	**98.7**
#10	2.00	13.34	3.3	4.6	95.4	**95.4**
#20	0.85	4.92	10.9	10.9	89.1	**85.0**
#40	0.425	6.44	14.3	25.2	74.8	**71.4**
#60	0.250	4.42	9.8	34.9	65.1	**62.0**
#140	0.106	6.00	13.3	48.2	51.8	**49.4**
#200	0.075	2.27	5.0	53.2	46.8	**44.6**
Pan	-	21.12	46.8	100.0	-	**-**

Notes :

Tested By SD Date 12/9/2010 Checked By GEM Date 12-9-10

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-53
Client Reference	DAVIDSON CO. LF	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-06	Soil Color	**BROWN**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	20.0	23.4	5.34	14.7	32.1	0.01291	0.0329	**30.7**
5	17.0	23.4	5.34	11.7	25.6	0.01291	0.0212	**24.4**
15	14.0	23.4	5.34	8.7	19.0	0.01291	0.0125	**18.1**
30	12.0	23.4	5.34	6.7	14.6	0.01291	0.0089	**13.9**
60	10.0	23.5	5.29	4.7	10.3	0.01290	0.0064	**9.8**
250	7.0	23.1	5.47	1.5	3.3	0.01296	0.0032	**3.2**
1440	6.0	22.9	5.57	0.4	1.0	0.01299	0.0013	**0.9**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	45.17	Hygroscopic Moisture Factor	0.903
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	95.37
		Specific Gravity	2.70 Assumed

Notes:

Tested By JBD Date 12/7/2010 Checked By GEM Date 12-9-10

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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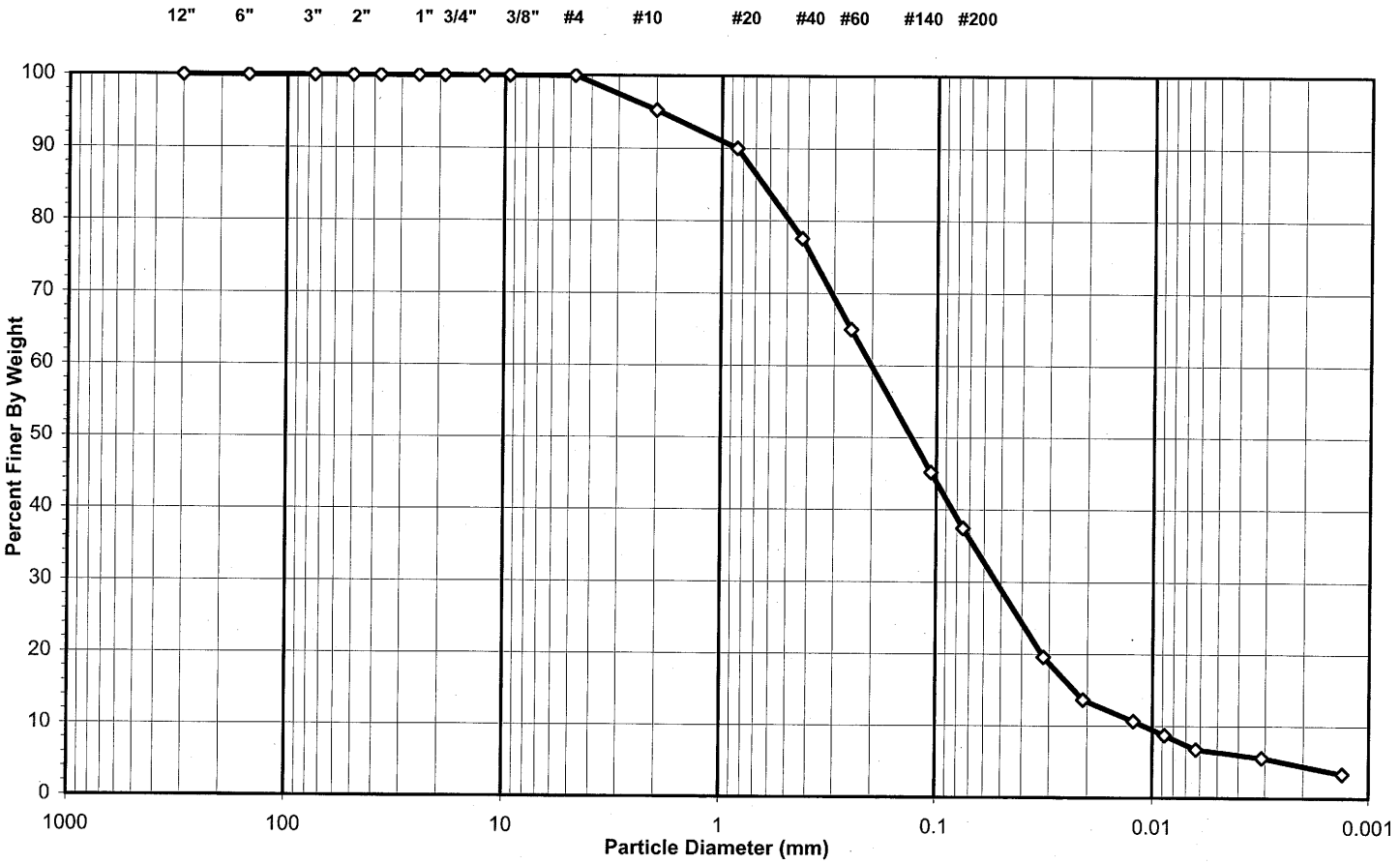
Client	R.S.G. & ASSOCIATES	Boring No.	PZ-54
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-13.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-07	Soil Color	**BROWN TAN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	62.62
Finer Than #200	*Silt & Clay*	37.38

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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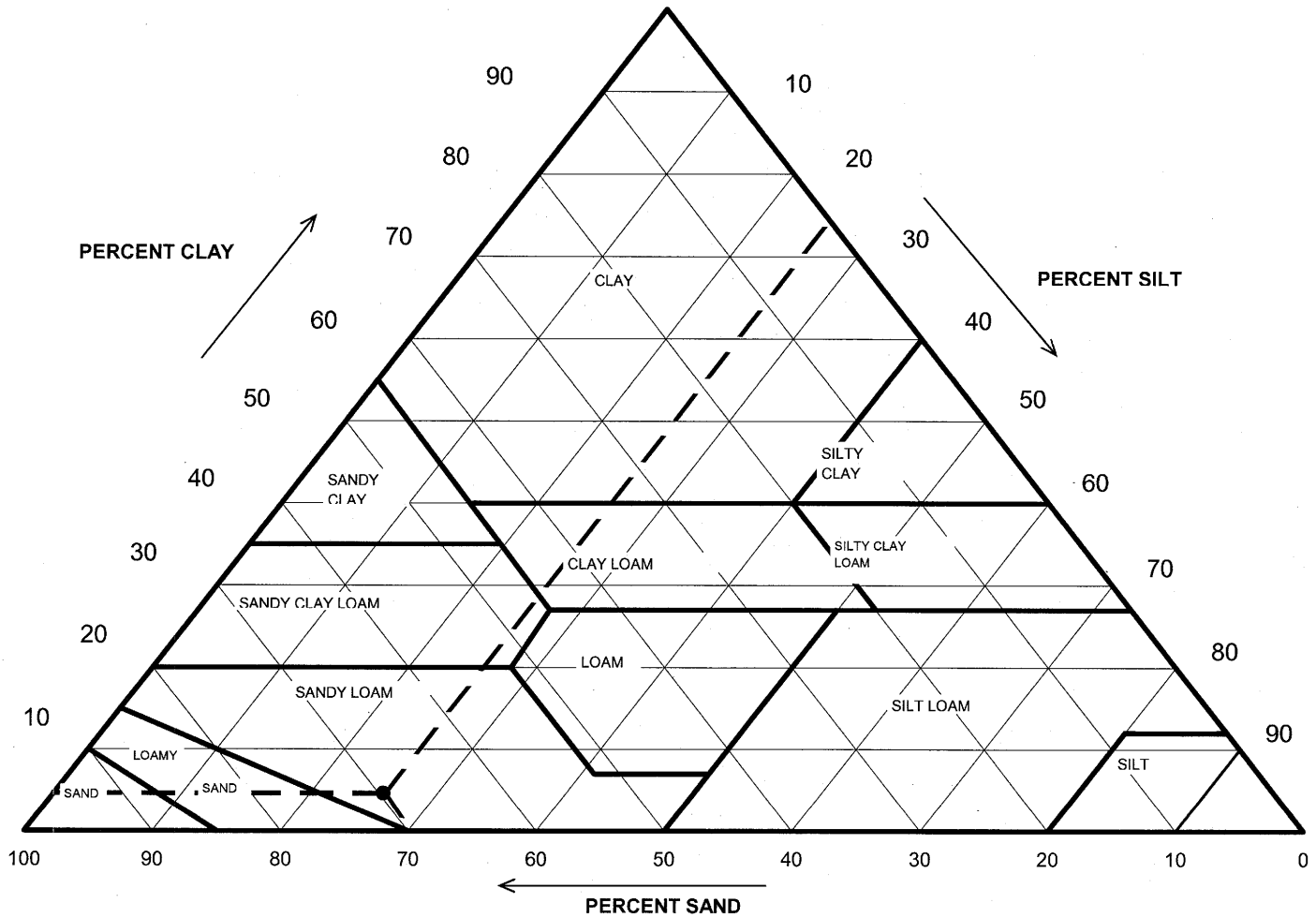
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-54
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-13.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-07	Soil Color	BROWN TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.74	**0.00**
2	95.26	*Sand*	66.32	**69.62**
0.05	28.95	*Silt*	24.52	**25.74**
0.002	4.42	*Clay*	4.42	**4.64**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-07 SIEVEHYD10.xls]Sheet1

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-54
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-13.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-07	Soil Color	**BROWN TAN**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	P-1	Air Dried - #10 Hydrometer Material (gm)	100.00
Wgt.Tare + Wet Soil (gm)	50.29	Corrected Dry Wt. of - #10 Material (gm)	95.34
Wgt.Tare + Dry Soil (gm)	48.68		
Weight of Tare (gm)	15.77	Weight of - #200 Material (gm)	37.41
Weight of Water (gm)	1.61	Weight of - #10 ; + #200 Material (gm)	57.93
Weight of Dry Soil (gm)	32.91		
Moisture Content (%)	**4.9**	**J-FACTOR (%FINER THAN #10)**	**0.9526**
	Soil Specimen Data		
Tare No.	829		
Wgt.Tare + Air Dry Soil (gm)	404.55		
Weight of Tare (gm)	261.58		
Air Dried Wgt. Total Sample (gm)	142.97	Dry Weight of Material Retained on #10 (gm)	6.47
Total Dry Sample Weight (gm)	136.60	Corrected Dry Sample Wt - #10 (gm)	130.13

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	6.47	4.7	4.7	95.3	**95.3**
#20	0.85	5.25	5.5	5.5	94.5	**90.0**
#40	0.425	12.48	13.1	18.6	81.4	**77.5**
#60	0.250	12.56	13.2	31.8	68.2	**65.0**
#140	0.106	19.88	20.9	52.6	47.4	**45.1**
#200	0.075	7.76	8.1	60.8	39.2	**37.4**
Pan	-	37.41	39.2	100.0	-	**-**

Notes :

Tested By SD Date 12/8/2010 Checked By GEM Date 12-8-10

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-54
Client Reference	DAVIDSON CO. LF	Depth (ft)	10.0-13.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-07	Soil Color	**BROWN TAN**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	25.0	23.6	5.25	19.8	20.5	0.01288	0.0318	**19.5**
5	19.0	23.6	5.25	13.8	14.3	0.01288	0.0209	**13.6**
15	16.0	23.6	5.25	10.8	11.2	0.01288	0.0123	**10.6**
30	14.0	23.7	5.20	8.8	9.1	0.01287	0.0088	**8.7**
60	12.0	23.7	5.20	6.8	7.1	0.01287	0.0063	**6.7**
250	11.0	23.3	5.38	5.6	5.8	0.01293	0.0031	**5.6**
1440	9.0	22.8	5.61	3.4	3.5	0.01300	0.0013	**3.4**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	95.34	Hygroscopic Moisture Factor	0.953
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	95.26
		Specific Gravity	2.70 Assumed

Notes:

Tested By TMS Date 12/6/2010 Checked By GDM Date 12-8-10

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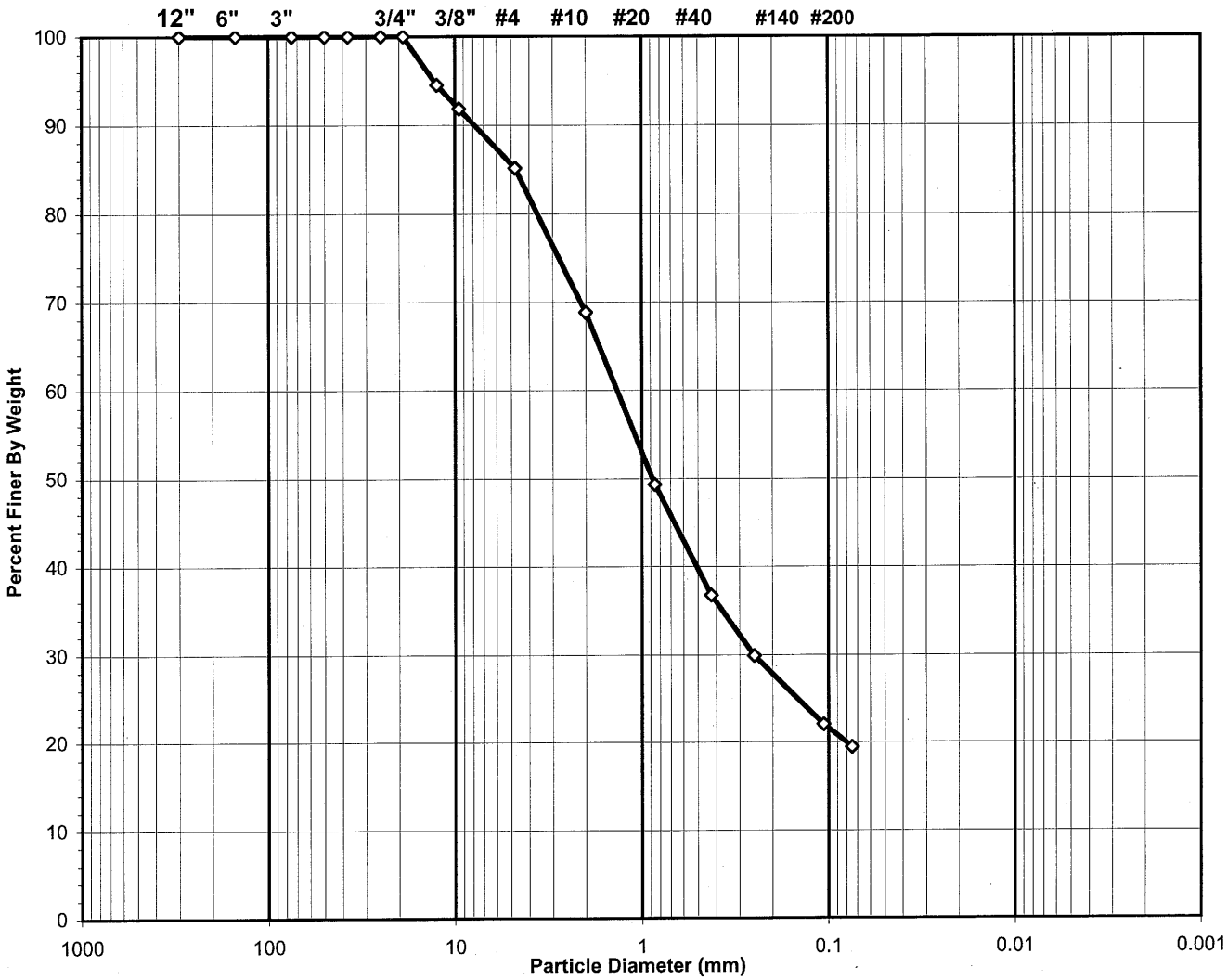
SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-55
Client Reference	DAVIDSON CO. LF.	Depth (ft)	5.0-6.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-08	Soil Color	**BROWN**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***SC-SM, TESTED***

USCS Classification ***SILTY, CLAYEY SAND***

Tested By TMS Date 12/3/2010 Checked By TBD Date 12-6-10

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-08 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-55
Client Reference	DAVIDSON CO. LF.	Depth (ft)	5.0-6.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-08	Soil Color	**BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	215	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	454.56	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	428.88	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	172.30	Weight of Tare (gm)	NA
Weight of Water (gm)	25.68	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	256.58	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**10.0**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	256.58
Dry Weight - 3/4" Sample (gm)	206.8	Weight of minus #200 material (gm)	49.81
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	206.77
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	14.03	5.5	5.5	94.5	**94.5**
3/8"	9.50	6.90	2.7	8.2	91.8	**91.8**
#4	4.75	17.23	6.7	14.9	85.1	**85.1**
#10	2.00	41.90	16.3	31.2	68.8	**68.8**
#20	0.850	50.00	19.5	50.7	49.3	**49.3**
#40	0.425	32.24	12.6	63.3	36.7	**36.7**
#60	0.250	17.59	6.9	70.1	29.9	**29.9**
#140	0.106	20.22	7.9	78.0	22.0	**22.0**
#200	0.075	6.66	2.6	80.6	19.4	**19.4**
Pan	-	49.81	19.4	100.0	-	**-**

Tested By TMS Date 12/3/2010 Checked By JBO Date 12-6-10

DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-08 SIEVON REV 4.XLS]Sheet1*

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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Client	R.S.G. & ASSOCIATES	Boring No.	PZ-56
Client Reference	DAVIDSON CO. LF	Depth (ft)	7.5-9.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-09	Soil Color	**GRAY**

	SIEVE ANALYSIS				HYDROMETER	
USCS	cobbles	gravel	sand		silt and clay fraction	
USDA	cobbles	gravel	sand		silt	clay

USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.64
#4 To #200	*Sand*	63.68
Finer Than #200	*Silt & Clay*	35.69

USCS Symbol ***SM, TESTED (NON PLASTIC FINES)***

USCS Classification ***SILTY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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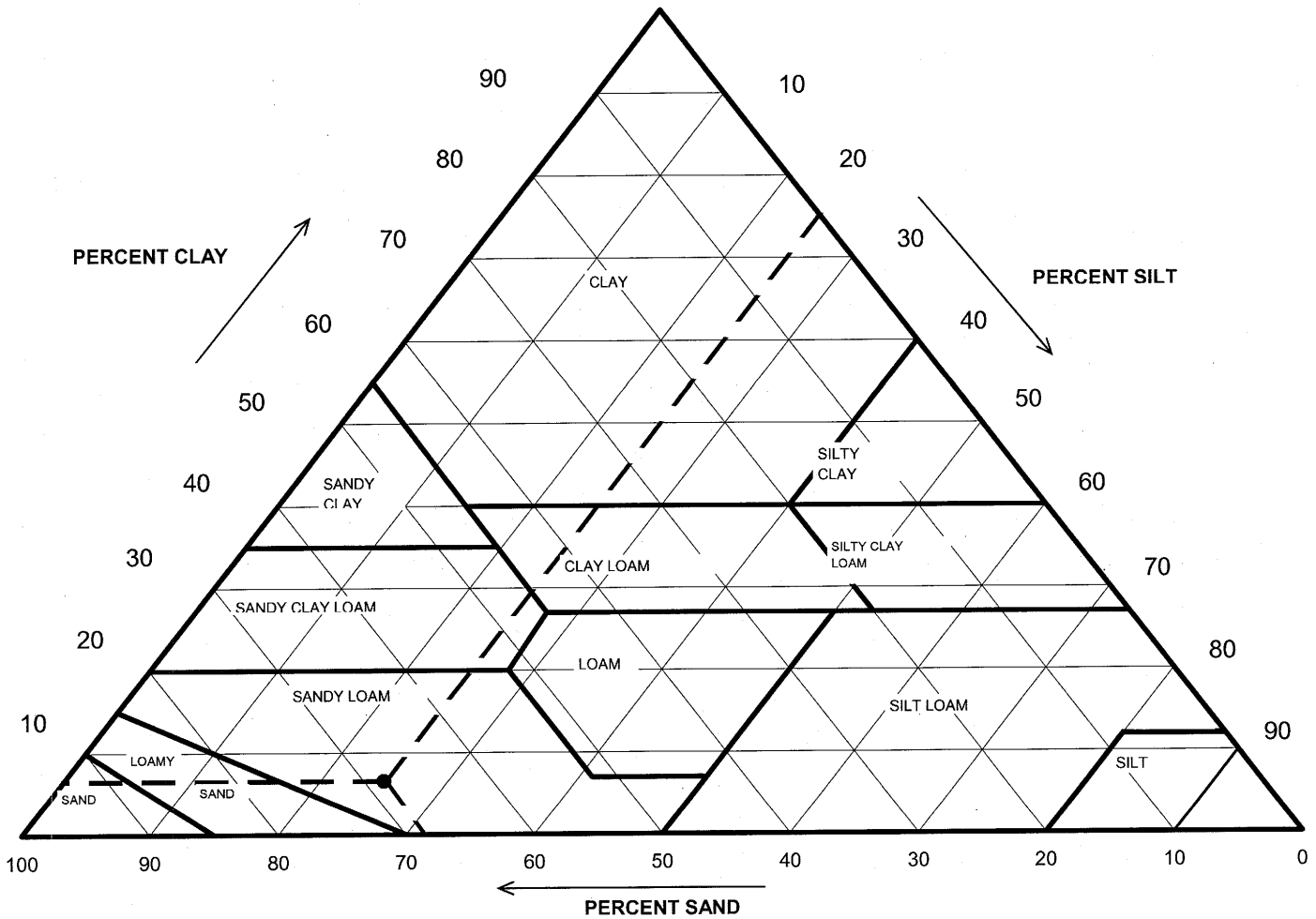
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-56
Client Reference	DAVIDSON CO. LF	Depth (ft)	7.5-9.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-09	Soil Color	GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	13.37	**0.00**
2	86.63	*Sand*	59.26	**68.41**
0.05	27.36	*Silt*	21.66	**25.01**
0.002	5.70	*Clay*	5.70	**6.58**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-56
Client Reference	DAVIDSON CO. LF	Depth (ft)	7.5-9.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-09	Soil Color	**GRAY**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	E-1	Air Dried - #10 Hydrometer Material (gm)	100.02
Wgt.Tare + Wet Soil (gm)	45.55	Corrected Dry Wt. of - #10 Material (gm)	98.48
Wgt.Tare + Dry Soil (gm)	45.19		
Weight of Tare (gm)	22.20	Weight of - #200 Material (gm)	40.57
Weight of Water (gm)	0.36	Weight of - #10 ; + #200 Material (gm)	57.91
Weight of Dry Soil (gm)	22.99		
Moisture Content (%)	**1.6**	**J-FACTOR (%FINER THAN #10)**	**0.8663**
	Soil Specimen Data		
Tare No.	842		
Wgt.Tare + Air Dry Soil (gm)	599.43		
Weight of Tare (gm)	255.84		
Air Dried Wgt. Total Sample (gm)	343.59	Dry Weight of Material Retained on #10 (gm)	45.34
Total Dry Sample Weight (gm)	338.99	Corrected Dry Sample Wt - #10 (gm)	293.65

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	2.16	0.6	0.6	99.4	**99.4**
#10	2.00	43.18	12.7	13.4	86.6	**86.6**
#20	0.85	11.61	11.8	11.8	88.2	**76.4**
#40	0.425	11.53	11.7	23.5	76.5	**66.3**
#60	0.250	8.97	9.1	32.6	67.4	**58.4**
#140	0.106	17.72	18.0	50.6	49.4	**42.8**
#200	0.075	8.08	8.2	58.8	41.2	**35.7**
Pan	-	40.57	41.2	100.0	-	**-**

Notes :

Tested By SD Date 12/8/2010 Checked By GM Date 12-8-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-56
Client Reference	DAVIDSON CO. LF	Depth (ft)	7.5-9.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-09	Soil Color	**GRAY**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	23.4	5.34	20.7	20.8	0.01291	0.0317	**18.0**
5	23.0	23.4	5.34	17.7	17.8	0.01291	0.0204	**15.4**
15	18.0	23.5	5.29	12.7	12.8	0.01290	0.0122	**11.1**
30	16.0	23.6	5.25	10.8	10.8	0.01288	0.0087	**9.4**
60	14.0	23.7	5.20	8.8	8.8	0.01287	0.0062	**7.7**
250	12.0	23.5	5.29	6.7	6.7	0.01290	0.0031	**5.8**
1440	12.0	22.8	5.61	6.4	6.4	0.01300	0.0013	**5.6**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	98.48	Hygroscopic Moisture Factor	0.985
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	86.63
		Specific Gravity	2.70 Assumed

Notes:

Tested By TMS Date 12/6/2010 Checked By GEM Date 12-8-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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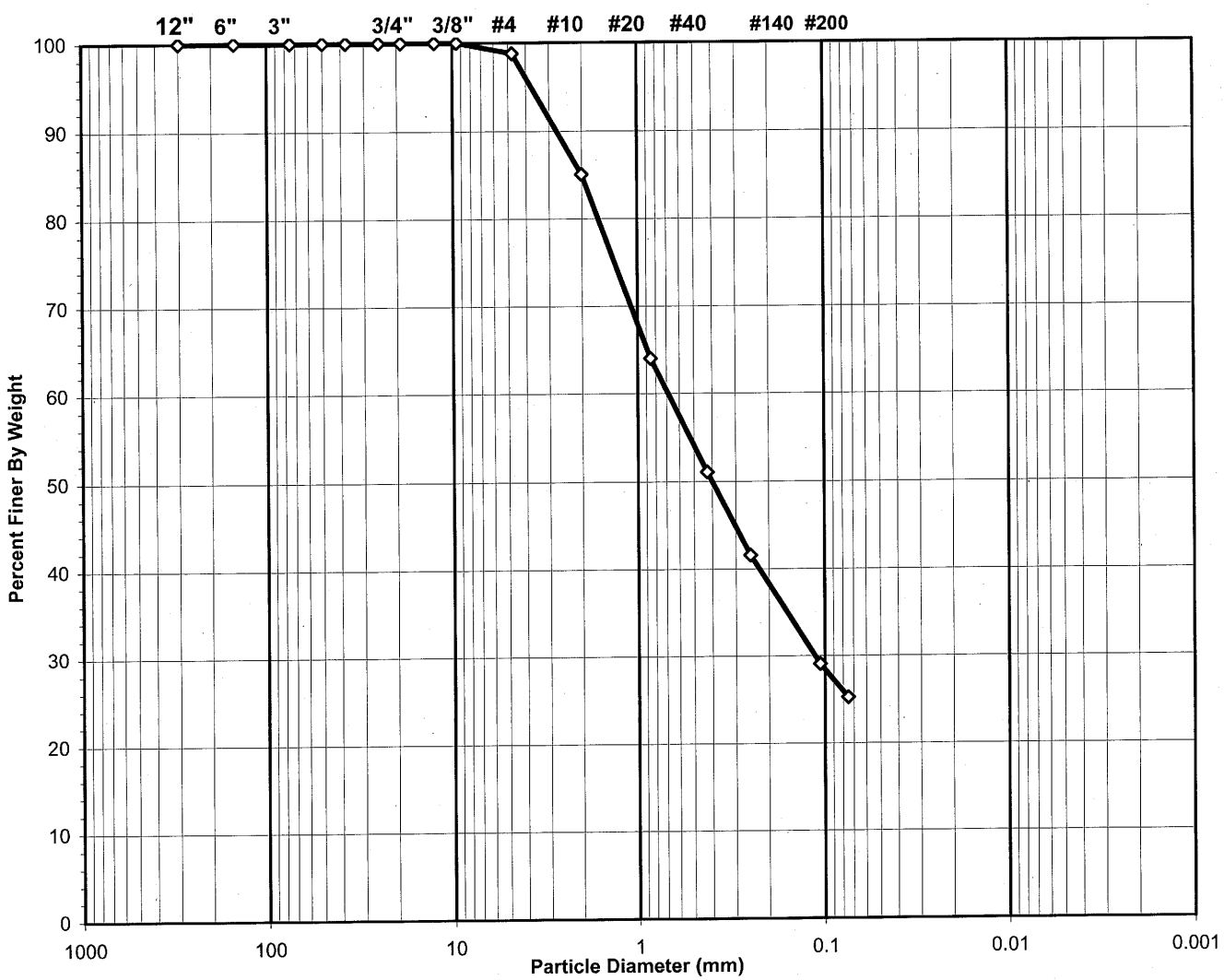
SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-57
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-10	Soil Color	**BROWN**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By TMS Date 12/3/2010 Checked By JAS Date 12-7-10

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-10 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-57
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-18.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-10	Soil Color	**BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	203	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1021.63	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	905.87	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	171.10	Weight of Tare (gm)	NA
Weight of Water (gm)	115.76	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	734.77	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**15.8**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	734.77
Dry Weight - 3/4" Sample (gm)	549.1	Weight of minus #200 material (gm)	185.71
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	549.06
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	8.99	1.2	1.2	98.8	**98.8**
#10	2.00	100.82	13.7	14.9	85.1	**85.1**
#20	0.850	154.51	21.0	36.0	64.0	**64.0**
#40	0.425	95.05	12.9	48.9	51.1	**51.1**
#60	0.250	69.96	9.5	58.4	41.6	**41.6**
#140	0.106	91.92	12.5	70.9	29.1	**29.1**
#200	0.075	27.81	3.8	74.7	25.3	**25.3**
Pan	-	185.71	25.3	100.0	-	**-**

Tested By TMS Date 12/3/2010 Checked By JRB Date 12.7.10

DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-10 SIEVON REV 4.XLS]Sheet1*

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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Client	R.S.G. & ASSOCIATES	Boring No.	PZ-58
Client Reference	DAVIDSON CO. LF	Depth (ft)	30-32
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-11	Soil Color	**TAN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**

USCS Summary

Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.98
#4 To #200	*Sand*	45.26
Finer Than #200	*Silt & Clay*	53.76

USCS Symbol ***ML, TESTED***

USCS Classification ***SANDY SILT***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-11 SIEVEHYD10.xls]Sheet1

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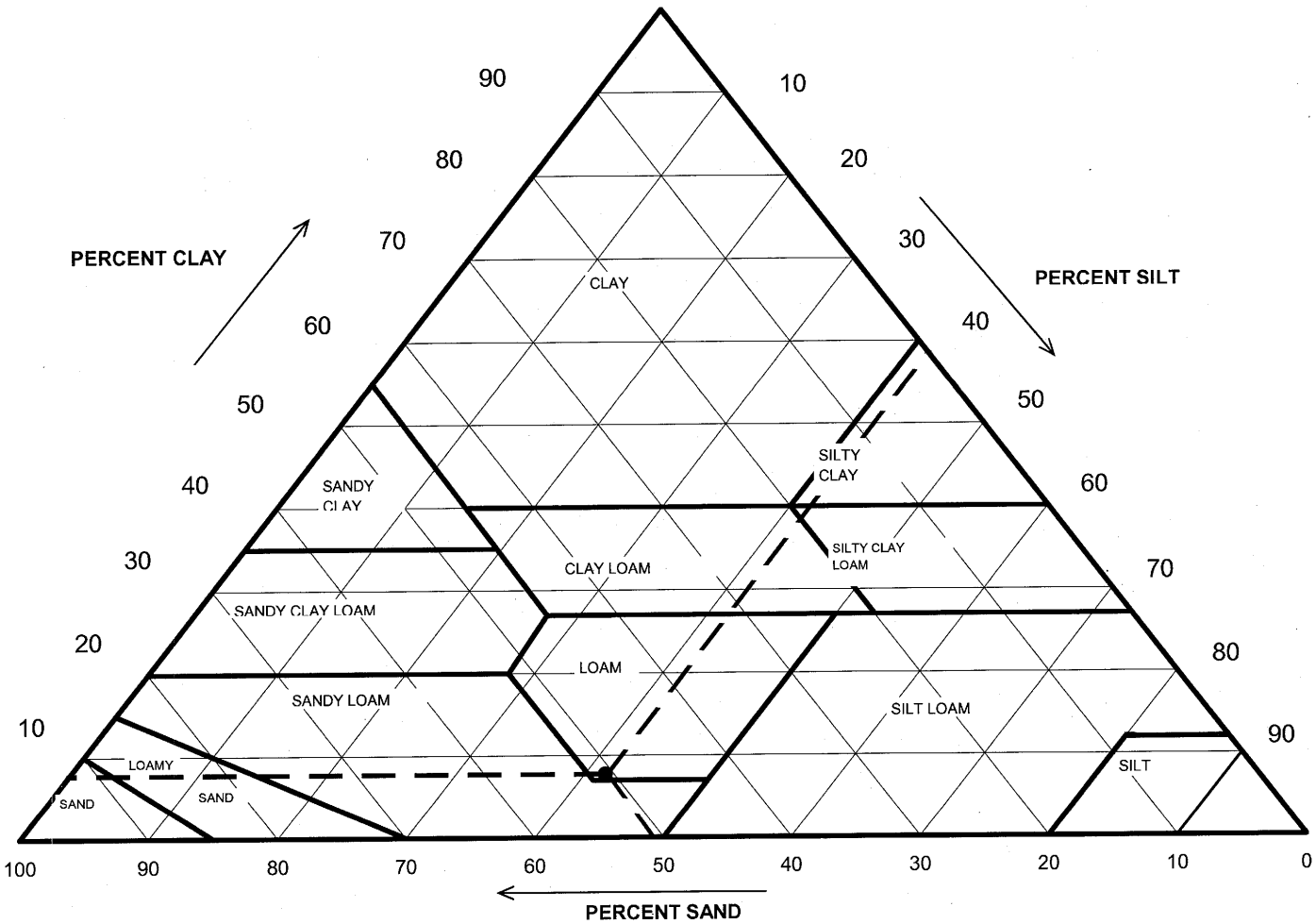
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-58
Client Reference	DAVIDSON CO. LF	Depth (ft)	30-32
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-11	Soil Color	TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.99	**0.00**
2	95.01	*Sand*	48.14	**50.67**
0.05	46.87	*Silt*	39.54	**41.61**
0.002	7.34	*Clay*	7.34	**7.72**

USDA Classification: ***LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-58
Client Reference	DAVIDSON CO. LF	Depth (ft)	30-32
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-11	Soil Color	**TAN**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	N-1	Air Dried - #10 Hydrometer Material (gm)	100.00
Wgt.Tare + Wet Soil (gm)	58.00	Corrected Dry Wt. of - #10 Material (gm)	90.56
Wgt.Tare + Dry Soil (gm)	54.00		
Weight of Tare (gm)	15.63	Weight of - #200 Material (gm)	51.24
Weight of Water (gm)	4.00	Weight of - #10 ; + #200 Material (gm)	39.32
Weight of Dry Soil (gm)	38.37		
Moisture Content (%)	**10.4**	**J-FACTOR (%FINER THAN #10)**	**0.9501**
	Soil Specimen Data		
Tare No.	P-12		
Wgt.Tare + Air Dry Soil (gm)	647.64		
Weight of Tare (gm)	196.44		
Air Dried Wgt. Total Sample (gm)	451.20	Dry Weight of Material Retained on #10 (gm)	20.47
Total Dry Sample Weight (gm)	410.54	Corrected Dry Sample Wt - #10 (gm)	390.07

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	2.43	0.6	0.6	99.4	**99.4**
#4	4.75	1.58	0.4	1.0	99.0	**99.0**
#10	2.00	16.46	4.0	5.0	95.0	**95.0**
#20	0.85	4.68	5.2	5.2	94.8	**90.1**
#40	0.425	7.85	8.7	13.8	86.2	**81.9**
#60	0.250	7.44	8.2	22.1	77.9	**74.1**
#140	0.106	13.44	14.8	36.9	63.1	**60.0**
#200	0.075	5.91	6.5	43.4	56.6	**53.8**
Pan	-	51.24	56.6	100.0	-	-

Notes :

Tested By SD Date 12/8/2010 Checked By GEM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-58
Client Reference	DAVIDSON CO. LF	Depth (ft)	30-32
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-11	Soil Color	**TAN**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	41.0	23.6	5.25	35.8	39.1	0.01288	0.0282	**37.1**
5	36.0	23.6	5.25	30.8	33.6	0.01288	0.0186	**31.9**
15	30.0	23.6	5.25	24.8	27.1	0.01288	0.0112	**25.7**
30	26.0	23.7	5.20	20.8	22.7	0.01287	0.0081	**21.6**
60	22.0	23.7	5.20	16.8	18.4	0.01287	0.0059	**17.5**
250	15.0	23.5	5.29	9.7	10.6	0.01290	0.0030	**10.1**
1440	10.0	22.8	5.61	4.4	4.8	0.01300	0.0013	**4.6**

Soil Specimen Data		Other Corrections	
Wgt. of Dry Material (gm)	90.56	Hygroscopic Moisture Factor	0.906
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	95.01
		Specific Gravity	2.70 Assumed

Notes:

Tested By TMS Date 12/6/2010 Checked By GEM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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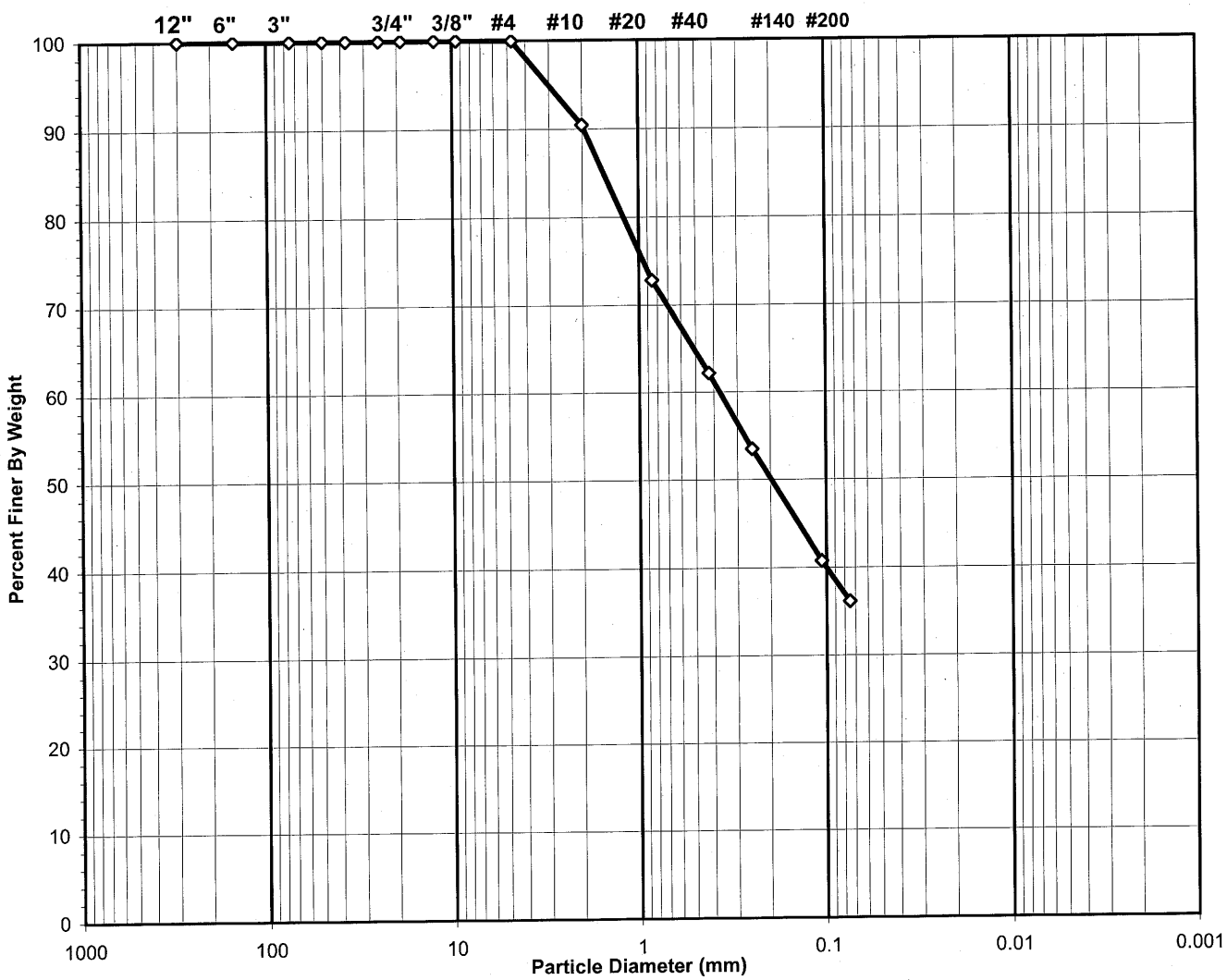
SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-59
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-20.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-12	Soil Color	**BROWN**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By TMS Date 12/3/2010 Checked By JBD Date 12-7-10

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-12 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-59
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-20.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-12	Soil Color	**BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	216	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	725.49	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	614.41	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	170.76	Weight of Tare (gm)	NA
Weight of Water (gm)	111.08	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	443.65	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**25.0**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	443.65
Dry Weight - 3/4" Sample (gm)	283.4	Weight of minus #200 material (gm)	160.28
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	283.37
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.18	0.0	0.0	100.0	**100.0**
#10	2.00	42.38	9.6	9.6	90.4	**90.4**
#20	0.850	78.04	17.6	27.2	72.8	**72.8**
#40	0.425	47.33	10.7	37.9	62.1	**62.1**
#60	0.250	38.35	8.6	46.5	53.5	**53.5**
#140	0.106	56.67	12.8	59.3	40.7	**40.7**
#200	0.075	20.42	4.6	63.9	36.1	**36.1**
Pan	-	160.28	36.1	100.0	-	-

Tested By TMS Date 12/3/2010 Checked By JRB Date 12.7.10

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SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-60
Client Reference	DAVIDSON CO. LF.	Depth (ft)	5.0-7.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-13	Soil Color	**GRAY**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By TMS Date 12/3/2010 Checked By JBD Date 12.07.10

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-60
Client Reference	DAVIDSON CO. LF.	Depth (ft)	5.0-7.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-13	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	200	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	887.03	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	832.67	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	171.76	Weight of Tare (gm)	NA
Weight of Water (gm)	54.36	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	660.91	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**8.2**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	660.91
Dry Weight - 3/4" Sample (gm)	452.7	Weight of minus #200 material (gm)	208.22
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	452.69
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.21	0.0	0.0	100.0	**100.0**
#10	2.00	7.27	1.1	1.1	98.9	**98.9**
#20	0.850	75.52	11.4	12.6	87.4	**87.4**
#40	0.425	106.85	16.2	28.7	71.3	**71.3**
#60	0.250	86.18	13.0	41.8	58.2	**58.2**
#140	0.106	130.21	19.7	61.5	38.5	**38.5**
#200	0.075	46.45	7.0	68.5	31.5	**31.5**
Pan	-	208.22	31.5	100.0	-	**-**

Tested By TMS Date 12/3/2010 Checked By JOD Date 12-7-10

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SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-61a
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-20.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-14	Soil Color	**BROWN**

	SIEVE ANALYSIS		HYDROMETER
USCS	gravel	sand	silt and clay

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By TMS Date 12/3/2010 Checked By JBD Date 12-7-10

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-14 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-61a
Client Reference	DAVIDSON CO. LF.	Depth (ft)	15.0-20.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-14	Soil Color	**BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	209	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	663.72	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	570.17	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	171.63	Weight of Tare (gm)	NA
Weight of Water (gm)	93.55	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	398.54	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**23.5**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	398.54
Dry Weight - 3/4" Sample (gm)	293.9	Weight of minus #200 material (gm)	104.62
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	293.92
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	2.15	0.5	0.5	99.5	**99.5**
#10	2.00	55.98	14.0	14.6	85.4	**85.4**
#20	0.850	74.63	18.7	33.3	66.7	**66.7**
#40	0.425	53.53	13.4	46.7	53.3	**53.3**
#60	0.250	40.82	10.2	57.0	43.0	**43.0**
#140	0.106	51.23	12.9	69.8	30.2	**30.2**
#200	0.075	15.58	3.9	73.7	26.3	**26.3**
Pan	-	104.62	26.3	100.0	-	-

Tested By TMS Date 12/3/2010 Checked By JBD Date 12-7-10

DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\SERVER\Data Drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-14 SIEVON REV 4.XLS]Sheet1*

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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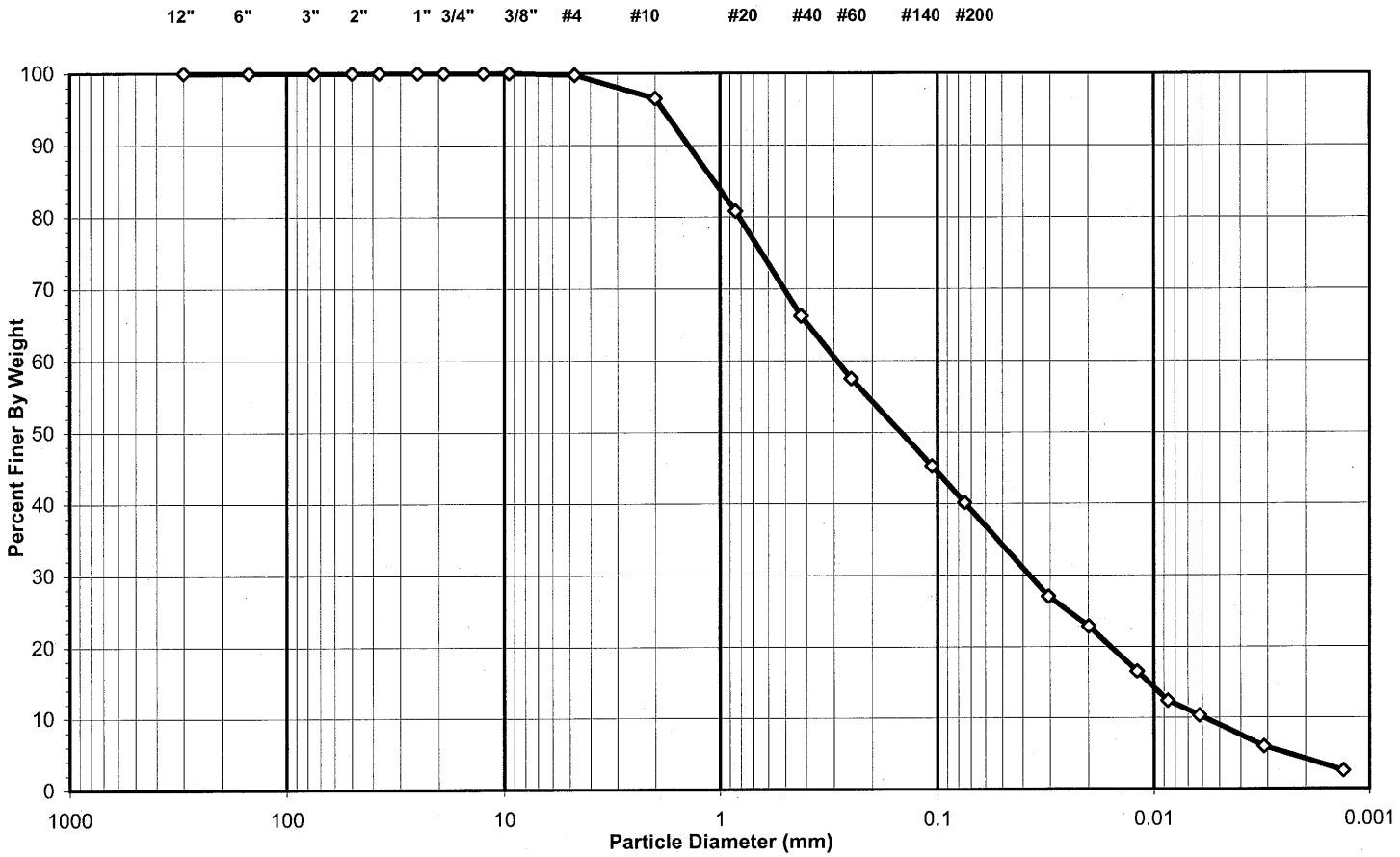
Client	R.S.G. & ASSOCIATES	Boring No.	PZ-62
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-25.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-15	Soil Color	**BROWN GRAY**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.19
#4 To #200	*Sand*	59.68
Finer Than #200	*Silt & Clay*	40.12

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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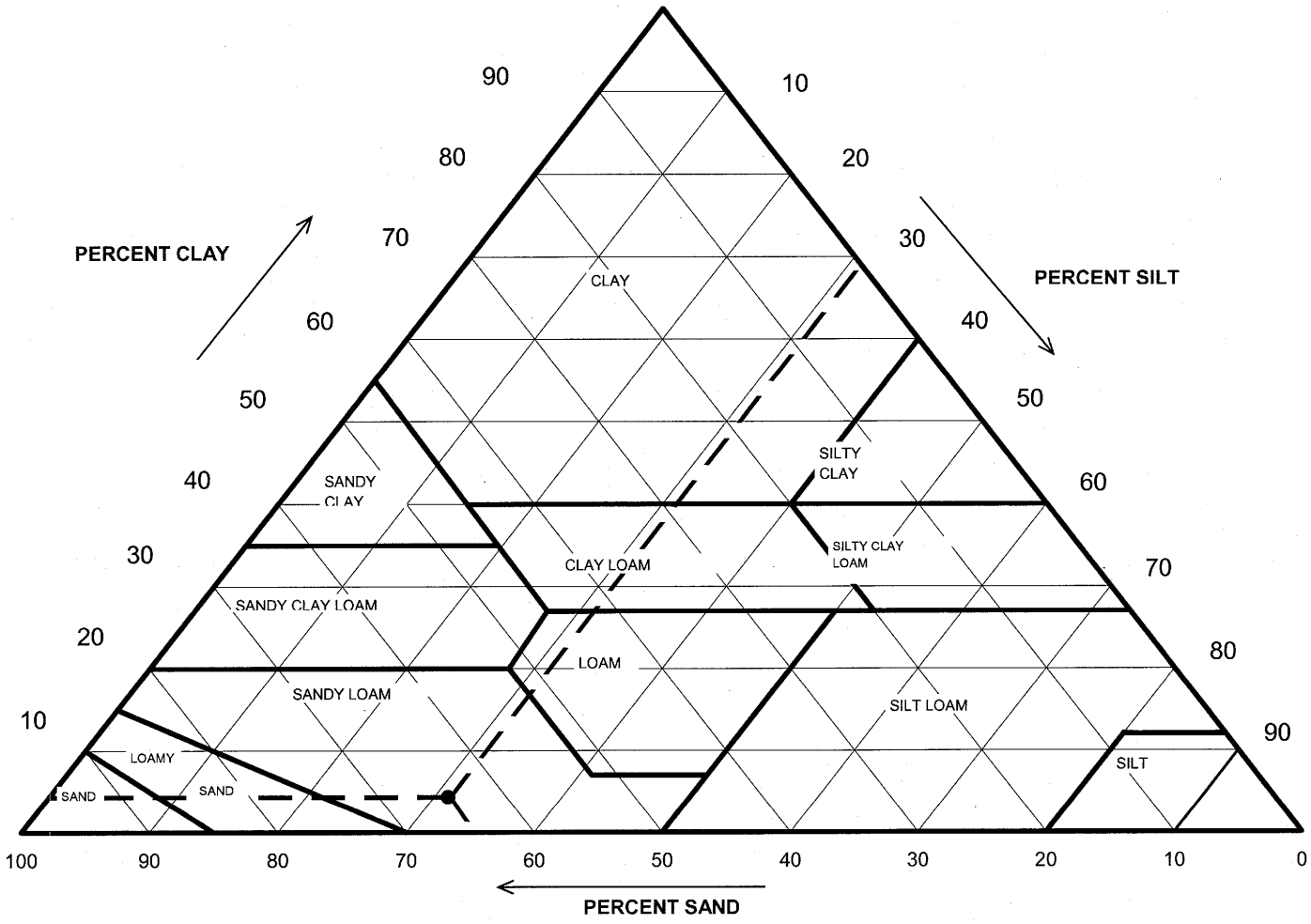
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-62
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-25.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-15	Soil Color	BROWN GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	3.49	**0.00**
2	96.51	*Sand*	62.30	**64.55**
0.05	34.21	*Silt*	30.01	**31.10**
0.002	4.20	*Clay*	4.20	**4.35**

USDA Classification: ***SANDY LOAM***

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-62
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-25.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-15	Soil Color	**BROWN GRAY**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	U-1	Air Dried - #10 Hydrometer Material (gm)	100.00
Wgt.Tare + Wet Soil (gm)	48.30	Corrected Dry Wt. of - #10 Material (gm)	90.92
Wgt.Tare + Dry Soil (gm)	45.35		
Weight of Tare (gm)	15.82	Weight of - #200 Material (gm)	37.80
Weight of Water (gm)	2.95	Weight of - #10 ; + #200 Material (gm)	53.12
Weight of Dry Soil (gm)	29.53		
Moisture Content (%)	**10.0**	**J-FACTOR (%FINER THAN #10)**	**0.9651**
		Soil Specimen Data	
Tare No.	843		
Wgt.Tare + Air Dry Soil (gm)	566.12		
Weight of Tare (gm)	262.19		
Air Dried Wgt. Total Sample (gm)	303.93	Dry Weight of Material Retained on #10 (gm)	9.68
Total Dry Sample Weight (gm)	277.20	Corrected Dry Sample Wt - #10 (gm)	267.52

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.54	0.2	0.2	99.8	**99.8**
#10	2.00	9.14	3.3	3.5	96.5	**96.5**
#20	0.85	14.78	16.3	16.3	83.7	**80.8**
#40	0.425	13.71	15.1	31.3	68.7	**66.3**
#60	0.250	8.26	9.1	40.4	59.6	**57.5**
#140	0.106	11.53	12.7	53.1	46.9	**45.3**
#200	0.075	4.84	5.3	58.4	41.6	**40.1**
Pan	-	37.80	41.6	100.0	-	-

Notes :

Tested By SD Date 12/8/2010 Checked By GEM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

\\Server\data drive\2010 PROJECTS\2010-774 R.S.G\[2010-774-01-15 SIEVEHYD10.xls]Sheet1

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INTEGRITY IN TESTING

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-62
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-25.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-15	Soil Color	**BROWN GRAY**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	31.0	23.5	5.29	25.7	28.0	0.01290	0.0305	**27.0**
5	27.0	23.5	5.29	21.7	23.6	0.01290	0.0199	**22.8**
15	21.0	23.5	5.29	15.7	17.1	0.01290	0.0119	**16.5**
30	17.0	23.6	5.25	11.8	12.8	0.01288	0.0086	**12.4**
60	15.0	23.7	5.20	9.8	10.7	0.01287	0.0062	**10.3**
250	11.0	23.4	5.34	5.7	6.2	0.01291	0.0031	**6.0**
1440	8.0	22.9	5.57	2.4	2.7	0.01299	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	90.92	Hygroscopic Moisture Factor	0.909
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	96.51
		Specific Gravity	2.70 Assumed

Notes:

Tested By TMS Date 12/6/2010 Checked By GZM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

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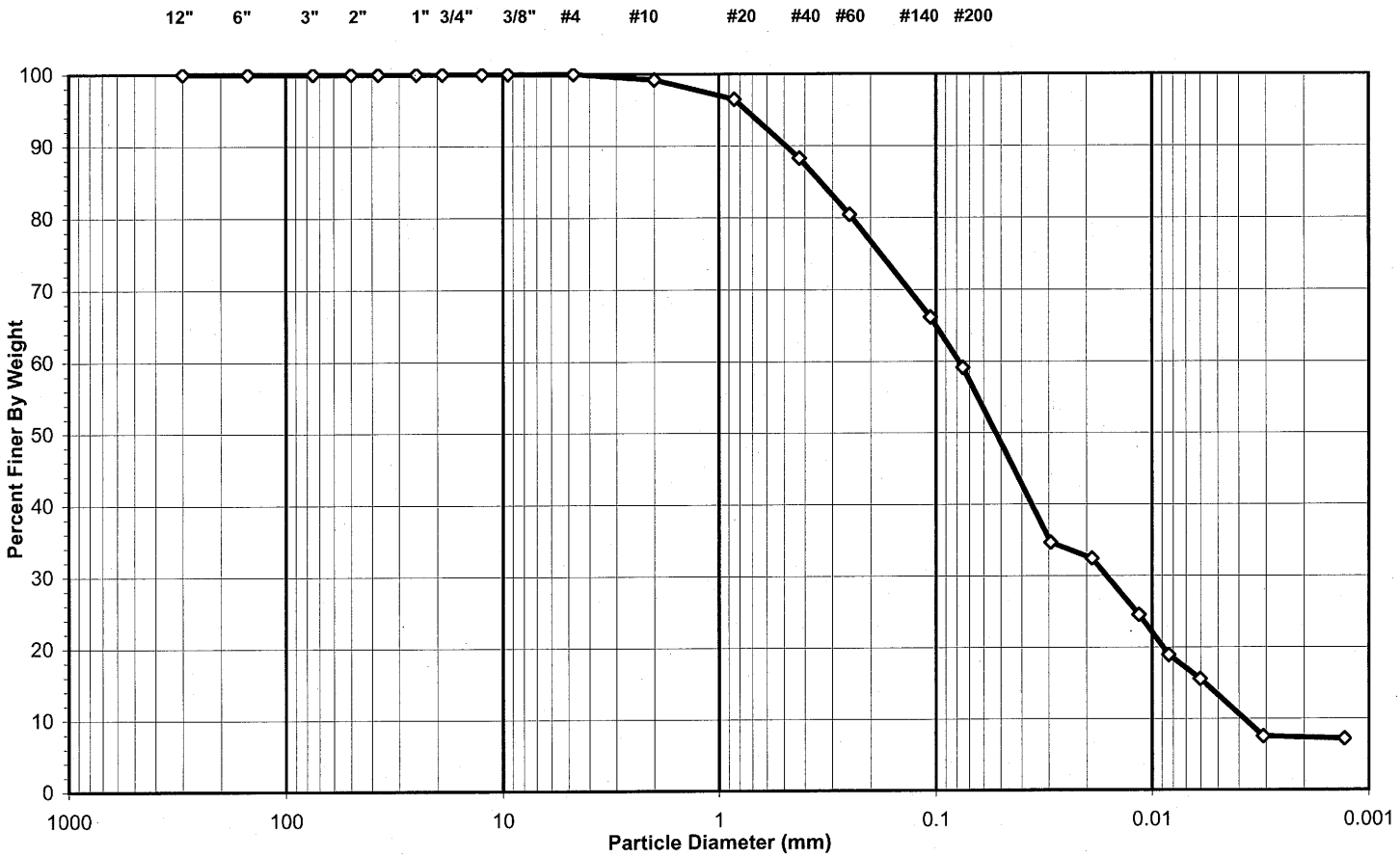
Client	R.S.G. & ASSOCIATES	Boring No.	PZ-63
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-23.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-16	Soil Color	**GRAY**

	SIEVE ANALYSIS			HYDROMETER	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**



USCS Summary

Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	40.83
Finer Than #200	*Silt & Clay*	59.17

USCS Symbol ***ML, TESTED***

USCS Classification ***SANDY SILT***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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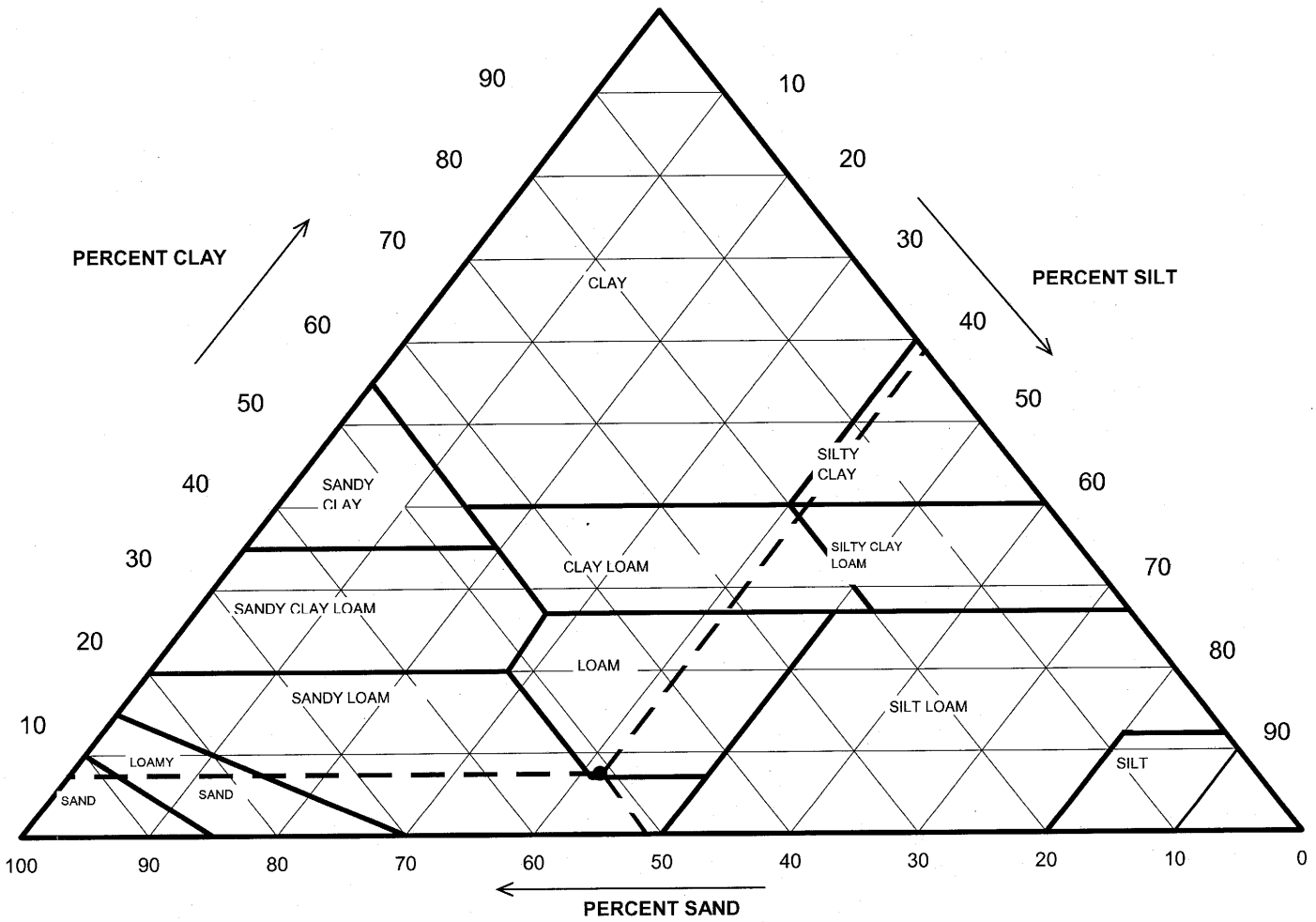
USDA CLASSIFICATION CHART

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-63
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-23.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-16	Soil Color	GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.75	**0.00**
2	99.25	*Sand*	50.68	**51.07**
0.05	48.56	*Silt*	41.19	**41.50**
0.002	7.38	*Clay*	7.38	**7.43**

USDA Classification: ***LOAM***

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-63
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-23.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-16	Soil Color	**GRAY**

Minus #10 for Hygroscopic Moisture Content		**Hydrometer Specimen Data**	
Tare No.	U-1	Air Dried - #10 Hydrometer Material (gm)	99.98
Wgt.Tare + Wet Soil (gm)	67.55	Corrected Dry Wt. of - #10 Material (gm)	87.22
Wgt.Tare + Dry Soil (gm)	60.93		
Weight of Tare (gm)	15.67	Weight of - #200 Material (gm)	52.00
Weight of Water (gm)	6.62	Weight of - #10 ; + #200 Material (gm)	35.22
Weight of Dry Soil (gm)	45.26		
Moisture Content (%)	**14.6**	**J-FACTOR (%FINER THAN #10)**	**0.9925**
Soil Specimen Data			
Tare No.	201		
Wgt.Tare + Air Dry Soil (gm)	437.92		
Weight of Tare (gm)	170.73		
Air Dried Wgt. Total Sample (gm)	267.19	Dry Weight of Material Retained on #10 (gm)	1.76
Total Dry Sample Weight (gm)	233.32	Corrected Dry Sample Wt - #10 (gm)	231.56

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	1.76	0.8	0.8	99.2	**99.2**
#20	0.85	2.42	2.8	2.8	97.2	**96.5**
#40	0.425	7.20	8.3	11.0	89.0	**88.3**
#60	0.250	6.91	7.9	19.0	81.0	**80.4**
#140	0.106	12.54	14.4	33.3	66.7	**66.2**
#200	0.075	6.15	7.1	40.4	59.6	**59.2**
Pan	-	52.00	59.6	100.0	-	-

Notes :

Tested By SD Date 12/8/2010 Checked By GEM Date 12-9-10

DCN: CT-S3OR DATE: 2/20/08 REVISION: 5

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	R.S.G. & ASSOCIATES	Boring No.	PZ-63
Client Reference	DAVIDSON CO. LF	Depth (ft)	20.0-23.0
Project No.	2010-774-01	Sample No.	NA
Lab ID	2010-774-01-16	Soil Color	**GRAY**

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	36.0	23.6	5.25	30.8	34.9	0.01288	0.0294	**34.6**
5	34.0	23.6	5.25	28.8	32.6	0.01288	0.0189	**32.4**
15	27.0	23.6	5.25	21.8	24.7	0.01288	0.0115	**24.5**
30	22.0	23.7	5.20	16.8	19.1	0.01287	0.0084	**18.9**
60	19.0	23.7	5.20	13.8	15.7	0.01287	0.0060	**15.5**
250	12.0	23.5	5.29	6.7	7.6	0.01290	0.0031	**7.6**
1440	12.0	22.8	5.61	6.4	7.3	0.01300	0.0013	**7.2**

Soil Specimen Data		**Other Corrections**	
Wgt. of Dry Material (gm)	87.22	Hygroscopic Moisture Factor	0.872
Weight of Deflocculant (gm)	5.0	a - Factor	0.99
		Percent Finer than # 10	99.25
		Specific Gravity	2.70 Assumed

Notes:

Tested By TMS Date 12/6/2010 Checked By GEM Date 12-9-10

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Appendix 3

Aquifer “Slug” Testing Results

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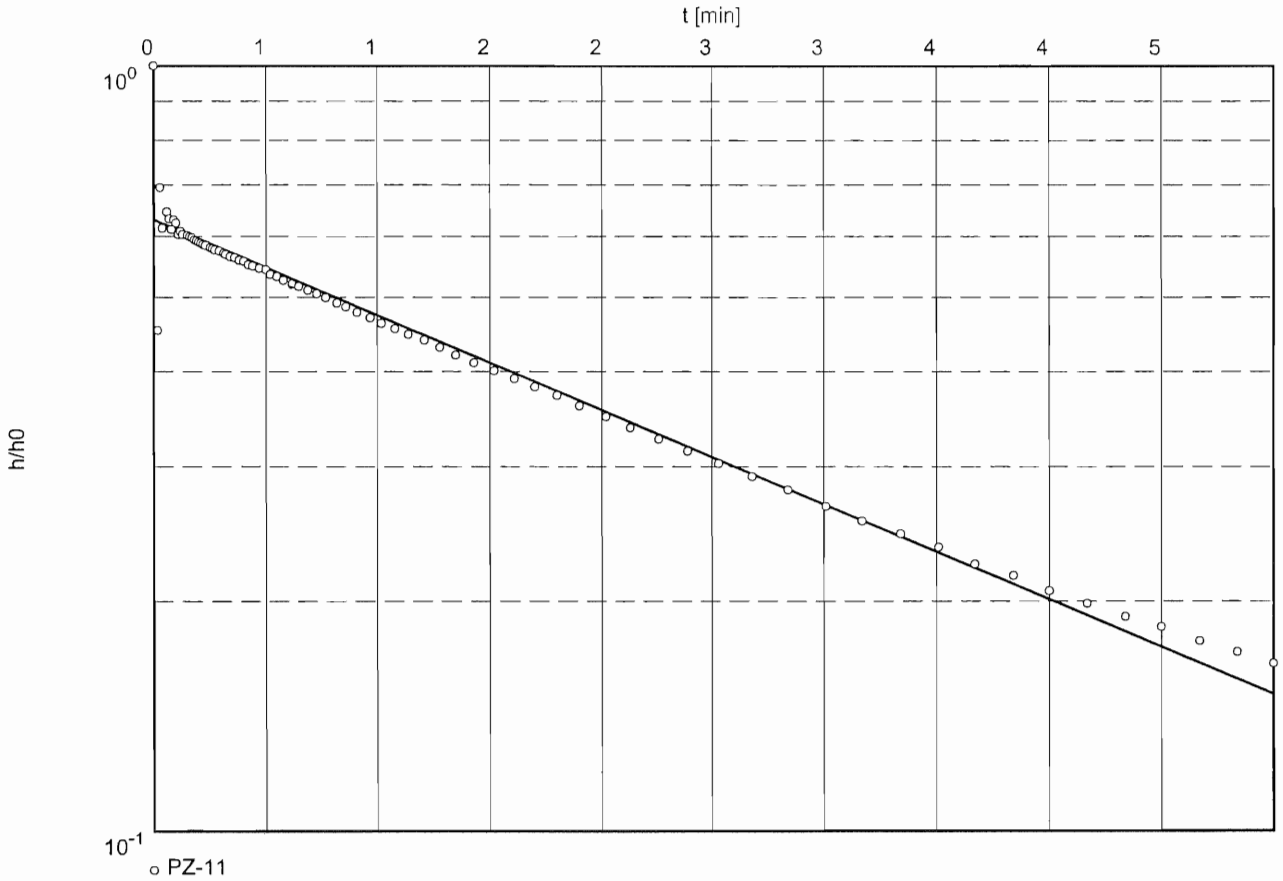
G. N. Richardson & Associates, Inc. 425 North Boylan Avenue Raleigh, NC 27603 ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 1/31/01	Phase 2, Page 1
		Project: Davidson County Landfill	
		Evaluated by: JAS	

Slug Test No.	Test conducted on: 1/29/01
PZ-11	



Hydraulic conductivity [ft/min]: 4.79×10^{-4}

G. N. Richardson & Associates, Inc.
425 North Boylan Avenue
Raleigh, NC 27603
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 1/31/01 | Phase 2, Page 2

Project: Davidson County Landfill

Evaluated by: JAS

Slug Test No.	Test conducted on: 1/29/01
PZ-11	PZ-11

Static water level: 40.10 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	45.29	5.19
2	0.02	42.45	2.35
3	0.03	43.70	3.60
4	0.04	43.29	3.19
5	0.06	43.45	3.35
6	0.07	43.38	3.28
7	0.08	43.28	3.18
8	0.09	43.37	3.27
9	0.10	43.34	3.24
10	0.11	43.23	3.13
11	0.12	43.26	3.16
12	0.13	43.23	3.13
13	0.15	43.22	3.12
14	0.16	43.21	3.11
15	0.17	43.20	3.10
16	0.18	43.18	3.08
17	0.19	43.17	3.07
18	0.20	43.16	3.06
19	0.21	43.15	3.05
20	0.22	43.14	3.04
21	0.23	43.13	3.03
22	0.25	43.11	3.01
23	0.26	43.10	3.00
24	0.27	43.09	2.99
25	0.29	43.08	2.98
26	0.31	43.06	2.96
27	0.32	43.05	2.95
28	0.34	43.03	2.93
29	0.36	43.02	2.92
30	0.38	43.00	2.90
31	0.40	42.99	2.89
32	0.42	42.96	2.86
33	0.44	42.95	2.85
34	0.47	42.93	2.83
35	0.50	42.92	2.82
36	0.52	42.88	2.78
37	0.55	42.86	2.76
38	0.58	42.83	2.73
39	0.62	42.80	2.70
40	0.65	42.78	2.68
41	0.69	42.75	2.65
42	0.73	42.72	2.62
43	0.77	42.69	2.59
44	0.82	42.65	2.55
45	0.86	42.62	2.52
46	0.91	42.58	2.48
47	0.97	42.54	2.44
48	1.02	42.50	2.40
49	1.08	42.46	2.36
50	1.14	42.42	2.32

G. N. Richardson & Associates, Inc.
425 North Boylan Avenue
Raleigh, NC 27603
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 1/31/01

Project: Davidson County Landfill

Evaluated by: JAS

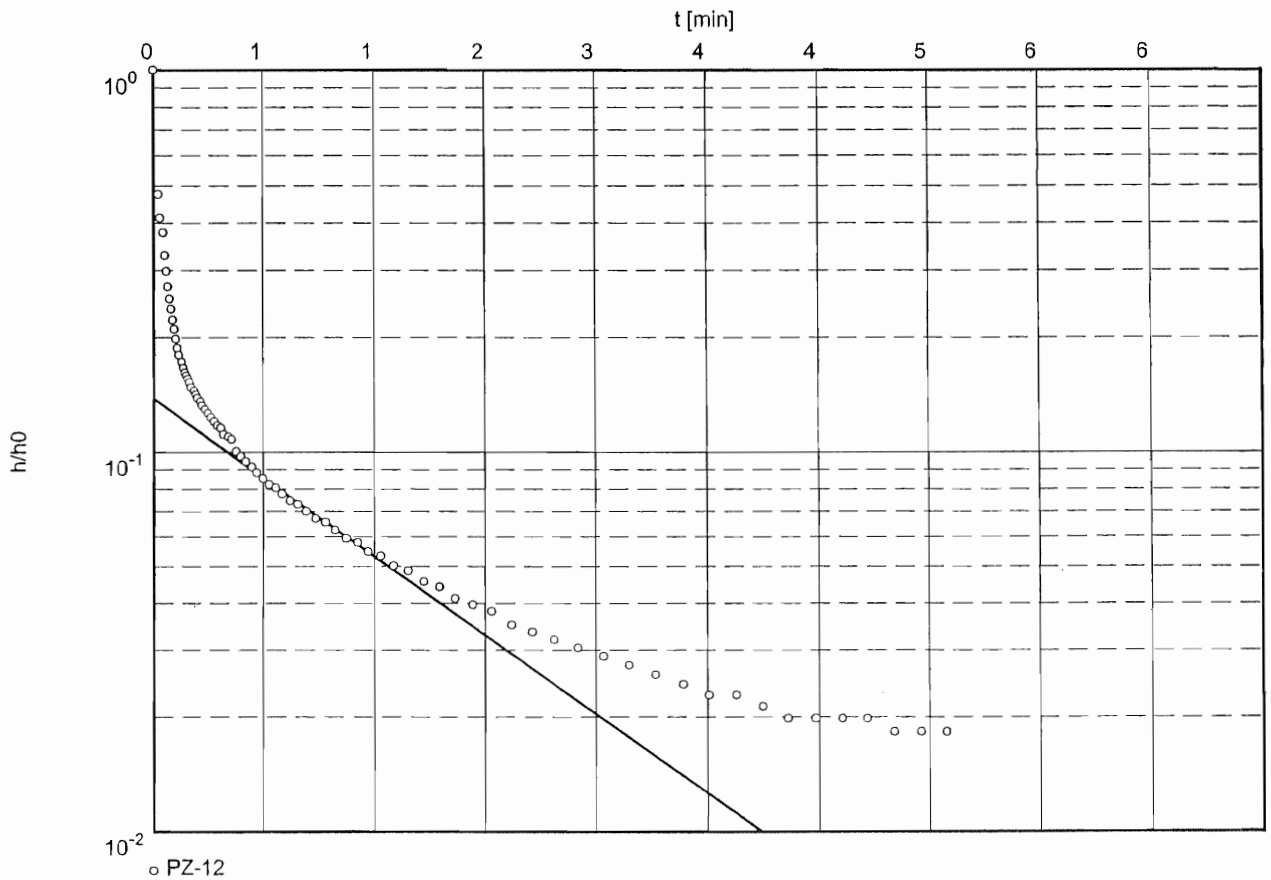
Slug Test No.	Test conducted on: 1/29/01
PZ-11	PZ-11

Static water level: 40.10 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	
51	1.21	42.38	2.28	
52	1.28	42.33	2.23	
53	1.35	42.28	2.18	
54	1.43	42.23	2.13	
55	1.52	42.18	2.08	
56	1.61	42.13	2.03	
57	1.70	42.08	1.98	
58	1.80	42.03	1.93	
59	1.90	41.97	1.87	
60	2.02	41.91	1.81	
61	2.13	41.85	1.75	
62	2.26	41.79	1.69	
63	2.39	41.73	1.63	
64	2.53	41.67	1.57	
65	2.68	41.61	1.51	
66	2.84	41.55	1.45	
67	3.01	41.48	1.38	
68	3.17	41.42	1.32	
69	3.34	41.37	1.27	
70	3.51	41.32	1.22	
71	3.67	41.26	1.16	
72	3.84	41.22	1.12	
73	4.00	41.17	1.07	
74	4.17	41.13	1.03	
75	4.34	41.09	0.99	
76	4.50	41.06	0.96	
77	4.67	41.02	0.92	
78	4.84	40.99	0.89	
79	5.00	40.96	0.86	

G. N. Richardson & Associates, Inc. 425 North Boylan Avenue Raleigh, NC 27603 ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 1/31/01	Phase 2, Page 1
		Project: Davidson County Landfill	
		Evaluated by: JAS	

Slug Test No.	Test conducted on: 1/29/01
PZ-12	



Hydraulic conductivity [ft/min]: 1.51×10^{-3}

G. N. Richardson & Associates, Inc.
425 North Boylan Avenue
Raleigh, NC 27603
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 1/31/01 | Phase 2, Page 2

Project: Davidson County Landfill

Evaluated by: JAS

Slug Test No.	Test conducted on: 1/29/01
PZ-12	PZ-12

Static water level: 19.20 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	25.77	6.57
2	0.03	22.32	3.12
3	0.04	21.91	2.71
4	0.06	21.68	2.48
5	0.07	21.36	2.16
6	0.08	21.16	1.96
7	0.09	20.99	1.79
8	0.10	20.86	1.66
9	0.11	20.76	1.56
10	0.12	20.66	1.46
11	0.13	20.58	1.38
12	0.14	20.50	1.30
13	0.15	20.43	1.23
14	0.16	20.38	1.18
15	0.18	20.33	1.13
16	0.19	20.29	1.09
17	0.20	20.26	1.06
18	0.21	20.24	1.04
19	0.22	20.22	1.02
20	0.23	20.20	1.00
21	0.24	20.17	0.97
22	0.26	20.15	0.95
23	0.27	20.13	0.93
24	0.28	20.11	0.91
25	0.30	20.09	0.89
26	0.31	20.07	0.87
27	0.33	20.05	0.85
28	0.35	20.03	0.83
29	0.37	20.01	0.81
30	0.39	19.99	0.79
31	0.41	19.97	0.77
32	0.43	19.96	0.76
33	0.45	19.93	0.73
34	0.48	19.92	0.72
35	0.50	19.91	0.71
36	0.53	19.86	0.66
37	0.56	19.84	0.64
38	0.59	19.82	0.62
39	0.63	19.80	0.60
40	0.66	19.78	0.58
41	0.70	19.76	0.56
42	0.74	19.74	0.54
43	0.78	19.73	0.53
44	0.82	19.71	0.51
45	0.87	19.69	0.49
46	0.92	19.68	0.48
47	0.97	19.66	0.46
48	1.03	19.64	0.44
49	1.09	19.63	0.43
50	1.15	19.61	0.41

G. N. Richardson & Associates, Inc. 425 North Boylan Avenue Raleigh, NC 27603 ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 1/31/01	Phase 2, Page 3
		Project: Davidson County Landfill	
		Evaluated by: JAS	

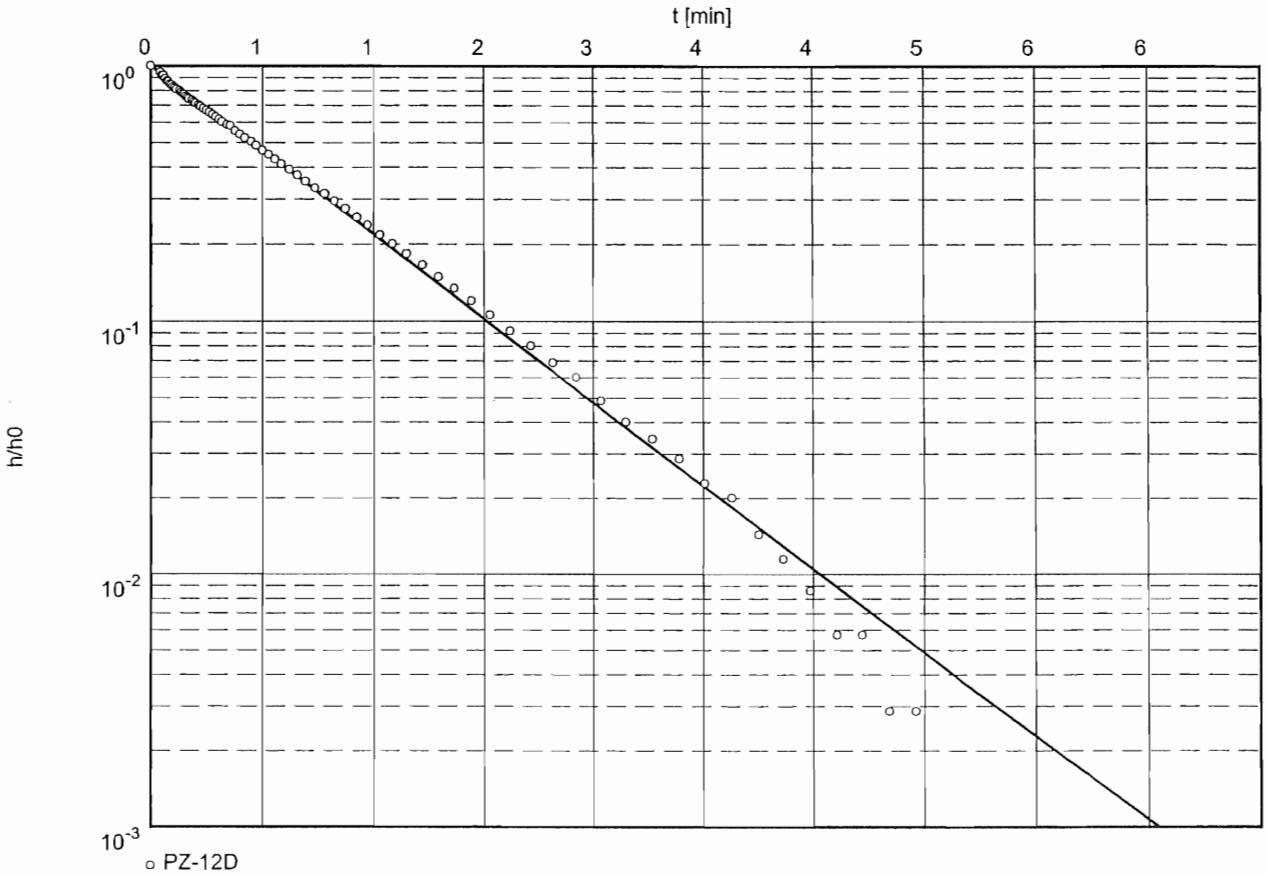
Slug Test No.	Test conducted on: 1/29/01
PZ-12	PZ-12

Static water level: 19.20 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	
51	1.22	19.59	0.39	
52	1.29	19.58	0.38	
53	1.36	19.56	0.36	
54	1.44	19.55	0.35	
55	1.52	19.53	0.33	
56	1.61	19.52	0.32	
57	1.71	19.50	0.30	
58	1.81	19.49	0.29	
59	1.91	19.47	0.27	
60	2.02	19.46	0.26	
61	2.14	19.45	0.25	
62	2.27	19.43	0.23	
63	2.40	19.42	0.22	
64	2.54	19.41	0.21	
65	2.69	19.40	0.20	
66	2.85	19.39	0.19	
67	3.01	19.38	0.18	
68	3.18	19.37	0.17	
69	3.35	19.36	0.16	
70	3.51	19.35	0.15	
71	3.68	19.35	0.15	
72	3.85	19.34	0.14	
73	4.01	19.33	0.13	
74	4.18	19.33	0.13	
75	4.35	19.33	0.13	
76	4.51	19.33	0.13	
77	4.68	19.32	0.12	
78	4.85	19.32	0.12	
79	5.01	19.32	0.12	

G. N. Richardson & Associates, Inc. 425 North Boylan Avenue Raleigh, NC 27603 ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 1/31/01	Phase 2, Page 1
		Project: Davidson County Landfill	
		Evaluated by: JAS	

Slug Test No.	Test conducted on: 1/24/01
PZ-12D	



Hydraulic conductivity [ft/min]: 1.14×10^{-3}

G. N. Richardson & Associates, Inc.
425 North Boylan Avenue
Raleigh, NC 27603
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 1/31/01 | Phase 2, Page 2

Project: Davidson County Landfill

Evaluated by: JAS

Slug Test No.	Test conducted on: 1/24/01
PZ-12D	PZ-12D

Static water level: 18.97 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	
1	0.00	22.46	3.49	
2	0.06	22.26	3.29	
3	0.07	22.16	3.19	
4	0.08	22.16	3.19	
5	0.09	22.07	3.10	
6	0.10	22.01	3.04	
7	0.11	21.99	3.02	
8	0.12	21.93	2.96	
9	0.13	21.91	2.94	
10	0.14	21.86	2.89	
11	0.15	21.82	2.85	
12	0.16	21.79	2.82	
13	0.18	21.76	2.79	
14	0.19	21.72	2.75	
15	0.20	21.69	2.72	
16	0.21	21.66	2.69	
17	0.22	21.62	2.65	
18	0.23	21.59	2.62	
19	0.24	21.56	2.59	
20	0.26	21.53	2.56	
21	0.27	21.49	2.52	
22	0.28	21.46	2.49	
23	0.30	21.42	2.45	
24	0.31	21.39	2.42	
25	0.33	21.34	2.37	
26	0.35	21.30	2.33	
27	0.37	21.26	2.29	
28	0.39	21.22	2.25	
29	0.41	21.17	2.20	
30	0.43	21.12	2.15	
31	0.45	21.07	2.10	
32	0.48	21.02	2.05	
33	0.50	21.00	2.03	
34	0.53	20.91	1.94	
35	0.56	20.85	1.88	
36	0.59	20.79	1.82	
37	0.63	20.73	1.76	
38	0.66	20.67	1.70	
39	0.70	20.60	1.63	
40	0.74	20.54	1.57	
41	0.78	20.47	1.50	
42	0.82	20.41	1.44	
43	0.87	20.34	1.37	
44	0.92	20.27	1.30	
45	0.97	20.20	1.23	
46	1.03	20.13	1.16	
47	1.09	20.07	1.10	
48	1.15	20.00	1.03	
49	1.22	19.93	0.96	
50	1.29	19.86	0.89	

G. N. Richardson & Associates, Inc. 425 North Boylan Avenue Raleigh, NC 27603 ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 1/31/01	Phase 2, Page 3
		Project: Davidson County Landfill	
		Evaluated by: JAS	

Slug Test No.	Test conducted on: 1/24/01
PZ-12D	PZ-12D

Static water level: 18.97 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
51	1.36	19.80	0.83
52	1.44	19.73	0.76
53	1.52	19.67	0.70
54	1.61	19.61	0.64
55	1.71	19.55	0.58
56	1.81	19.49	0.52
57	1.91	19.44	0.47
58	2.02	19.39	0.42
59	2.14	19.34	0.37
60	2.27	19.29	0.32
61	2.40	19.25	0.28
62	2.54	19.21	0.24
63	2.69	19.18	0.21
64	2.85	19.14	0.17
65	3.01	19.11	0.14
66	3.18	19.09	0.12
67	3.35	19.07	0.10
68	3.51	19.05	0.08
69	3.68	19.04	0.07
70	3.85	19.02	0.05
71	4.01	19.01	0.04
72	4.18	19.00	0.03
73	4.35	18.99	0.02
74	4.51	18.99	0.02
75	4.68	18.98	0.01
76	4.85	18.98	0.01
77	5.01	18.97	0.00

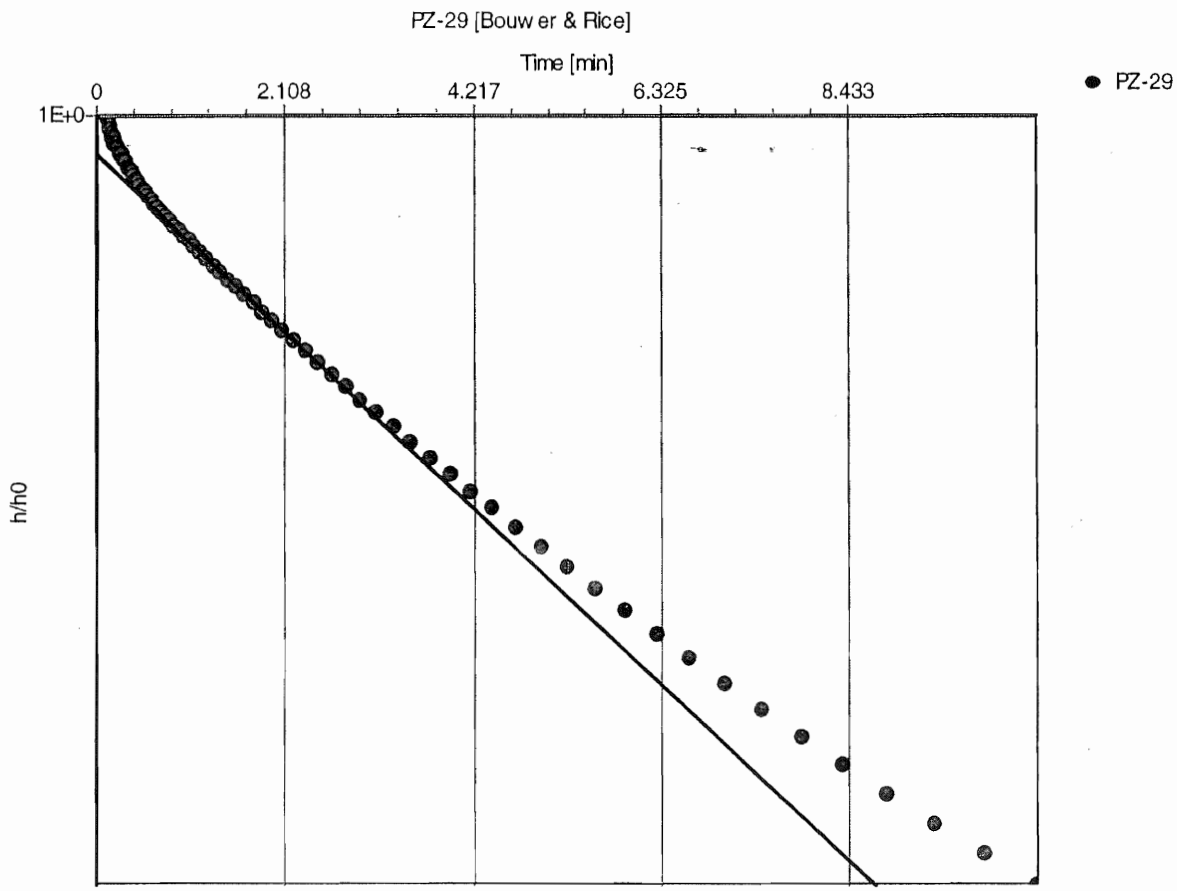
G. N. Richardson and Assoc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
ph: 919-828-0577

Slug Test Analysis Report

Project: Davidson Phase 2

Number:

Client:



Slug Test: **PZ-29**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 2.76E-4 [ft/min]

Test parameters:				
	Test Well:	PZ-29	Aquifer Thickness:	51 [ft]
	Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
	Screen length:	5 [ft]		
	Boring radius:	0.1667 [ft]		
	r(eff):	0.110 [ft]		

Comments:

Evaluated by:

Evaluation Date: 8/28/2003

G. N. Richardson and Assoc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
ph: 919-828-0577

Slug Test Data Report

Project: Davidson Phase 2

Number:

Client:

Test Well:	**PZ-29**	**Slug Test:**	**PZ-29**
		Test Well:	PZ-29
Depth to Static WL:	46.73 [ft]	Casing radius:	0.083 [ft]
Location:	Davidson County	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	8/26/2003	Aquifer Thickness:	51 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0.133	50.29	3.56
2	0.14	50.26	3.53
3	0.148	50.22	3.49
4	0.158	50.19	3.46
5	0.167	50.19	3.46
6	0.177	50.16	3.43
7	0.188	50.14	3.41
8	0.198	50.13	3.40
9	0.21	50.10	3.37
10	0.223	50.10	3.37
11	0.237	50.08	3.35
12	0.25	50.07	3.34
13	0.265	50.03	3.30
14	0.28	50.03	3.30
15	0.297	50.03	3.30
16	0.315	49.99	3.26
17	0.333	49.98	3.25
18	0.353	49.94	3.21
19	0.373	49.92	3.19
20	0.397	49.91	3.18
21	0.42	49.89	3.16
22	0.445	49.87	3.14
23	0.47	49.85	3.12
24	0.497	49.83	3.10
25	0.525	49.81	3.08
26	0.555	49.79	3.06
27	0.587	49.77	3.04
28	0.622	49.75	3.02
29	0.658	49.73	3.00
30	0.697	49.70	2.97
31	0.738	49.68	2.95

G. N. Richardson and Assoc. 14 N. Boylan Avenue Raleigh, North Carolina 27603 ph: 919-828-0577	**Slug Test Data Report** Project: Davidson Phase 2 Number: Client:	Page 2

Test Well:	**PZ-29**	**Slug Test:**	**PZ-29**
		Test Well:	PZ-29
Depth to Static WL:	46.73 [ft]	Casing radius:	0.083 [ft]
Location:	Davidson County	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	8/26/2003	Aquifer Thickness:	51 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	0.782	49.65	2.92
33	0.828	49.63	2.90
34	0.877	49.60	2.87
35	0.928	49.57	2.84
36	0.983	49.54	2.81
37	1.042	49.52	2.79
38	1.103	49.48	2.75
39	1.168	49.45	2.72
40	1.238	49.42	2.69
41	1.312	49.38	2.65
42	1.39	49.35	2.62
43	1.473	49.31	2.58
44	1.562	49.27	2.54
45	1.655	49.23	2.50
46	1.753	49.19	2.46
47	1.858	49.15	2.42
48	1.968	49.11	2.38
49	2.085	49.06	2.33
50	2.21	49.02	2.29
51	2.342	48.97	2.24
52	2.482	48.92	2.19
53	2.63	48.87	2.14
54	2.787	48.82	2.09
55	2.953	48.77	2.04
56	3.13	48.71	1.98
57	3.317	48.66	1.93
58	3.515	48.60	1.87
59	3.725	48.54	1.81
60	3.947	48.49	1.76
61	4.182	48.43	1.70
62	4.43	48.37	1.64

G. N. Richardson and Assoc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
ph: 919-828-0577

Slug Test Data Report

Project: Davidson Phase 2

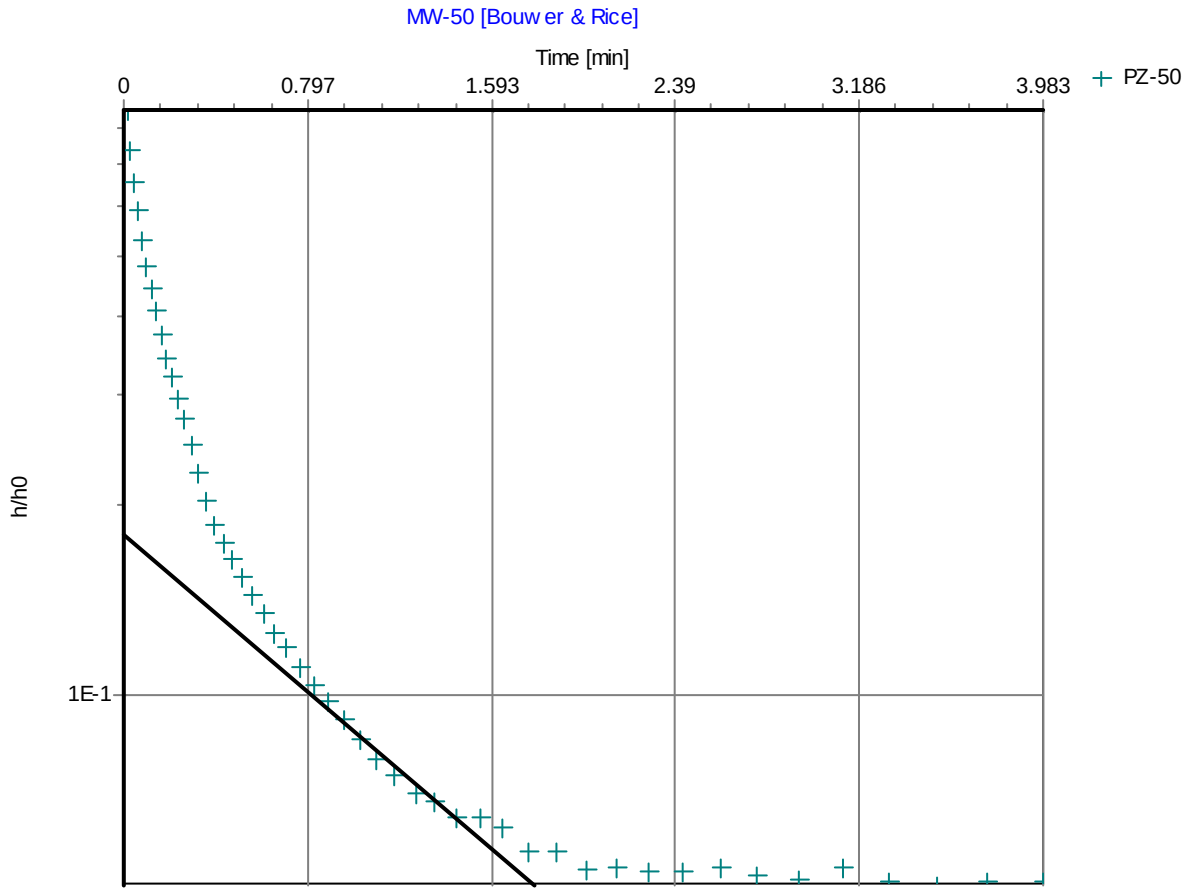
Number:

Client:

Test Well:	**PZ-29**	**Slug Test:**	**PZ-29**
		Test Well:	PZ-29
Depth to Static WL:	46.73 [ft]	Casing radius:	0.083 [ft]
Location:	Davidson County	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	8/26/2003	Aquifer Thickness:	51 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
63	4.693	48.31	1.58
64	4.973	48.25	1.52
65	5.27	48.19	1.46
66	5.583	48.13	1.40
67	5.915	48.07	1.34
68	6.267	48.01	1.28
69	6.64	47.95	1.22
70	7.035	47.89	1.16
71	7.453	47.83	1.10
72	7.897	47.77	1.04
73	8.367	47.71	0.98
74	8.865	47.66	0.93
75	9.392	47.61	0.88
76	9.95	47.55	0.82
77	10.542	47.50	0.77

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Analysis Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County



Slug Test: **PZ-50**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.89E+0 [ft/d]

Test parameters:

Test Well:	PZ-50	Aquifer Thickness:	25 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	5 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 1

Test Well:	**PZ-50**	**Slug Test:**	**PZ-50**
		Test Well:	PZ-50
Depth to Static WL:	25.65 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	5/11/2011	Aquifer Thickness:	25 [ft]

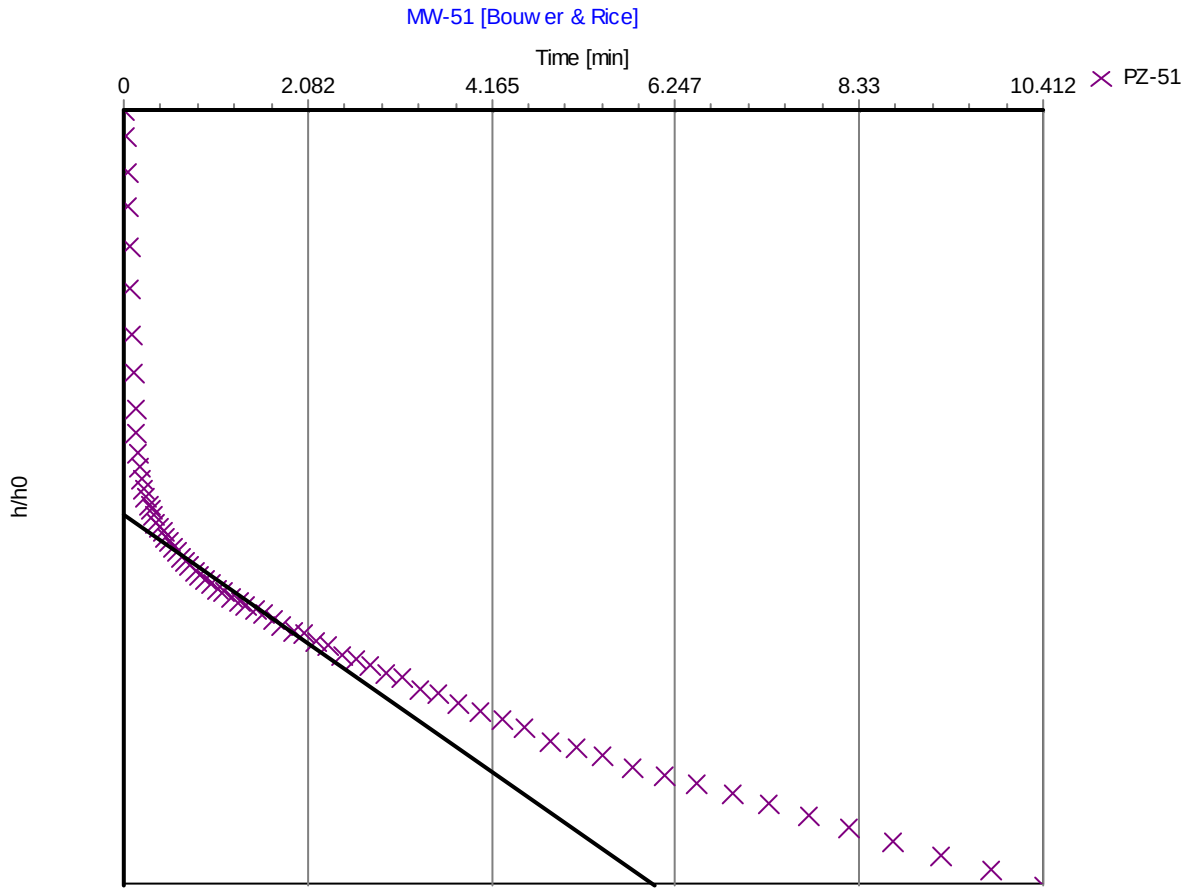
	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	28.02	2.37
2	0.014	27.67	2.02
3	0.029	27.40	1.75
4	0.045	27.20	1.55
5	0.061	27.04	1.39
6	0.079	26.91	1.26
7	0.098	26.79	1.14
8	0.118	26.70	1.05
9	0.139	26.62	0.97
10	0.161	26.54	0.89
11	0.185	26.46	0.81
12	0.21	26.41	0.76
13	0.236	26.35	0.70
14	0.264	26.30	0.65
15	0.294	26.24	0.59
16	0.325	26.19	0.54
17	0.359	26.13	0.48
18	0.394	26.09	0.44
19	0.431	26.06	0.41
20	0.471	26.04	0.39
21	0.513	26.01	0.36
22	0.557	25.99	0.34
23	0.604	25.97	0.32
24	0.654	25.95	0.30
25	0.707	25.93	0.28
26	0.763	25.91	0.26
27	0.823	25.90	0.25
28	0.883	25.88	0.23
29	0.953	25.87	0.22
30	1.023	25.85	0.20
31	1.093	25.84	0.19

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 2

Test Well:	**PZ-50**	**Slug Test:**	**PZ-50**
		Test Well:	PZ-50
Depth to Static WL:	25.65 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	5/11/2011	Aquifer Thickness:	25 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	1.173	25.83	0.18
33	1.263	25.82	0.17
34	1.343	25.81	0.16
35	1.443	25.80	0.15
36	1.543	25.80	0.15
37	1.643	25.80	0.15
38	1.753	25.78	0.13
39	1.873	25.78	0.13
40	2.003	25.78	0.13
41	2.133	25.78	0.13
42	2.273	25.77	0.12
43	2.423	25.77	0.12
44	2.583	25.78	0.13
45	2.743	25.77	0.12
46	2.923	25.77	0.12
47	3.113	25.78	0.13
48	3.313	25.77	0.12
49	3.523	25.77	0.12
50	3.743	25.77	0.12
51	3.983	25.77	0.12

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Analysis Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County



Slug Test: **PZ-51**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 2.07E-1 [ft/d]

Test parameters:

Test Well:	PZ-51	Aquifer Thickness:	29 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	10 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 1

Test Well:	**PZ-51**	**Slug Test:**	**PZ-51**
		Test Well:	PZ-51
Depth to Static WL:	11.05 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/17/2011	Aquifer Thickness:	29 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	13.47	2.42
2	0.011	13.28	2.23
3	0.023	13.13	2.08
4	0.036	12.95	1.90
5	0.049	12.78	1.73
6	0.063	12.61	1.56
7	0.078	12.44	1.39
8	0.094	12.28	1.23
9	0.11	12.16	1.11
10	0.128	12.06	1.01
11	0.147	12.00	0.95
12	0.167	11.95	0.90
13	0.188	11.92	0.87
14	0.21	11.89	0.84
15	0.234	11.87	0.82
16	0.259	11.85	0.80
17	0.285	11.84	0.79
18	0.313	11.82	0.77
19	0.343	11.81	0.76
20	0.374	11.80	0.75
21	0.408	11.79	0.74
22	0.443	11.78	0.73
23	0.48	11.77	0.72
24	0.52	11.76	0.71
25	0.562	11.75	0.70
26	0.606	11.74	0.69
27	0.653	11.73	0.68
28	0.703	11.73	0.68
29	0.756	11.72	0.67
30	0.812	11.71	0.66
31	0.872	11.70	0.65

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 2

Test Well:	**PZ-51**	**Slug Test:**	**PZ-51**
		Test Well:	PZ-51
Depth to Static WL:	11.05 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/17/2011	Aquifer Thickness:	29 [ft]

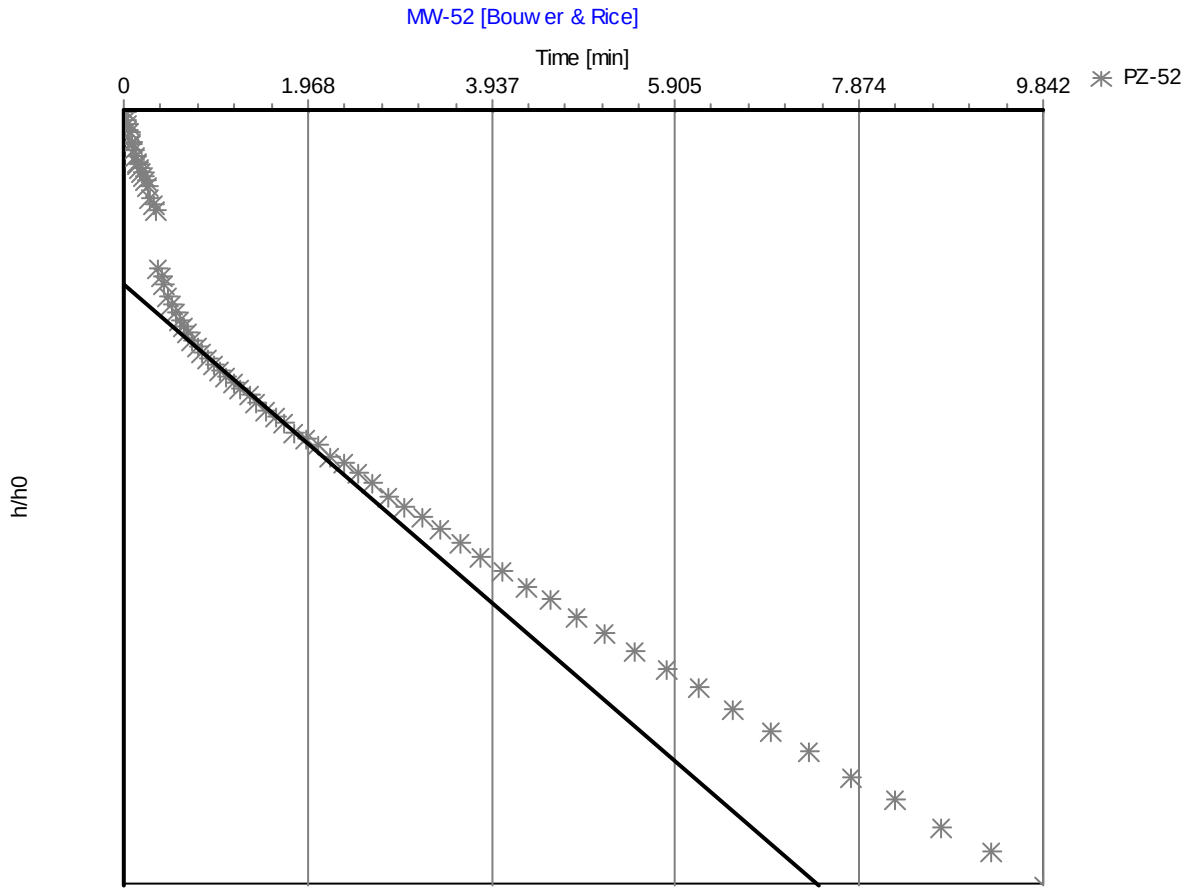
	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	0.932	11.70	0.65
33	1.002	11.69	0.64
34	1.072	11.68	0.63
35	1.142	11.68	0.63
36	1.222	11.66	0.61
37	1.312	11.66	0.61
38	1.392	11.65	0.60
39	1.492	11.65	0.59
40	1.592	11.64	0.59
41	1.692	11.63	0.58
42	1.802	11.62	0.57
43	1.922	11.61	0.56
44	2.052	11.61	0.56
45	2.182	11.60	0.55
46	2.322	11.59	0.54
47	2.472	11.58	0.53
48	2.632	11.57	0.52
49	2.792	11.56	0.51
50	2.972	11.55	0.50
51	3.162	11.55	0.50
52	3.362	11.53	0.48
53	3.572	11.53	0.48
54	3.792	11.51	0.46
55	4.032	11.50	0.45
56	4.282	11.49	0.44
57	4.542	11.48	0.43
58	4.822	11.47	0.42
59	5.122	11.46	0.41
60	5.432	11.45	0.40
61	5.772	11.44	0.39
62	6.122	11.43	0.38

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 3

Test Well:	**PZ-51**	**Slug Test:**	**PZ-51**
		Test Well:	PZ-51
Depth to Static WL:	11.05 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/17/2011	Aquifer Thickness:	29 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
63	6.492	11.42	0.37
64	6.892	11.41	0.36
65	7.312	11.41	0.35
66	7.752	11.39	0.34
67	8.222	11.38	0.33
68	8.722	11.37	0.32
69	9.252	11.36	0.31
70	9.812	11.35	0.30
71	10.412	11.34	0.29

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Analysis Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County



Slug Test: **PZ-52**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 2.24E-1 [ft/d]

Test parameters:

Test Well:	PZ-52	Aquifer Thickness:	25 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	5 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner
14 N. Boylan Avenue
Raleigh, North Carolina 27603
Ph. 919-828-0577

Slug Test Data Report

Project: Davidson County Phase 2
Number: Davdco-10-4
Client: Davidson County

Test Well:	**PZ-52**	**Slug Test:**	**PZ-52**
		Test Well:	PZ-52
Depth to Static WL:	34.47 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	5/17/2011	Aquifer Thickness:	25 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	37.52	3.05
2	0.01	37.50	3.02
3	0.02	37.49	3.02
4	0.03	37.47	3.00
5	0.041	37.46	2.99
6	0.053	37.44	2.97
7	0.066	37.43	2.96
8	0.079	37.40	2.93
9	0.093	37.40	2.93
10	0.108	37.38	2.91
11	0.124	37.36	2.89
12	0.14	37.34	2.87
13	0.158	37.34	2.87
14	0.177	37.33	2.86
15	0.197	37.32	2.84
16	0.218	37.30	2.83
17	0.24	37.29	2.82
18	0.264	37.28	2.81
19	0.289	37.24	2.77
20	0.315	37.23	2.76
21	0.343	37.21	2.74
22	0.373	37.06	2.59
23	0.404	37.03	2.56
24	0.438	37.02	2.55
25	0.473	36.98	2.51
26	0.51	36.97	2.50
27	0.55	36.95	2.48
28	0.592	36.93	2.46
29	0.636	36.91	2.44
30	0.683	36.90	2.43
31	0.733	36.88	2.41

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 2

Test Well:	**PZ-52**	**Slug Test:**	**PZ-52**
		Test Well:	PZ-52
Depth to Static WL:	34.47 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	5/17/2011	Aquifer Thickness:	25 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	0.786	36.86	2.39
33	0.842	36.85	2.38
34	0.902	36.84	2.37
35	0.962	36.82	2.35
36	1.032	36.81	2.34
37	1.102	36.79	2.32
38	1.172	36.78	2.31
39	1.252	36.77	2.30
40	1.342	36.75	2.28
41	1.422	36.74	2.27
42	1.522	36.72	2.25
43	1.622	36.71	2.23
44	1.722	36.69	2.22
45	1.832	36.67	2.20
46	1.952	36.66	2.19
47	2.082	36.64	2.17
48	2.212	36.62	2.15
49	2.352	36.60	2.13
50	2.502	36.58	2.11
51	2.662	36.56	2.09
52	2.822	36.53	2.06
53	3.002	36.52	2.05
54	3.192	36.50	2.02
55	3.392	36.47	2.00
56	3.602	36.44	1.97
57	3.822	36.42	1.95
58	4.062	36.39	1.92
59	4.312	36.36	1.89
60	4.572	36.34	1.87
61	4.852	36.30	1.83
62	5.152	36.28	1.80

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County	Page 3

Test Well:	**PZ-52**	**Slug Test:**	**PZ-52**
		Test Well:	PZ-52
Depth to Static WL:	34.47 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	5 [ft]
Date:	5/17/2011	Aquifer Thickness:	25 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
63	5.462	36.24	1.77
64	5.802	36.21	1.74
65	6.152	36.18	1.71
66	6.522	36.14	1.67
67	6.922	36.11	1.64
68	7.342	36.07	1.60
69	7.782	36.03	1.56
70	8.252	36.00	1.53
71	8.752	35.96	1.49
72	9.282	35.92	1.45
73	9.842	35.88	1.41

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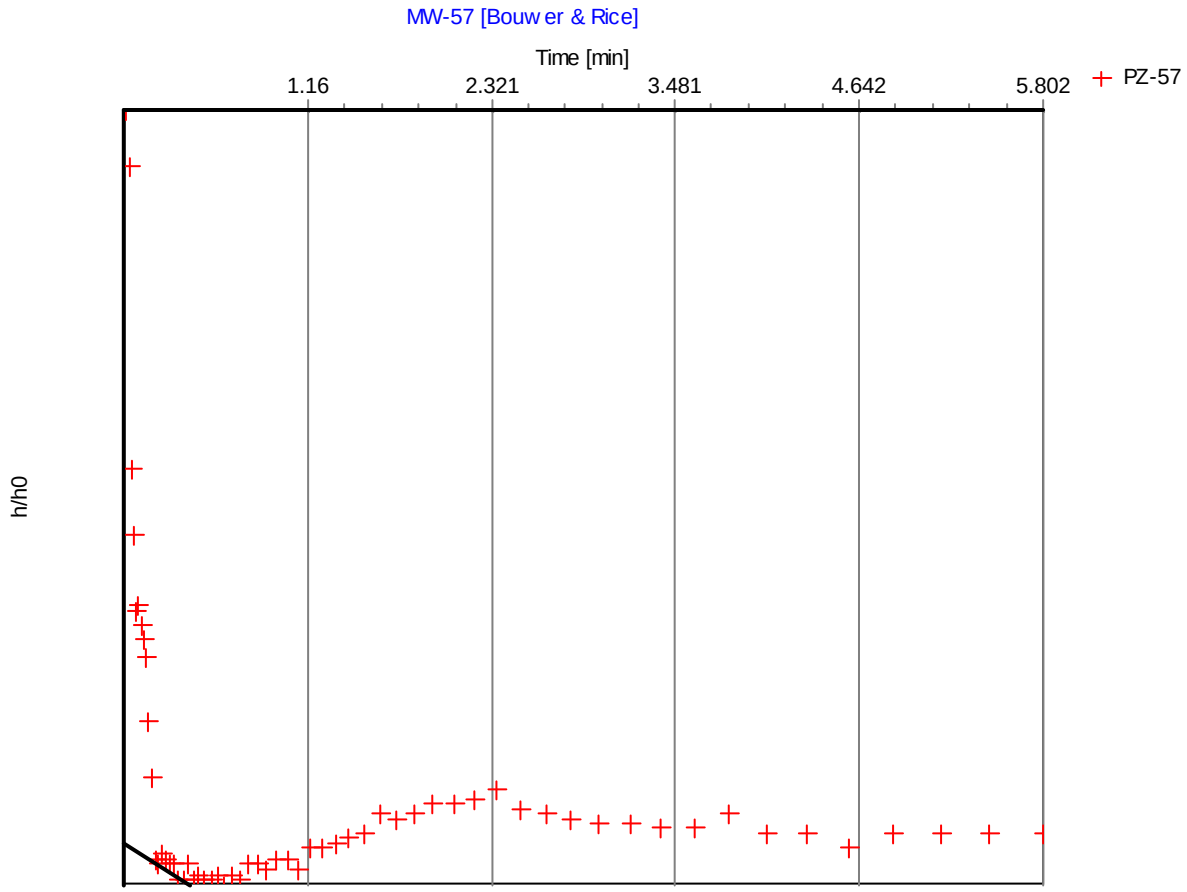
Slug Test Analysis Report

Project:	Davidson County Phase 2
Number:	Davdco-10-4
Client:	Davidson County



Slug Test: **PZ-57**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 2.24E-1 [ft/d]

Test parameters:

Test Well:	PZ-57	Aquifer Thickness:	23 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	10 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by:

Evaluation Date: 5/17/2011

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 1

Test Well:	**PZ-57**	**Slug Test:**	**PZ-57**
		Test Well:	PZ-57
Depth to Static WL:	17.13 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/11/2011	Aquifer Thickness:	23 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	17.81	0.68
2	0.01	17.54	0.41
3	0.041	17.50	0.37
4	0.053	17.34	0.21
5	0.066	17.32	0.19
6	0.079	17.29	0.16
7	0.093	17.30	0.17
8	0.108	17.29	0.16
9	0.124	17.29	0.16
10	0.14	17.28	0.15
11	0.158	17.26	0.13
12	0.177	17.25	0.12
13	0.197	17.23	0.10
14	0.218	17.23	0.10
15	0.24	17.24	0.11
16	0.264	17.23	0.10
17	0.289	17.23	0.10
18	0.315	17.23	0.10
19	0.343	17.23	0.10
20	0.373	17.23	0.10
21	0.404	17.23	0.10
22	0.438	17.23	0.10
23	0.473	17.23	0.10
24	0.51	17.23	0.10
25	0.55	17.23	0.10
26	0.592	17.23	0.10
27	0.636	17.23	0.10
28	0.683	17.23	0.10
29	0.733	17.23	0.10
30	0.786	17.23	0.10
31	0.842	17.23	0.10

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577		**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County	Page 2

Test Well:	**PZ-57**	**Slug Test:**	**PZ-57**
		Test Well:	PZ-57
Depth to Static WL:	17.13 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/11/2011	Aquifer Thickness:	23 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	0.902	17.23	0.10
33	0.962	17.23	0.10
34	1.032	17.23	0.10
35	1.102	17.23	0.10
36	1.172	17.24	0.11
37	1.252	17.24	0.11
38	1.342	17.24	0.11
39	1.422	17.24	0.11
40	1.522	17.24	0.11
41	1.622	17.24	0.11
42	1.722	17.24	0.11
43	1.832	17.24	0.11
44	1.952	17.25	0.12
45	2.082	17.25	0.12
46	2.212	17.25	0.12
47	2.352	17.25	0.12
48	2.502	17.24	0.11
49	2.662	17.24	0.11
50	2.822	17.24	0.11
51	3.002	17.24	0.11
52	3.192	17.24	0.11
53	3.392	17.24	0.11
54	3.602	17.24	0.11
55	3.822	17.24	0.11
56	4.062	17.24	0.11
57	4.312	17.24	0.11
58	4.572	17.24	0.11
59	4.852	17.24	0.11
60	5.152	17.24	0.11
61	5.462	17.24	0.11
62	5.802	17.24	0.11

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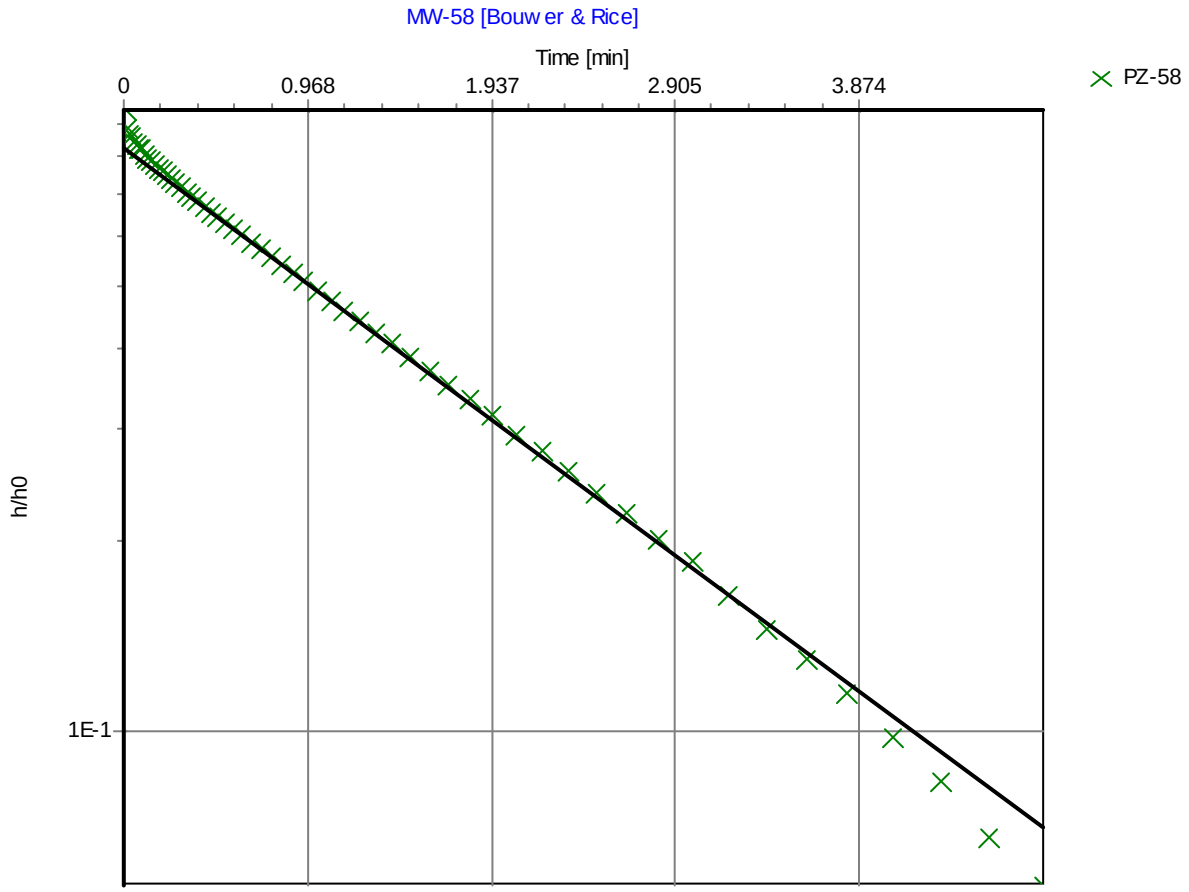
Slug Test Analysis Report

Project:	Davidson County Phase 2
Number:	Davdco-10-4
Client:	Davidson County



Slug Test: **PZ-58**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 7.41E-1 [ft/d]

Test parameters:

Test Well:	PZ-58	Aquifer Thickness:	24.47 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	10 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 1

Test Well:	**PZ-58**	**Slug Test:**	**PZ-58**
		Test Well:	PZ-58
Depth to Static WL:	25.53 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/11/2011	Aquifer Thickness:	24.47 [ft]

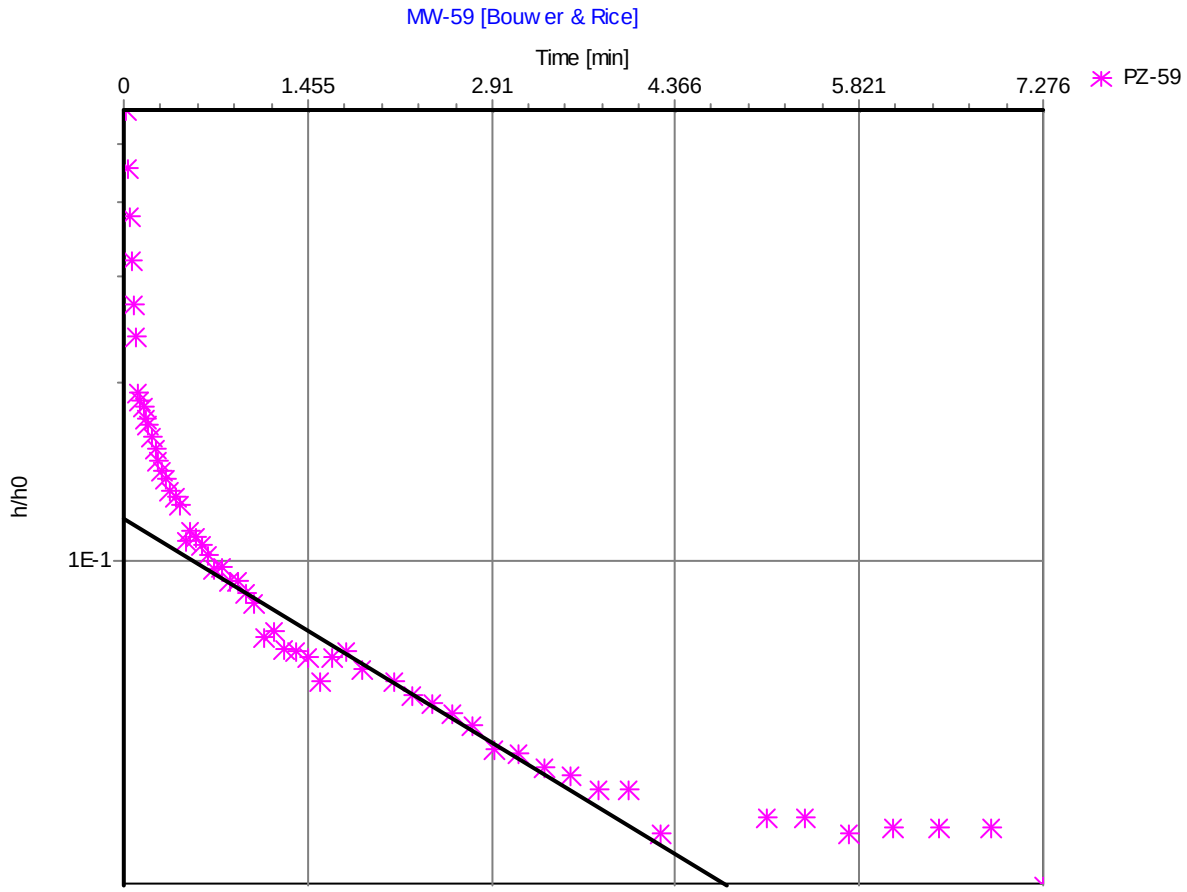
	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	28.01	2.47
2	0.01	27.87	2.34
3	0.02	27.72	2.19
4	0.031	27.67	2.14
5	0.043	27.66	2.13
6	0.056	27.62	2.09
7	0.069	27.60	2.07
8	0.083	27.58	2.05
9	0.098	27.57	2.04
10	0.114	27.53	2.00
11	0.13	27.51	1.97
12	0.148	27.48	1.95
13	0.167	27.45	1.92
14	0.187	27.44	1.90
15	0.208	27.41	1.88
16	0.23	27.38	1.85
17	0.254	27.36	1.83
18	0.279	27.33	1.80
19	0.305	27.30	1.77
20	0.333	27.27	1.74
21	0.363	27.25	1.72
22	0.394	27.22	1.69
23	0.428	27.19	1.66
24	0.463	27.15	1.62
25	0.5	27.12	1.59
26	0.54	27.09	1.56
27	0.582	27.06	1.53
28	0.626	27.02	1.49
29	0.673	26.98	1.45
30	0.723	26.95	1.42
31	0.776	26.91	1.38

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577		**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County	Page 2

Test Well:	**PZ-58**	**Slug Test:**	**PZ-58**
		Test Well:	PZ-58
Depth to Static WL:	25.53 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/11/2011	Aquifer Thickness:	24.47 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	0.832	26.87	1.34
33	0.892	26.83	1.30
34	0.952	26.80	1.27
35	1.022	26.75	1.22
36	1.092	26.71	1.18
37	1.162	26.67	1.14
38	1.242	26.62	1.09
39	1.332	26.58	1.05
40	1.412	26.54	1.01
41	1.512	26.49	0.96
42	1.612	26.44	0.91
43	1.712	26.40	0.87
44	1.822	26.36	0.82
45	1.942	26.31	0.78
46	2.072	26.26	0.73
47	2.202	26.21	0.68
48	2.342	26.17	0.63
49	2.492	26.12	0.59
50	2.652	26.08	0.54
51	2.812	26.03	0.50
52	2.992	25.99	0.46
53	3.182	25.94	0.40
54	3.382	25.89	0.36
55	3.592	25.85	0.32
56	3.812	25.81	0.28
57	4.052	25.77	0.24
58	4.302	25.74	0.21
59	4.562	25.70	0.17
60	4.842	25.67	0.14

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Analysis Report**	
	Project:	Davidson County Phase 2
	Number:	Davdco-10-4
	Client:	Davidson County



Slug Test: **PZ-59**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 3.58E-1 [ft/d]

Test parameters:

Test Well:	PZ-59	Aquifer Thickness:	25 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	10 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 1

Test Well:	**PZ-59**	**Slug Test:**	**PZ-59**
		Test Well:	PZ-59
Depth to Static WL:	19.23 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/12/2011	Aquifer Thickness:	25 [ft]

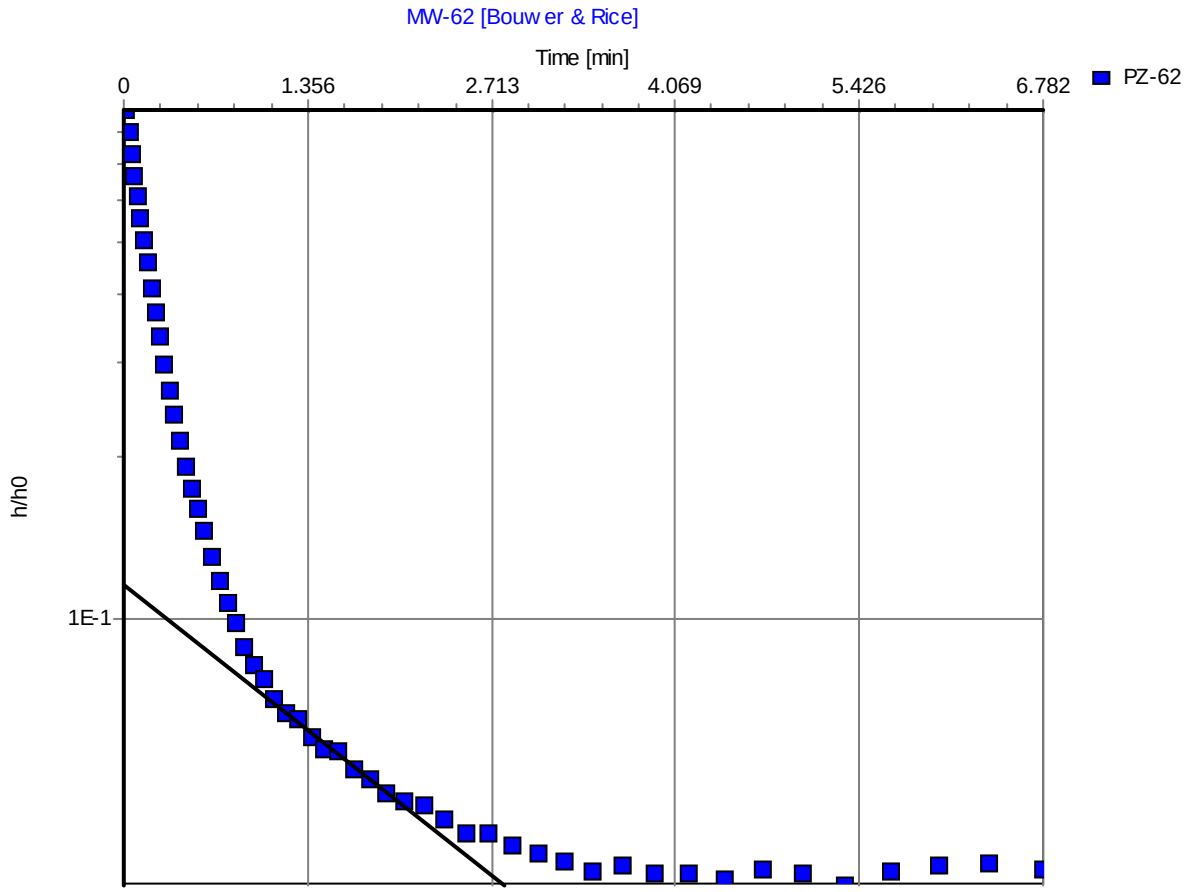
	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	20.49	1.26
2	0.013	19.95	0.72
3	0.027	19.80	0.57
4	0.042	19.71	0.48
5	0.058	19.63	0.40
6	0.074	19.57	0.34
7	0.092	19.53	0.30
8	0.111	19.47	0.24
9	0.131	19.46	0.23
10	0.152	19.46	0.23
11	0.174	19.45	0.22
12	0.198	19.44	0.21
13	0.223	19.43	0.20
14	0.249	19.43	0.20
15	0.277	19.42	0.18
16	0.307	19.41	0.18
17	0.338	19.40	0.17
18	0.372	19.40	0.16
19	0.407	19.39	0.16
20	0.444	19.39	0.16
21	0.484	19.37	0.14
22	0.526	19.37	0.14
23	0.57	19.37	0.14
24	0.617	19.36	0.13
25	0.667	19.36	0.13
26	0.72	19.35	0.12
27	0.776	19.35	0.12
28	0.836	19.35	0.12
29	0.896	19.35	0.12
30	0.966	19.34	0.11
31	1.036	19.34	0.11

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 2

Test Well:	**PZ-59**	**Slug Test:**	**PZ-59**
		Test Well:	PZ-59
Depth to Static WL:	19.23 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	JAS	Screen length:	10 [ft]
Date:	5/12/2011	Aquifer Thickness:	25 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	1.106	19.32	0.09
33	1.186	19.33	0.10
34	1.276	19.32	0.09
35	1.356	19.32	0.09
36	1.456	19.32	0.09
37	1.556	19.31	0.08
38	1.656	19.32	0.09
39	1.766	19.32	0.09
40	1.886	19.31	0.08
41	2.146	19.31	0.08
42	2.286	19.31	0.07
43	2.436	19.30	0.07
44	2.596	19.30	0.07
45	2.756	19.30	0.07
46	2.936	19.29	0.06
47	3.126	19.29	0.06
48	3.326	19.29	0.06
49	3.536	19.29	0.05
50	3.756	19.28	0.05
51	3.996	19.28	0.05
52	4.246	19.27	0.04
53	5.086	19.28	0.05
54	5.396	19.28	0.05
55	5.736	19.27	0.04
56	6.086	19.28	0.04
57	6.456	19.28	0.04
58	6.856	19.28	0.04
59	7.276	19.27	0.04

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Analysis Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County



Slug Test: **PZ-62**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 6.75E-1 [ft/d]

Test parameters:

Test Well:	PZ-62	Aquifer Thickness:	24 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	10 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner
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Ph. 919-828-0577

Slug Test Data Report

Project: Davidson County Phase 2
Number: Davdco-10-4
Client: Davidson County

Test Well:	**PZ-62**	**Slug Test:**	**PZ-62**
		Test Well:	PZ-62
Depth to Static WL:	16.19 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	DMM	Screen length:	10 [ft]
Date:	5/17/2011	Aquifer Thickness:	24 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	18.74	2.54
2	0.018	18.43	2.23
3	0.037	18.22	2.03
4	0.057	18.05	1.86
5	0.078	17.88	1.69
6	0.1	17.74	1.55
7	0.124	17.60	1.41
8	0.149	17.47	1.28
9	0.175	17.35	1.16
10	0.203	17.24	1.05
11	0.233	17.14	0.95
12	0.264	17.04	0.85
13	0.298	16.95	0.76
14	0.333	16.87	0.68
15	0.37	16.80	0.61
16	0.41	16.74	0.54
17	0.452	16.68	0.49
18	0.496	16.64	0.45
19	0.543	16.60	0.41
20	0.593	16.56	0.37
21	0.646	16.52	0.33
22	0.702	16.49	0.30
23	0.762	16.46	0.27
24	0.822	16.44	0.25
25	0.892	16.42	0.23
26	0.962	16.40	0.21
27	1.032	16.39	0.20
28	1.112	16.37	0.18
29	1.202	16.36	0.17
30	1.282	16.36	0.17
31	1.382	16.34	0.15

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 2

Test Well:	**PZ-62**	**Slug Test:**	**PZ-62**
		Test Well:	PZ-62
Depth to Static WL:	16.19 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	DMM	Screen length:	10 [ft]
Date:	5/17/2011	Aquifer Thickness:	24 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	1.482	16.34	0.15
33	1.582	16.34	0.14
34	1.692	16.32	0.13
35	1.812	16.32	0.13
36	1.942	16.31	0.12
37	2.072	16.31	0.12
38	2.212	16.31	0.11
39	2.362	16.30	0.11
40	2.522	16.29	0.10
41	2.682	16.29	0.10
42	2.862	16.29	0.10
43	3.052	16.28	0.09
44	3.252	16.28	0.09
45	3.462	16.28	0.09
46	3.682	16.28	0.09
47	3.922	16.28	0.09
48	4.172	16.28	0.09
49	4.432	16.27	0.08
50	4.712	16.28	0.09
51	5.012	16.28	0.09
52	5.322	16.27	0.08
53	5.662	16.28	0.09
54	6.012	16.28	0.09
55	6.382	16.28	0.09
56	6.782	16.28	0.09

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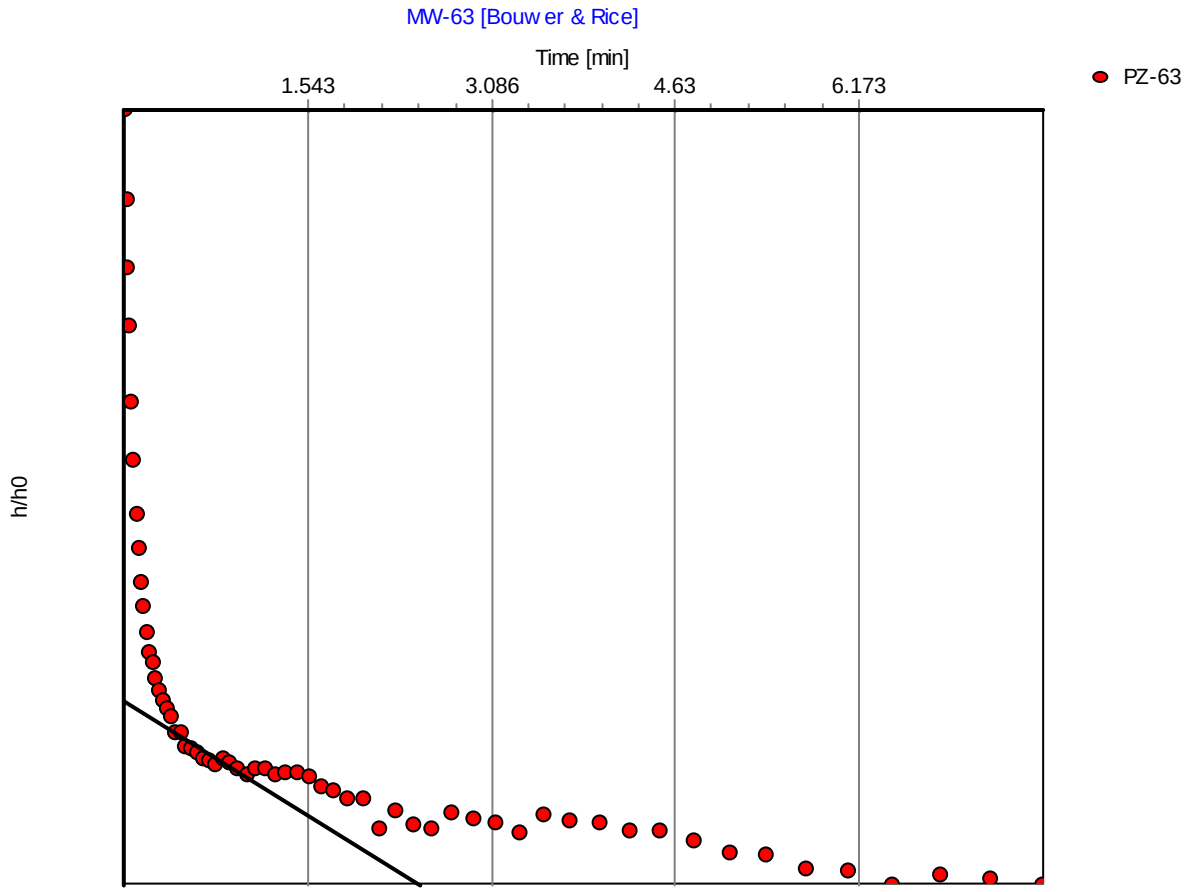
Slug Test Analysis Report

Project:	Davidson County Phase 2
Number:	Davdco-10-4
Client:	Davidson County



Slug Test: **PZ-63**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.59E-1 [ft/d]

Test parameters:

Test Well:	PZ-63	Aquifer Thickness:	15 [ft]
Casing radius:	0.083 [ft]	Gravel Pack Porosity (%)	25
Screen length:	10 [ft]		
Boring radius:	0.1667 [ft]		
r(eff):	0.110 [ft]		

Comments:

Evaluated by: JAS

Evaluation Date: 5/17/2011

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 1

Test Well:	**PZ-63**	**Slug Test:**	**PZ-63**
		Test Well:	PZ-63
Depth to Static WL:	35.77 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	DMM	Screen length:	10 [ft]
Date:	5/12/2011	Aquifer Thickness:	15 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
1	0	36.90	1.13
2	0.013	36.75	0.98
3	0.027	36.62	0.84
4	0.042	36.52	0.75
5	0.058	36.46	0.69
6	0.074	36.38	0.60
7	0.092	36.32	0.55
8	0.111	36.27	0.50
9	0.131	36.25	0.48
10	0.152	36.22	0.45
11	0.174	36.20	0.43
12	0.198	36.18	0.41
13	0.223	36.17	0.40
14	0.249	36.16	0.39
15	0.277	36.15	0.38
16	0.307	36.15	0.38
17	0.338	36.14	0.37
18	0.372	36.14	0.36
19	0.407	36.13	0.36
20	0.444	36.12	0.35
21	0.484	36.12	0.35
22	0.526	36.11	0.34
23	0.57	36.11	0.34
24	0.617	36.11	0.34
25	0.667	36.11	0.34
26	0.72	36.11	0.33
27	0.776	36.10	0.33
28	0.836	36.11	0.34
29	0.896	36.10	0.33
30	0.966	36.10	0.33
31	1.036	36.10	0.33

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County — Page 2

Test Well:	**PZ-63**	**Slug Test:**	**PZ-63**
		Test Well:	PZ-63
Depth to Static WL:	35.77 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	DMM	Screen length:	10 [ft]
Date:	5/12/2011	Aquifer Thickness:	15 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
32	1.106	36.10	0.33
33	1.186	36.10	0.33
34	1.276	36.10	0.33
35	1.356	36.10	0.33
36	1.456	36.10	0.33
37	1.556	36.10	0.33
38	1.656	36.09	0.32
39	1.766	36.09	0.32
40	1.886	36.09	0.31
41	2.016	36.09	0.31
42	2.146	36.07	0.30
43	2.286	36.08	0.31
44	2.436	36.07	0.30
45	2.596	36.07	0.30
46	2.756	36.08	0.31
47	2.936	36.07	0.30
48	3.126	36.07	0.30
49	3.326	36.07	0.30
50	3.536	36.08	0.31
51	3.756	36.07	0.30
52	3.996	36.07	0.30
53	4.246	36.07	0.30
54	4.506	36.07	0.30
55	4.786	36.06	0.29
56	5.086	36.06	0.29
57	5.396	36.06	0.29
58	5.736	36.05	0.28
59	6.086	36.05	0.28
60	6.456	36.04	0.27
61	6.856	36.05	0.28
62	7.276	36.05	0.28

Richardson Smith Gardner 14 N. Boylan Avenue Raleigh, North Carolina 27603 Ph. 919-828-0577	**Slug Test Data Report** Project: Davidson County Phase 2 Number: Davdco-10-4 Client: Davidson County	Page 3

Test Well:	**PZ-63**	**Slug Test:**	**PZ-63**
		Test Well:	PZ-63
Depth to Static WL:	35.77 [ft]	Casing radius:	0.083 [ft]
Location:	Thomasville, NC	Boring radius:	0.1667 [ft]
Recorded by:	DMM	Screen length:	10 [ft]
Date:	5/12/2011	Aquifer Thickness:	15 [ft]

	Time [min]	Depth to WL [ft]	Drawdown [ft]
63	7.716	36.04	0.27

Appendix 4

Water Quality Monitoring Plan

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Water Quality Monitoring Plan

Davidson County MSW Landfill
Phase 2 Areas 1 & 2
Thomasville, North Carolina

NC Solid Waste Permit No. 29-06

Prepared For:

Davidson County Integrated Solid Waste
1242 Old US Hwy 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

May 2012

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Water Quality Monitoring Plan

Davidson County MSW Landfill - Phase 2 Areas 1 & 2
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, North Carolina

RSG Project No. DAVDCO-10-5

Joan A. Smyth, P.G.
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DAVIDSON COUNTY PHASE 2 LANDFILL
WATER QUALITY MONITORING PLAN

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Overview 1
1.2 Site Contact Information 2
1.2.1 Davidson County Integrated Solid Waste 2
1.2.2 North Carolina DENR 2
1.2.3 Division of Waste Management (DWM) – Solid Waste Section 2
1.3 Site Background 2
1.3.1 Geology 3
1.3.2 Hydrogeology 3
2.0 MONITORING PROGRAM 4
2.1 Overview 4
2.2 Monitoring Network and Analytical Parameters 4
2.2.1 Modifications from Previous Monitoring Network 4
2.3 Groundwater Sample Collection 5
2.3.1 Introduction 5
2.3.1.1 Guidance Documents 5
2.3.1.2 Fuel Powered Equipment 5
2.3.1.3 Equipment Decontamination 6
2.3.2 Water Level Measurements 7
2.3.2.1 Static Water Levels 7
2.3.2.2 Contamination Prevention 7
2.3.2.3 Equipment 7
2.3.3 Well Monitor Evaluations 8
2.3.3.1 Description 8
2.3.3.2 Contamination Prevention 8
2.3.3.3 Calculations 8
2.3.3.4 Well Purging 8
2.3.3.5 Purge Rate 11
2.3.3.6 Purge Water Disposal 11
2.3.3.7 Non-Dedicated Equipment 11
2.3.4 Sample Collection 11
2.3.4.1 Field Parameters 12
2.3.4.2 Sample Equipment 12
2.3.4.3 Sample Transference 13
2.3.4.4 Order of Sample Collection 13
2.3.4.5 Decontamination 14
2.3.4.6 Sample Preservation 14
2.3.4.7 Field Quality Assurance 14
2.3.4.8 Sample Containers 14
2.4 Surface Water Sample Collection 15
2.4.1 Surface Water Level Observations 15

2.4.1.1 Monitoring Conditions 15
2.4.1.2 Monitoring Condition Modification 15
2.4.2 Sample Collection 16
2.4.2.1 Collection Procedure 16
2.4.2.2 Field Parameters 16
2.4.2.3 Observation 16
2.4.2.4 Decontamination 17
2.4.2.5 Sample Containers 17
3.0 FIELD QA/QC PROGRAM 18
3.1 Overview 18
3.2 Blank Samples 18
3.2.1 Trip Blanks 18
3.2.2 Field Blanks 18
3.3 Blank Concentrations 18
3.4 Field Instruments 18
4.0 SAMPLE PRESERVATION AND SHIPMENT 20
4.1 Overview 20
4.2 Sample Preservation 20
4.3 Storage/Transport Conditions 20
4.4 Sample Delivery 20
4.5 Chain of Custody 20
5.0 FIELD LOGBOOK 22
5.1 Overview 22
6.0 LABORATORY ANALYSIS 23
6.1 Overview 23
6.2 Laboratory Quality Assurance/Quality Control 23
6.3 Laboratory Quality Control Checks 23
6.4 Data Review 23
7.0 RECORD KEEPING AND REPORTING 24
7.1 Overview 24
7.2 Groundwater System Evaluations 24
7.3 Result Reporting 24
8.0 MONITORING PROGRAM MODIFICATIONS 26
8.1 Overview 26
8.2 Well Abandonment/Rehabilitation 26
8.3 Additional Well Installations 26
8.4 Implementation Schedule 26

Figures

Figure 1 – Water Quality Monitoring Locations

Tables

Table 1 – Water Quality Monitoring Parameters

1.0 INTRODUCTION

1.1 OVERVIEW

This Water Quality Monitoring Plan (WQMP) specifies the procedures and requirements to satisfy North Carolina Solid Waste Management Rule 15A NCAC 13B.0544 (b) and (c). The WQMP addresses the following two (2) major elements; monitoring/sampling of the groundwater system and monitoring/sampling of the surface water.

The WQMP will meet the following requirements:

- *Represent the quality of the background groundwater that has not been affected by leakage from the unit (.0544 (b)(1)(A)).*
- *Represent the quality of the groundwater passing the relevant point of compliance as approved by the Division (.0544 (b)(1)(B)).*
- *The groundwater monitoring programs must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and down-gradient wells (.0544 (b)(1)(C)).*
- *Detection Groundwater monitoring program (.0544 (b)(1)(D)).*
- *The sampling procedures and frequency must be protective of human health and the environment (.0544 (b)(1)(E)).*
- *Responsibility of sample collection and analysis must be defined as a part of the monitoring plan (.0544 (c)(2)).*

This WQMP also addresses the following procedures that will be implemented to ensure the integrity of each sampling event:

- Sample preservation and shipment;
- Laboratory analytical procedures;
- Sample Chain-of-custody control; and
- Quality assurance/quality control programs.

The methods and procedures described in the WQMP are intended to facilitate the collection of true and representative samples and test data. Field procedures are presented in **Section 2.0** in their general order of implementation. Equipment requirements for each field task are presented within the applicable section. Laboratory procedures, quality assurance methods, and record keeping requirements are presented in **Sections 3.0 through 8.0.**

Strict adherence to the procedures stipulated in this plan is required. Any variations from these procedures should be thoroughly documented.

1.2 SITE CONTACT INFORMATION

In case of emergencies, or if questions arise during the implementation of this program, please contact the following:

1.2.1 Davidson County Integrated Solid Waste

1242 Old US Hwy 29
Thomasville, North Carolina 27360
Phone: (336) 242-2284
Mr. Charles Brushwood – Solid Waste Director
Charlie.Brushwood@davidsoncountync.gov

1.2.2 North Carolina DENR

North Carolina DENR – Raleigh Central Office (RCO)
401 Oberlin Road, Suite 150
Raleigh, NC 27605
Phone: (919) 707-8200

North Carolina DENR – Winston-Salem Regional Office (WRO)
585 Waughtown St
Winston-Salem, NC 27107
Phone: (336) 771-5000

1.2.3 Division of Waste Management (DWM) – Solid Waste Section

Field Operations Branch Head:	Mark Poindexter (RCO)
Solid Waste Permit Engineer	John Murray (WRO)
Environmental Senior Specialist:	Hugh Jernigan (WRO)

1.3 SITE BACKGROUND

The Davidson County Phase 2 Landfill (Permit 29-06), located at 1242 Old Hwy 29 Thomasville, NC, has been in operation since 2008. The facility is located approximately 5 miles southwest of Thomasville. Area development consists of a mix of residential and wooded undeveloped use. In general, development in the area is primarily along the main roads. The site and monitoring locations are shown on **Figure 1**.

1.3.1 Geology

The Davidson County Landfill facility is located in the Piedmont Physiographic Province of North Carolina. More specifically, the Geologic Map of North Carolina (1985) indicates that the site lies within, but at the western margin of, the Carolina Slate Belt. This belt includes predominantly volcanic and sedimentary rocks of Late Proterozoic to Cambrian age that have been metamorphosed and intruded by numerous igneous plutons. The boundary zone between the Carolina Slate Belt and the adjacent Charlotte Belt is known as the Gold Hill/Silver Hill shear zone.

The most detailed mapping of the area was published by the US Geological Survey in the Geologic Map of Charlotte by Goldsmith, Milton and Horton (1988). This mapping indicates that the site vicinity is underlain by two stratigraphic units: metavolcanic rocks (mv), and metamorphosed granodiorite (mgd).

The metavolcanic rocks include mafic, intermediate and felsic volcanic rocks, rocks from the Flat Swamp Member of the Cid Formation, and metavolcanic rocks of the Battleground Formation. The Battleground Formation is characterized as a quartz-sericite schist and phyllite. It contains subordinate beds of quartz-pebble conglomerate, quartzite, kyanite or sillmanite quartzite and manganiferous schist. The metamorphosed granodiorite (mgd) occurs in the central portion of the proposed Phase 2 area. This unit is locally porphyritic.

Two geophysical studies performed at the site indicate nine (9) major bedrock fractures trending NW-SE across the Phase 2 site. Additionally five (5) diabase dikes trending NE-SW were noted. Only three of these show extensive expression, while two of them are inferred from minor results in limited areas.

1.3.2 Hydrogeology

The uppermost aquifer on-site is seen at approximately elevation 660 feet to 690 feet and consists primarily of unconsolidated sandy silts and clays. This is an unconfined aquifer. Discharge from the uppermost aquifer occurs year-round along Rich Fork Creek to the north, and west and toward Jimmy's Creek to south of the site. A potentiometric surface of the site is included as **Figure 1**.

This Water Quality Monitoring Plan (WQMP) has been prepared to meet the field sampling and laboratory analysis requirements of ongoing monitoring at the site. The WQMP details field and laboratory protocols that must be followed to meet the data objectives of semi-annual groundwater monitoring.

2.0 MONITORING PROGRAM

2.1 OVERVIEW

This section of the Water Quality Monitoring Plan addresses each aspect of the monitoring program. As a minimum, the Davidson County landfill will monitor the groundwater quality on a semi-annual basis.

2.2 MONITORING NETWORK AND ANALYTICAL PARAMETERS

A review of historical water level data indicates that groundwater is flowing to the east at both the MSW and C&D landfills toward the discharge point of Rich Fork Creek. There are 14 locations proposed for inclusion in the MSW landfill monitoring network. In general, these are similar to the previous Water Quality Monitoring Plan; however, modifications from prior monitoring events are discussed in detail in **Section 2.2.1**. The monitoring network is summarized in the table below.

MSW Landfill Monitoring Network

Well	Location	Sampling Frequency	Analytical Parameters
MW-1	Upgradient	Semi-Annual	Appendix I + Field
MW-2	Downgradient	Semi-Annual	Appendix I + Field
MW-3S	Downgradient	Semi-Annual	Appendix I + Field
MW-3D	Downgradient - bedrock	Semi-Annual	Water Level Only
MW-4S	Downgradient	Semi-Annual	Appendix I + Field
MW-4D	Downgradient - bedrock	Semi-Annual	Water Level Only
MW-5	Downgradient	Semi-Annual	Appendix I + Field
MW-6S	Downgradient	Semi-Annual	Appendix I + Field
MW-8	Downgradient	Semi-Annual	Appendix I + Field
MW-9	Downgradient	Semi-Annual	Appendix I + Field
MW-10S	Downgradient	Semi-Annual	Appendix I + Field
MW-10D	Downgradient - bedrock	Semi-Annual	Water Level Only
SW-1	Upgradient Rich Fork Creek	Semi-Annual	Appendix I + Field
SW-2	Downgradient Rich Fork Creek	Semi-Annual	Appendix I + Field

Note: Appendix I parameters are listed in **Table 1**.
Water Level Only – Bedrock wells will be monitored for water levels only. Should analysis of upper aquifer wells associated with the bedrock wells indicate impact from the landfill, these wells will be considered for future sampling/analysis.

2.2.1 Modifications from Previous Monitoring Network

Monitoring wells MW-10S and MW-10D will be added to the groundwater monitoring network for this site. These wells will be converted from existing piezometers PZ-37S and PZ-37D. These piezometers were installed downgradient of the proposed Area 2 with the deeper well (PZ-37D) installed in an identified fracture within the bedrock. These wells are constructed to 27 and 44 feet below grade respectively, and the deep well (designated by "D") is installed in the bedrock.

Additionally, the bedrock aquifer wells (MW-3d, MW-4d, and MW-10D) will only be monitored for water levels. The uppermost aquifer is the first location where detection of impact from the landfill would occur since the horizontal component of groundwater flow is greater than the vertical component. Therefore, we request to only monitor water levels in the bedrock aquifer wells on a semi-annual basis. If the upper aquifer wells associated with these bedrock wells (MW-3s, MW-4s, or MW-10s) indicate groundwater quality impact from the landfill, the bedrock aquifer wells will be considered for water quality sampling and analysis.

Finally, two existing wells MW-6d and MW-7 have been found to be consistently dry. Monitoring well MW-6d has been found dry from April 2010 through September 2011, while MW-7 has been found to be dry from April 2009 through September 2011. Due to the dry condition of these wells, they will be removed from the monitoring network.

2.3 GROUNDWATER SAMPLE COLLECTION

2.3.1 Introduction

This section presents details of the procedures and equipment required to perform groundwater field measurements and sampling from monitoring wells during each monitoring event. **Where possible, phases of work will proceed from the upgradient (background) wells to downgradient (compliance) wells.**

2.3.1.1 Guidance Documents

Sampling, analysis and submittals shall be performed in accordance with this plan and the following guidance documents:

1. Groundwater, Surface Water and Soil Sampling for Landfills - NCDENR Guidance updated April 2008.

2. October 26, 2006 Memo from NCDENR entitled "New Guidelines for Electronic Submittal of Environmental Monitoring Data."

3. February 23, 2007 Memo from NCDENR entitled Addendum to October 27, 2006, North Carolina Solid Waste Section Memorandum Regarding New Guidelines for Electronic Submittal of Environmental Data.

4. October 16, 2007 Memo from NCDENR entitled Environmental Monitoring Data for North Carolina Solid Waste Management Facilities.

2.3.1.2 Fuel Powered Equipment

Fuel-powered equipment, such as generators for pumps, must be situated away and downwind from all site activities (i.e. purging and sampling). If field conditions prevent such placement, then the fuel source must be placed as far away as possible from the sampling activities. The conditions of sampling must be described in detail in the field notes.

If fuel must be handled, it should be done the day before sampling. Effort should be made to avoid handling fuels on the day of sampling. If fuels must be dispensed during sampling activities, dispense fuel downwind and well away from any sampling locations. Wear gloves while working with fuel and dispose of the gloves away from sampling activities. Wash hands thoroughly after handling any fuels.

2.3.1.3 Equipment Decontamination

All non-dedicated equipment that will come in contact with the well casing and water will be decontaminated between wells. The procedure for decontaminating non-dedicated equipment is as follows:

1. Don new powder-free nitrile gloves.

2. Clean item with tap water and phosphate-free laboratory detergent Liqui-Nox or equivalent), using a brush if necessary to remove particulate matter and surface films.

3. Rinse thoroughly with pesticide grade isopropanol and allow to air dry.

4. Rinse with organic-free water (Milli-Q water or other ultra-pure water) and allow to air dry.

5. Wrap with commercial-grade aluminum foil, if necessary, to prevent contamination of equipment during storage or transport.

It should be noted that Liqui-Nox detergent solutions will be stored in a clearly marked HDPE or PP container. Containers for pesticide-grade isopropanol will be made of inert materials such as Teflon, stainless steel, or glass.

Sampling will be planned and conducted in such a way as to minimize the need for decontamination in the field through the use of dedicated sampling equipment, or a new disposable Teflon bailer at each well. Unclean equipment will be segregated from clean equipment during all field activities. All clean equipment will remain in the manufacturer's packaging until use, or will be wrapped in commercial-grade aluminum foil or untreated butcher paper.

2.3.2 Water Level Measurements

2.3.2.1 Static Water Levels

Static water level and depth to the well bottom will be measured in each well prior to any purging or sampling activities. Static water level and well depth measurements are necessary to calculate the volume of stagnant water in the well prior to purging. Additionally, these measurements provide a field check on well integrity, degree of siltation, and are used to prepare potentiometric maps, calculate aquifer flow velocities and monitor changes in site hydrogeologic conditions.

Groundwater depths will be measured to a vertical accuracy of 0.01 feet relative to established wellhead elevations. Each well will have a permanent, easily identified reference point on the lip of the well riser from which all water level measurements will be taken. The elevation of the reference point will be established by a Registered Land Surveyor.

2.3.2.2 Contamination Prevention

Upon opening each well, new nitrile surgical gloves will be donned. Appropriate measures will be taken during all measurement activities to prevent soils, decontamination supplies, precipitation, and other potential contaminants from entering the well or contacting clean equipment.

2.3.2.3 Equipment

An electronic water level indicator will be used to accurately measure depth to groundwater in each well and/or piezometer. The electronic water level indicator will be constructed of inert materials such as stainless steel and Teflon. **Between each well, the device will be thoroughly decontaminated by washing with non-phosphate (Liqui-Nox) soap and rinsing with organic-free water to prevent cross contamination from one well to another.**

The following measurements will be recorded in a dedicated field book prior to sample collection (see Section 5.0 for detailed description of field notes to be collected):

- Depth to static water level and well bottom (to the nearest 0.01 foot);
- Height of water column in the riser (based upon measured depth of well);
- Condition of wellhead protective casing, base pad and riser; and

- Changes in condition of well and surroundings.

2.3.3 Well Monitor Evaluations

2.3.3.1 Description

Water accumulated in each well may be stagnant and unrepresentative of surrounding aquifer conditions and therefore must be removed to insure that fresh formation water is sampled. Each well will be purged of standing water in the well casing following the measurement of the static water level. Monitoring well evacuation should be performed in upgradient wells first, and by systematically moving to downgradient well locations.

2.3.3.2 Contamination Prevention

New latex or nitrile surgical gloves will be donned for all well purging and sampling activities and whenever handling decontaminated field equipment. Appropriate measures will be taken during all measurement, purging and sampling activities to prevent surface soils, decontaminated supplies, precipitation, and other potential contaminants from entering the well or contacting cleaned equipment.

2.3.3.3 Calculations

The volume of standing water in the well riser and screen will be calculated immediately before well evacuation during each monitoring event. A standing water volume will be calculated for each well using measured static water level, well depth and well casing diameter according to the following equation:

$$\mathbf{V = (TD - SWL) \times C}$$

Where: V = One well volume (gallons)
TD = Total depth of the well (in feet)
SWL = Static water level (in feet)
C = Volume constant for given well diameter (gallons/foot)
C = 0.163 gal/ft for two-inch wells.
C = 0.653 gal/ft for four-inch wells.

2.3.3.4 Well Purging

Several options for well purging are used at this site including:

- Bailers;
- Low Flow Pumps; and

- Grundfos Redi-flo Pumps.

Bailers – Where bailers are used, new, disposable bailers with either double or bottom check-valves will be used to purge each well. Disposable purge bailers will be constructed of fluorocarbon resin (Teflon) or inert plastic suitable for the well and ground conditions. Each bailer will be factory-clean and remain sealed in a plastic sleeve until use. A new Teflon-coated stainless steel, inert mono-filament line or nylon cord will be used for each well to retrieve the bailers. Where bailers are used, a minimum of three well volumes shall be purged unless the well runs dry.

Low Flow Pumps – Monitoring wells may be purged and sampled using the low-flow sampling method in accordance with the *Solid Waste Section Guidelines for Groundwater, Soil, and Surface Water Sampling* (NCDENR, 2008).

Depth-to-water measurements will be obtained using an electronic water level indicator capable of recording the depth to an accuracy of 0.01 foot. A determination of whether or not the water table is located within the screened interval of the well will be made. If the water table is not within the screened interval, the amount of drawdown that can be achieved before the screen is intersected will be calculated. If the water table is within the screened interval, total drawdown should not exceed 1 foot so as to minimize the amount of aeration and turbidity. If the water table is above the top of the screened interval, the amount of drawdown should be minimized to keep the screen from being exposed.

If the purging equipment is non-dedicated, the equipment will be lowered into the well, taking care to minimize the disturbance to the water column. If conditions (i.e., water column height and well yield) allow, the pump will be placed in the uppermost portion of the water column (minimum of 18 inches of pump submergence is recommended).

The minimum volume/time period for obtaining independent Water Quality Parameter Measurements (WQPM) will be determined. The minimum volume/time period is determined based on the stabilized flow rate and the amount of volume in the pump and the discharge tubing (alternatively, the volume of the flow cell can be used, provided it is greater than the volume of the pump and discharge tubing). Volume of the bladder pump should be obtained from the manufacturer. Volume of the discharge tubing is as follows:

3/8-inch inside diameter tubing:	20 milliliters per foot
1/4-inch inside diameter tubing:	10 milliliters per foot
3/16-inch inside diameter tubing:	5 milliliters per foot

Once the volume of the flow-cell or the pump and the discharge tubing has been calculated, the well purge will begin. The flow rate should be based on historical data for that well (if available) and should not exceed 500 milliliters per minute. The initial round of WQPM should be recorded and the flow rate adjusted until drawdown in the well stabilizes. Water levels should be measured periodically to maintain a stabilized water level. The water level should not fall within 1 foot of the top of the well screen. If the purge rate has been reduced to 100 milliliters or less and the head level in the well continues to decline, the required water samples should be collected following stabilization of the WQPM, based on the criteria presented below.

If neither the head level nor the WQPM stabilize, a passive sample should be collected. Passive sampling is defined as sampling before WQMP have stabilized if the well yield is low enough that the well will purge dry at the lowest possible purge rate (generally 100 milliliters per minute or less).

WQPM stabilization is defined as follows: pH (+/- 0.2 S.U.), conductance (+/- 5% of reading), temperature (+/- 10% of reading or 0.2^{o}C), and dissolved oxygen [+/- 20% of reading or 0.2 mg/L (whichever is greater)]. Oxidation reduction potential will be measured and ideally should also fall within +/- 10mV of reading; however, this is not a required parameter. At a minimum, turbidity measurements should also be recorded at the beginning of purging, following the stabilization of the WQPM, and following the collection of the samples. The optimal turbidity range for micropurging is 25 Nephelometric Turbidity Units (NTU) or less. Turbidity measurements above 25 NTU are generally indicative of an excessive purge rate or natural conditions related to excessive fines in the aquifer matrix.

Stabilization of the WQPM should occur in most wells within five to six rounds of measurements. If stabilization does not occur following the removal of a purge volume equal to three well volumes, a passive sample will be collected.

The direct-reading equipment used at each well will be calibrated in the field according to the manufacturer's specifications prior to each day's use and checked at a minimum at the end of each sampling day. Calibration information should be documented in the instrument's calibration logbook and the field book.

Each well is to be sampled immediately following stabilization of the WQPM. The sampling flow rate must be maintained at a rate that is less than or equal to the purging rate. For volatile organic compounds, lower sampling rates (100 - 200 milliliters/minute) should be used. Final field parameter readings should be recorded prior to and after sampling.

Grundfos Redi-Flo Pumps – Where Redi-Flo pumps are used, the same low flow techniques for sampling will be used. Please see above for detailed summary of purging/sampling techniques.

2.3.3.5 Purge Rate

Wells will be purged at a rate that will not cause recharge water to be excessively agitated or cascade through the screen. Care will also be taken to minimize disturbance to the well sidewalls and bottom which could result in the suspension of silt and fine particulate matter. The volume of water purged from each well and the relative rate of recharge will be documented in sampling field notes. Wells which have very low recharge rates will be purged once until dry. Damaged, dry or low yielding and high turbidity wells will be documented for reconsideration before the next sampling event.

2.3.3.6 Purge Water Disposal

Purge water will be managed to prevent possible soil and surface water contamination. Well site management options may include temporary containment and disposal as leachate or portable activated carbon filtration if warranted by field characteristics.

2.3.3.7 Non-Dedicated Equipment

Durable, non-dedicated equipment that is lowered into the well or which may come in contact with the water samples will be thoroughly decontaminated before each use. Equipment shall be disassembled to the degree practical, washed with (non-phosphate) soapy potable tap water, and triple rinsed using de-ionized water. Detailed equipment decontamination procedures are detailed in **Section 2.3.1.3**.

2.3.4 Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. Sampling is undoubtedly the most critical stage and the focus of the water quality monitoring program. Samples should be collected from least contaminated location(s) first, followed by locations of increasing contamination across the site. Prior to sample collection, all sample labels should be properly filled-out with permanent ink, such as Sharpie Pen. At a minimum, the label should identify the sample with the following information:

- Sample Location or Well Number;
- Sample Identification Number;

- Date and Time of Collection;
- Analysis Required;
- Sampler's Initials;
- Preservative Used (if any); and
- Other Pertinent Information As Necessary.

Upon completion of the sample label, the label should be affixed to the sample bottle prior to sampling.

Sampling will occur within 24-hours of the purging of each well and as soon after well recovery as possible. Wells which fail to recharge or produce an adequate sample volume within 24-hours of purging will not be sampled.

2.3.4.1 Field Parameters

Field measurements of temperature, pH, and specific conductance will be made immediately prior to sampling each monitoring point. For all low-flow sampling, dissolved oxygen (DO) and oxidation reduction potential (ORP) shall also be collected. Additionally, turbidity measurements should also be collected for evaluation of any metals detected. The field test specimens will be collected with the sampling bailer and placed in a clean, non-conductive glass or plastic container for observation. The calibration of the pH, temperature, conductivity and turbidity meters will be completed according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste -Physical/Chemical Methods (SW-846). A pocket thermometer and litmus paper will be available in case of meter malfunction.

2.3.4.2 Sample Equipment

Several options for sample collection are used at this site including:

- Teflon Bailers;
- Low Flow Pumps; and
- Grundfos Redi-flo Pumps.

Of these, Low Flow purging/sampling systems are the most prevalent as the Grundfos pumps are utilized for low flow purging/sampling. Low flow purging/sampling is recommended for this site wherever possible.

Teflon Bailers – Where bailers are used, each well will be sampled using a new, factory-cleaned, disposable Teflon bailer with bottom check-valve and sample discharge mechanism. A new segment of Teflon-coated

stainless steel wire, inert mono-filament line or nylon cord will be used to lower and retrieve each bailer. The bailer will be lowered into each well to the point of groundwater contact and then allowed to fill as it sinks below the water table. Bottom contact will be avoided in order to avoid suspending sediment in the samples. The bailer will be retrieved and emptied in a manner which minimizes sample agitation.

Low Flow Pumps – Upon completion of purging with the low flow pump systems, samples may be collected immediately from the pumping system. Samples are to be collected in the order outlined in **Section 2.3.4.4**.

Redi-Flo Pumps - Upon completion of purging of three well volumes of water, samples may be collected from the Redi-Flo pumps. Samples will be collected in the order outlined in **Section 2.3.4.4**.

2.3.4.3 Sample Transference

Samples will be transferred directly from the Teflon bailer into a sample container that has been specifically prepared for the preservation and storage of compatible parameters. A bottom emptying device provided will be used to transfer samples from bailer to sample container. The generation air bubbles and sample agitation will be minimized during bailer discharge. Groundwater samples will be collected and contained in the order of volatilization sensitivity.

2.3.4.4 Order of Sample Collection

Initially, only purgeable organics and total metals samples will be collected for laboratory analysis. Subsequently, other analytical methods may be required. When collected, the following order of sampling will be observed:

- Volatile Organics and Volatile Inorganics;
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease;
- Total Metals;
- Inorganic Nonmetallics, Physical and Aggregate Properties and Biologicals;
- Microbiologicals; and
- Measurements of pH, Temperature, DO, ORP, Conductivity and Turbidity.

Note: If the pump used to collect groundwater samples is not suitable to collect volatile or extractable organics then collect all other parameters and withdraw the pump and tubing. Then collect the volatile and extractable organics.

All samples will be collected and analyzed in an **unfiltered** state during sampling events. Samples for dissolved metal analysis, if subsequently required, will be prepared by field filtration using a decontaminated peristaltic pump and a disposable 0.45 micron filter cartridge specifically manufactured for this purpose.

2.3.4.5 Decontamination

All reusable sampling equipment including water level probes, water quality meters, interface probes, and filtering pumps which might contact aquifer water or samples will be thoroughly decontaminated between wells by washing with non-phosphate soapy, de-ionized water and rinsing with isopropanol and organic-free water. Detailed equipment decontamination procedures are detailed in **Section 2.3.1.3**.

2.3.4.6 Sample Preservation

Upon completion of sampling at each location, the sample bottles will be placed in a cooler with ice that is sealed in Ziploc bag for preservation.

2.3.4.7 Field Quality Assurance

Field and trip blanks will be prepared, handled and analyzed as groundwater samples to ensure cross-contamination has not occurred. One set of trip blanks, as described later in this document, will be prepared before leaving the laboratory to ensure that the sample containers or handling processes have not affected the quality of the samples. One set of field (equipment) blanks will be created in the field at the time of sampling to ensure that the field conditions, equipment, and handling during sampling collection have not affected the quality of the samples. This sample will be collected using the same equipment utilized for well sampling. A duplicate groundwater sample may be collected from a single well as a check of laboratory accuracy. Blanks and duplicate containers, preservatives, handling, and transport procedures for surface water samples will be identical to those noted for groundwater samples.

2.3.4.8 Sample Containers

Sample containers will be provided by the laboratory for each sampling event. Containers must be either new, factory-certified analytically clean by the manufacturer, or cleaned by the laboratory prior to shipment for sampling. Laboratory cleaning methods will be based on the bottle type

and analyte of interest. Metal containers are thoroughly washed with non-phosphate detergent and tap water, and rinsed with (1:1) nitric acid, tap water, (1:1) hydrochloric acid, tap water, and non-organic water, in that order. Organic sample containers are thoroughly washed with non-phosphate detergent in hot water and rinsed with tap water, distilled water, acetone, and pesticide quality hexane, in that order. Other sample containers are thoroughly washed with non-phosphate detergent and tap water, rinsed with tap water, and rinsed with non-organic water. The laboratory shall provide proper preservatives in the sample containers prior to shipment (see **Section 6.0**).

2.4 SURFACE WATER SAMPLE COLLECTION

This section presents details of the procedures and equipment required to perform surface water field measurements and sampling from springs, streams and ponds during each monitoring event.

2.4.1 Surface Water Level Observations

Surface water quality analyses are particularly sensitive to site hydrologic conditions and recent precipitation events. Water levels may fluctuate significantly in comparison the groundwater table and may result in either diluting or increasing contaminant loadings. The scheduling of sampling events and the interpreted surface water data must take into account recent weather and sampling station conditions.

2.4.1.1 Monitoring Conditions

Surface water level and sampling station conditions may be observed one day prior to, and during each sampling event if warranted by site conditions. Surface water observations will include the flood stage in streams, seasonal base flow conditions, and confirm location and timing for meaningful surface water quality sampling. The following objective observations will be recorded in a dedicated field book prior to sample collection:

- Relative stream water level;
- Surface water clarity; and
- Changes in surface monitoring station conditions and surroundings.

2.4.1.2 Monitoring Condition Modification

Modifications to surface sampling station conditions may be required prior to each sampling event. These modifications may include the removal of surface and submerged debris, slightly deepening the station to allow sample container immersion, or channeling/piping to consolidate local

discharge. When modifications are required, sufficient time will be allowed for settlement of suspended solids between the disturbance and sample collection. A minimum settling period of four hours prior to sampling will be observed.

2.4.2 Sample Collection

2.4.2.1 Collection Procedure

Surface water samples will be obtained from areas of minimal turbulence and aeration. Samples will only be collected if flowing water is observed during the sampling event. New nitrile surgical gloves will be donned prior to sample collection. The following procedure will be implemented regarding sampling of surface waters:

1. Put on new nitrile surgical gloves.

2. Hold the bottle in the bottom with one hand, and with the other, remove the cap.

3. Push the sample container slowly into the water and tilt up towards the current to fill. A water depth of six inches is generally satisfactory. Care will be taken to avoid breaching the surface or losing sample preservatives while filling the container.

4. If there is little current movement, the container should be moved slowly, in a lateral, side to side direction, with the mouth of the container pointing upstream.

2.4.2.2 Field Parameters

Temperature, pH, specific conductivity and turbidity will be taken at the start of sampling as a measure of field conditions and check on the stability of the water samples over time. Measurements of temperature, pH, specific conductivity and turbidity will be recorded for all surface water samples. The calibration of the pH, temperature, conductivity, and turbidity meters will be completed at the beginning of each sampling event, according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846).

2.4.2.3 Observation

Surface water samples will be collected and contained in the order of volatilization sensitivity of the parameters as follows:

- Volatile Organics and Volatile Inorganics;

- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease;
- Total Metals;
- Inorganic Nonmetallics, Physical /Aggregate Properties, Biologicals;
- Microbiologicals; and
- Measurements of pH, Temperature, DO, ORP, Conductivity and Turbidity.

All surface water samples will be collected unfiltered. If future dissolved metal analysis is required, samples will be prepared by field filtration using a decontaminated peristaltic filtering pump (or equivalent) and a disposable 0.45 micron filter cartridge manufactured for this purpose.

Surface water samples will be collected from surface water monitoring points shown on the attached **Figure 1**. Samples will be collected directly from the station in the container that has been prepared for the preservation and storage of compatible parameters. Samples will be collected in a manner that assures minimum agitation. Additional blanks and duplicate samples will not be taken with the surface water samples.

2.4.2.4 Decontamination

All field meters which might contact surface water samples will be thoroughly decontaminated between stations by washing with non-phosphate soapy, de-ionized water and rinsed with isopropanol and organic-free water. Detailed equipment decontamination procedures are detailed in **Section 2.3.1.3**.

2.4.2.5 Sample Containers

Sample containers shall be prepared and provided by the laboratory for each surface water sampling event. Each container's preparation and preservatives shall be the same as those utilized for groundwater sampling and addressed previously in **Section 2.3.4.8**.

3.0 FIELD QA/QC PROGRAM

3.1 OVERVIEW

Field Quality Assurance/Quality Control (QA/QC) requires the routine collection and analysis of trip blanks to verify that the handling process has not affected the quality of the samples. Any contaminants found in the trip blanks could be attributed to:

1. Interaction between the sample and the container;
2. Contaminated source water; or
3. A handling procedure that alters the sample.

3.2 BLANK SAMPLES

3.2.1 Trip Blanks

The laboratory will prepare a trip blank by filling each type of sample bottle with laboratory grade distilled or deionized water. Trip blanks will be placed in bottles of the specific type required for the analyzed parameters and taken from a bottle pack specifically assembled by the laboratory for each groundwater sampling event. Trip blanks will be taken prior to the sampling event and transported with the empty bottle packs. The blanks will be analyzed for volatile and purgeable organics only.

3.2.2 Field Blanks

Where there are wells that are sampled with non-dedicated equipment, field blank samples shall be collected at a rate of one sample per day. To collect a field blank, a bailer shall be filled with non-organic (milli-Q) water. Handling the bailer in a manner identical to well sampling, the water is to be transferred into the sample collection jars specified for the field blanks. These samples are packed and sent to the laboratory with the other samples.

3.3 BLANK CONCENTRATIONS

The concentration levels of any contaminants found in the trip or field blank will be reported but will not be used to correct the groundwater data. In the event that elevated parameter concentrations are found in a blank, the analysis will be flagged for future evaluation and possible re-sampling.

3.4 FIELD INSTRUMENTS

All field instruments utilized to measure groundwater characteristics will be calibrated prior to entering the field, and recalibrated in the field as required, to insure accurate measurement for each sample. The specific conductivity and pH meter shall be recalibrated utilizing two prepared solutions of known concentration in the range of anticipated values (between 4 and 10). A permanent thermometer, calibrated against a

National Bureau of Standards Certified thermometer, will be used for temperature meter calibration. Other field equipment should be calibrated at least daily using the manufacturer's recommended specifications.

4.0 SAMPLE PRESERVATION AND SHIPMENT

4.1 OVERVIEW

Methods of sample preservation, shipment, and chain-of-custody procedures to be observed between sampling and laboratory analysis are presented in the following sections.

4.2 SAMPLE PRESERVATION

Pre-measured chemical preservatives will be provided by the analytical laboratory. Hydrochloric acid will be used as a chemical stabilizer and preservative for volatile and purgeable organic specimens. Nitric acid will be used as the preservative for samples for metals analysis.

4.3 STORAGE/TRANSPORT CONDITIONS

Proper storage and transport conditions must be maintained in order to preserve the integrity of samples between collection and analysis. Ice and chemical cold packs will be used to cool and preserve samples, as directed by the analytical laboratory. Samples will be maintained at a temperature of 4° C. **Dry ice is not to be used**. Samples will be packed and/or wrapped in plastic bubble wrap to inhibit breakage or accidental spills.

Chain-of-Custody control documents will be placed in a waterproof pouch and sealed inside the cooler with the samples for shipping. Tape and/or custody seals shall be placed on the outside of the shipping coolers, in a manner to prevent and detect tampering with the samples.

4.4 SAMPLE DELIVERY

Samples shall be delivered to the analytical laboratory within a reasonable period of time in person or using an overnight delivery service to insure holding times are not exceeded. If samples are not shipped the same day, the ice used to keep the samples cool shall be replenished in order to maintain the required temperature of 4° C. Shipment and receipt of samples will be coordinated with the laboratory. Do NOT store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same cooler or shipping container with other environmental samples.

4.5 CHAIN OF CUSTODY

Chain-of-Custody control will be maintained from sampling through analysis to prevent tampering with analytical specimens. Chain-of-Custody control procedures for all samples will consist of the following:

1. Chain-of-Custody will originate at the laboratory with the shipment of prepared sample bottles and a sealed trip blank. Identical container kits will

be shipped by express carrier to the sampler or site or picked up at the laboratory in sealed coolers.

2. Upon receipt of the sample kit, the sampler will inventory the container kit and check its consistency with number and types of containers indicated in the Chain-of-Custody forms and required for the sampling event.

3. Labels for individual sample containers will be completed in the field, indicating the site, time of sampling, date of sampling, sample location/well number, and preservation methods used for the sample.

4. Collected specimens will be placed in the iced coolers and will remain in the continuous possession of the field technician until shipment or transferal as provided by the Chain-of-Custody form has occurred. If continuous possession can not be maintained by the field technician, the coolers will be temporarily sealed and placed in a secured area.

5. Upon delivery to the laboratory, samples will be given laboratory sample numbers and recorded into a logbook indicating client, well number, and date and time of delivery. The laboratory director or his designee will sign the Chain-of-Custody control forms and formally receive the samples. The field technician, project manager and the laboratory director will work together to insure that proper refrigeration of the samples is maintained.

6. Copies of the complete Chain-of-Custody forms will be placed in the laboratory's analytical project file and attached to the laboratory analysis report upon completion.

Chain-of-Custody forms will be used to transfer direct deliveries from the sampler to the laboratory. A coded, express delivery shipping bill shall constitute the Chain-of-Custody between the sampler and laboratory for overnight courier deliveries.

5.0 FIELD LOGBOOK

5.1 OVERVIEW

The field technician will keep an up-to-date logbook documenting important information pertaining to the technician's field activities. The field logbook will document the following:

- Site Name and Location
- Date and Time of Sampling
- Climatic Conditions During Sampling Event
- Sampling Point/Well Identification Number
- Well Static Water Level
- Height of Water Column in Well
- Purged Water Volume and Well Yield (High or Low)
- Presence of Immiscible Layers and Detection Method
- Observations on Purging and Sampling Event
- Time of Sample Collection
- Temperature, pH, and Conductivity Readings
- Signature of Field Technician
- Relative stream water level
- Surface water clarity
- Changes in surface monitoring station conditions and surroundings

6.0 LABORATORY ANALYSIS

6.1 OVERVIEW

The ground and surface water parameters will be analyzed for field indicators of water quality (pH, conductivity, temperature and turbidity) and those constituents listed in **Table 1**. All analytical methods are taken from Test Methods For Evaluating Solid Waste - Physical/Chemical Methods (SW-846) or Methods For the Chemical Analysis of Water and Wastes and will be consistent with the Division of Waste Management's policies regarding analytical methods and reporting limits. Analysis will be performed by a laboratory certified by the North Carolina DENR for the analyzed parameters.

6.2 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Formal environmental laboratory Quality Assurance/Quality Control (QA/QC) procedures are to be utilized at all times. The owner/operator of the landfill is responsible for selecting a laboratory contractor and insuring that the laboratory is utilizing proper QA/QC procedures. The laboratory must have a QA/QC program based upon specific routine procedures outlined in a written laboratory Quality Assurance/Quality Control Manual. The QA/QC procedures listed in the manual shall provide the lab with the necessary assurances and documentation that accuracy and precision goals are achieved in all analytical determinations. Internal quality control checks shall be undertaken regularly by the lab to assess the precision and accuracy of analytical procedures.

6.3 LABORATORY QUALITY CONTROL CHECKS

The internal quality control checks include the use of calibration standards, standard references, duplicate samples, and spiked or fortified samples. Calibration standards shall be verified against a standard reference obtained from a second (alternate) source. For most analytical methods, calibration curves shall be developed using at least one (1) blank and three (3) standards. Samples shall be diluted, if necessary, to ensure that analytical measurements fall within the linear portion of the calibration curve. Where required, duplicate samples shall be processed at an average frequency of 10 percent to assess the precision of testing methods, and standard references shall be processed not less than monthly to assess the accuracy of analytical procedures. Method or procedural blanks and spiked or fortified samples shall be carried through all stages of sample preparation and measurement to validate the efficiency and accuracy of the analysis.

6.4 DATA REVIEW

During the course of the analyses, quality control data and sample data shall be reviewed by the laboratory manager to identify questionable data and determine if the necessary QA/QC requirements are being followed. If a portion of the lab work is subcontracted, it is the responsibility of the contracted laboratory to verify that all subcontracted work is completed by certified laboratories, using identical QA/QC procedures.

7.0 RECORD KEEPING AND REPORTING

7.1 OVERVIEW

This section addresses the documentation and reporting requirements associated with the implementation of the WQMP.

7.2 GROUNDWATER SYSTEM EVALUATIONS

After each monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site. The direction of groundwater flow will be determined by a comparison of groundwater surface elevations across the site through the construction of a potentiometric surface map. Groundwater flow rate will be determined using the following equation:

$$V=KI/n$$

Where:
V = Velocity (feet/day)
K = Hydraulic Conductivity (feet/day)
I = Hydraulic Gradient (foot/foot)
n = Effective Porosity of aquifer soils (unit less)

If these evaluations indicate the groundwater monitoring system is insufficient in meeting the requirements of the rules, the monitoring system will be modified accordingly and a work plan will be submitted to NCDENR for review prior to modifications to enhance the monitoring system.

7.3 RESULT REPORTING

Copies of all laboratory analytical data will be forwarded to the SWS within 60 calendar days of the receipt of laboratory data. The analytical data submitted will specify the date of sample collection, the sampling point identification and include a map of sampling locations. Should a significant concentration of contaminants be detected in ground and surface water, as defined in North Carolina Solid Waste Rules, Groundwater Quality Standards, or Surface Water Quality Standards, the owner/operator of the landfill shall notify the SWS and will place a notice in the landfill records as to which constituents were detected.

All monitoring reports will be submitted with the following:

1. An evaluation of potentiometric surface
2. Analytical laboratory reports and summary tables
3. A Solid Waste Environmental Monitoring Data Form (included in **Attachment A**)
4. Laboratory Data submitted in accordance with the Electronic Data Deliverable Template.

Monitoring reports may be submitted electronically by e-mail or in paper copy form. Copies of all laboratory results and water quality reports for the Davidson County landfill will be kept in the landfill office. Reports summarizing all groundwater quality results and data evaluation will be submitted to the Division of Waste Management for each sampling event. Depending upon the analytical results received, graphical analyses may be performed to evaluate plume movement and contaminant trends over time.

8.0 MONITORING PROGRAM MODIFICATIONS

8.1 OVERVIEW

This section addresses the procedures that should be followed with respect to any water quality program modifications.

8.2 WELL ABANDONMENT/REHABILITATION

After each groundwater monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site.

Should wells become irreversibly damaged or require rehabilitation, the Solid Waste Section (SWS) shall be notified. If monitoring wells and/or piezometers are damaged irreversibly they shall be abandoned under the direction of the SWS. The abandonment procedure in unconsolidated materials will consist of over-drilling and/or pulling the well casing and plugging the well with an impermeable, chemically-inert sealant such as neat cement grout and/or bentonite clay. For bedrock well completions the abandonment will consist of plugging the interior well riser and screen with an impermeable neat cement grout and/or bentonite clay sealant.

8.3 ADDITIONAL WELL INSTALLATIONS

Any additional well installations will be carried out in accordance with SWS directives. If the potentiometric maps reveal that the depths, location, or number of wells is insufficient to monitor potential releases of solid waste constituents from the solid waste management area, new well locations and depths will be submitted to the SWS for approval.

All monitoring wells shall be installed under the supervision of a geologist or engineer who is registered in North Carolina and who will certify to the SWS that the installation complies with the North Carolina Regulations. Upon installation of future wells the documentation for the construction of each well will be submitted by the registered geologist or engineer within 30 days after well construction.

8.4 IMPLEMENTATION SCHEDULE

This Monitoring Program will be implemented upon approval of this Water Quality Monitoring Plan.

Figures

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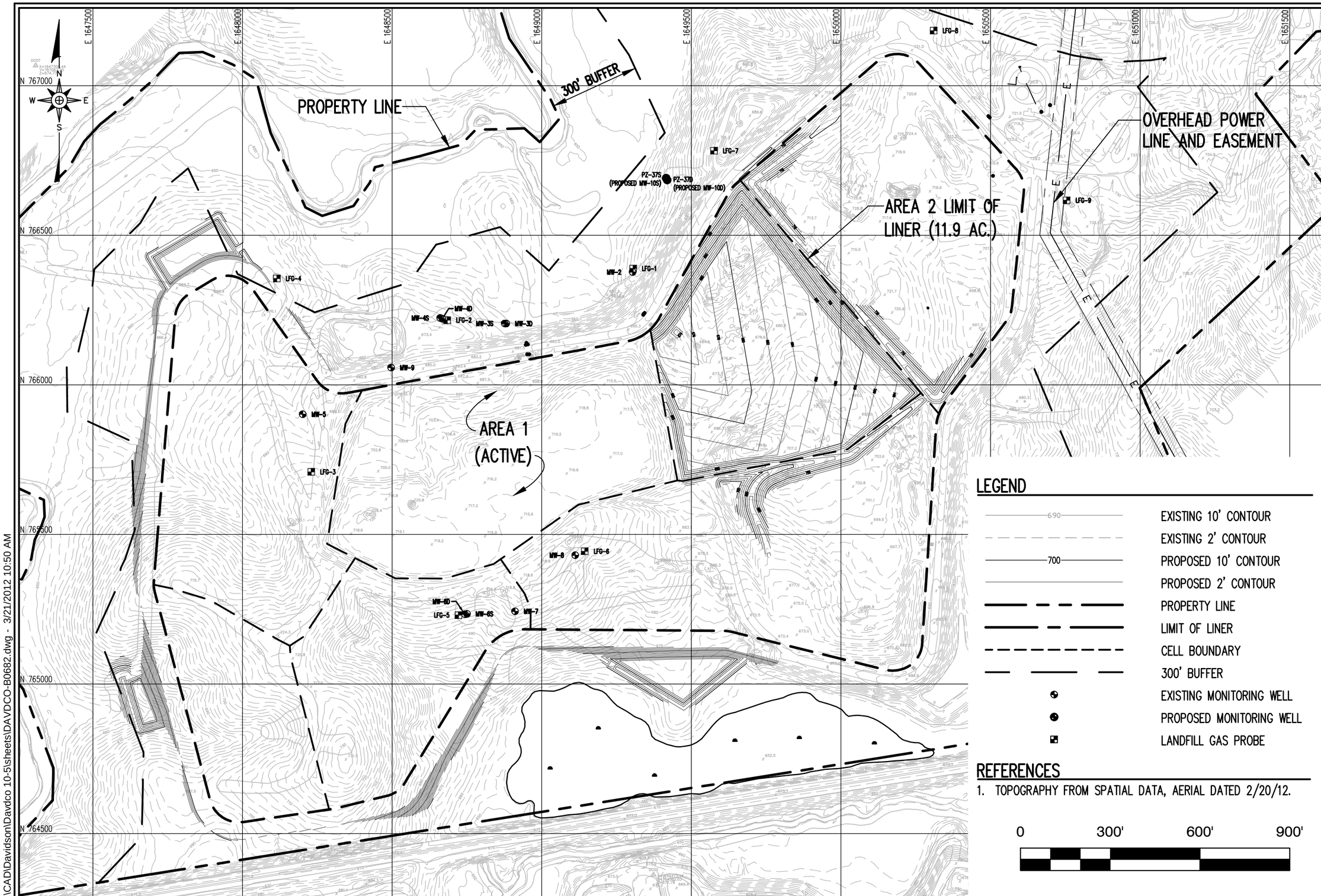

LEGEND

- 690 — EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- 700 — PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- LIMIT OF LINER
- CELL BOUNDARY
- 300' BUFFER
- EXISTING MONITORING WELL
- PROPOSED MONITORING WELL
- LANDFILL GAS PROBE

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.

0 300' 600' 900'

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com
NC LICENSE NO. C-0907 (Engineering)

FIGURE NO.	1
FILE NAME	DAVDCO-B0682
SCALE:	AS NOTED
PROJECT NO.	DAVDCO 10-5
CHECKED BY:	M.M.G.
DRAWN BY:	J.A.L.
DATE:	Mar. 2012

TITLE: SITE PLAN
DAVIDSON COUNTY
PHASE 2 MSW LANDFILL

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Tables

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RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC. LIC. NO. C0828 (ENGINEERING)

By: JAS
Date: 4/26/12

Table 1
Appendix I Analyte List with Field Parameters

Appendix I Constituents	Groundwater Standard	EPA Method	Synonyms
Antimony		7041	
Arsenic		7060/7061	
Barium		7080/6010	
Beryllium		7091	
Cadmium		7131	
Chromium		7191	
Cobalt		7201	
Copper		7210/6010	
Lead		7421	
Nickel		7520/6010	
Selenium		7740/7741	
Silver		7761	
Thallium		7841	
Vanadium		7911	
Zinc		7950/6010	
Temperature		Field	
pH		Field	
Turbidity		Field	
Specific Conductance		Field	
Acetone		8260	2-Propanone
Acrylonitrile		8260	2-Propenenitrile
Benzene		8260	
Bromochloromethane		8260	Chlorobromomethane
Bromodichloromethane		8260	Dibromochloromethane
Bromoform		8260	Tribromomethane
Carbon Disulfide		8260	
Carbon Tetrachloride		8260	Tetrachloromethane
Chlorobenzene		8260	
Chloroethane		8260	Ethyl chloride
Chloroform		8260	Trichloromethane
Dibromochloromethane		8260	Chlorodibromomethane
1,2-Dibromo-3-chloropropane		8260	DBCP
1,2-Dibromoethane		8260	Ethylene dibromide, EDB
1,2-Dichlorobenzene		8260	o-Dichlorobenzene
1,4-Dichlorobenzene		8260	p-Dichlorobenzene
trans-1,4-Dichloro-2-butene		8260	
1,1-Dichloroethane		8260	Ethyldidene chloride
1,2-Dichloroethane		8260	Ethylene dichloride
1,1-Dichloroethylene		8260	Vinylidene chloride
cis-1,2-Dichloroethylene		8260	
trans-1,2-Dichloroethylene		8260	
1,2-Dichloropropane		8260	Propylene dichloride
cis-1,3-Dichloropropene		8260	
trans-1,3-Dichloropropene		8260	
Ethylbenzene		8260	
2-Hexanone		8260	Methyl butyl ketone
Methyl bromide		8260	Bromomethane
Methyl chloride		8260	Chloromethane
Methyl ethyl ketone		8260	2-Butanone
Methyl iodide		8260	Iodomethane
4-Methyl-2-pentanone		8260	Methyl isobutyl ketone
Methylene bromide		8260	Dibromomethane
Methylene chloride		8260	Dichloromethane
Styrene		8260	Ethenylbenzene
1,1,1,2-Tetrachloroethane		8260	
1,1,2,2-Tetrachloroethane		8260	
Tetrachloroethylene		8260	Perchloroethylene
Toluene		8260	Methyl benzene
1,1,1-Trichloroethane		8260	Methyl chloroform
1,1,2-Trichloroethane		8260	
Trichloroethylene		8260	
Trichloroflouromethane		8260	CFC-11
1,2,3-Trichloropropane		8260	
Vinyl acetate		8260	Acetic acid, ethenyl ester
Vinyl chloride		8260	Choroethene
Xylenes		8260	Dimethyl benzene

Note: Most recent version of EPA method for analysis should be used.

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Appendix 5

Landfill Gas Monitoring Plan

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Landfill Gas Monitoring Plan

Davidson County MSW Landfill
Phase 2 Areas 1 & 2
Thomasville, North Carolina

NC Solid Waste Permit No. 29-06

Prepared For:

Davidson County Integrated Solid Waste
1242 Old US Hwy 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

May 2012

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DAVIDSON COUNTY PHASE 2 LANDFILL
NC SOLID WASTE PERMIT NO. 29-06

LANDFILL GAS MONITORING PLAN

Table of Contents

SECTION 1.0 - INTRODUCTION 1
1.2 PROJECT DESCRIPTION 1
1.2 REGULATORY LIMITS 1
1.3 CONTACT INFORMATION 2
1.3.1 Owner 2
1.3.2 Engineer 2
1.3.3 Solid Waste Regulatory Agency 2
1.3.4 Air Quality Regulatory Agency 3
1.4 EXISTING SITE CONDITIONS 3
1.4.1 Topography 3
1.4.2 Adjacent Areas 3
1.4.3 Site Geology 4
1.4.4 Local Groundwater Regime 4
1.5 Regulatory Status 4
SECTION 2.0 - MONITORING PROGRAM 6
2.1 PERIMETER MONITORING NETWORK 6
2.1.1 Introduction 6
2.1.2 Structure and Ambient Sampling 6
2.1.3 Well Placement Limitations 6
2.1.4 LFG Monitoring Well Construction 6
2.2 MONITORING AND REPORTING 7
2.2.1 Frequency 7
2.2.2 Personnel 7
2.2.3 Equipment 7
2.2.4 Procedures 7
2.2.5 Precautionary Action Plan 8
2.2.6 Record Keeping 8
2.2.7 Sampling Reports 9
2.3 MAINTENANCE 9
SECTION 3.0 - CONTINGENCY PLAN 10
3.1 Introduction 10
3.2 Compliance Action Plan 10
3.2.1 Immediate Action Plan 10
3.2.2 Reporting and Documentation 10
3.2.3 Remediation Plan 11
SECTION 4.0 - Conclusion 12

FIGURES

Figure 1 Site Vicinity Map
Figure 2 Site Plan
Figure 3 Details

APPENDICES

Appendix A Boring Logs
Appendix B Annual Training Logs
Appendix C Monitoring Logs and Reporting Forms

SECTION 1.0
INTRODUCTION

1.2 PROJECT DESCRIPTION

The Landfill Gas Monitoring Plan (Plan), prepared by Richardson Smith Gardner & Associates, Inc. (RSG), presents a comprehensive landfill gas (LFG) monitoring program at the Davidson County Phase 2 Landfill (NC Solid Waste Permit 29-06); with the objective to provide clear guidelines and procedures for field and laboratory personnel when collecting and analyzing methane samples.

The proposed plan presents the rationale for the monitoring program as well as necessary actions required by the Owner to protect and safeguard the area surrounding the landfill and to satisfy North Carolina Solid Waste Management Rules [13B.0503(2)(a)] for monitoring and controlling LFG.

The Engineer utilized the best available site data, practices, experience and judgment to develop this plan; however, the program may require modification and maintenance over time to accommodate changing landfill conditions, changing receptors in areas adjacent and around the landfill, or other conditions that cannot be fully anticipated. Maintenance suggestions are also provided to help identify secondary conditions that may require Plan updates. Facility conditions or unforeseen sampling variables that warrant deviation from standard procedure will conform to the Solid Waste Section Landfill Gas Monitoring Document (Guidance Document).

Uncontrolled LFG migration can result in loss of property, loss of life, injury, vegetative damage and intolerable odors. Landfill monitoring includes exposure to explosive gases. Operational and/or monitoring staff should be specifically trained in the management and response for situations such as fire or explosion, and possess and awareness of changing conditions around these sites.

1.2 REGULATORY LIMITS

Methane well readings will be collected quarterly in accordance with Rule 15A NCAC 13B and results will be submitted to the Solid Waste Section if methane levels exceed Solid Waste Section (SWS) limits at the property boundary. Davidson County will follow the operational requirements for MSWLF facilities; ensuring the measured concentration of methane gas does not exceed the lower explosive limit at the facility boundary and 25 percent of the lower explosive limit for methane in facility structures.

1.3 CONTACT INFORMATION

In case of emergency, or if questions arise during implementation, please contact the following:

1.3.1 Owner

Davidson County
Davidson County Integrated Solid Waste Management Department
220 Davidson County Landfill Road
Lexington, NC 27292
Phone: (336) 242-2284
Fax: (336) 249-7524

County Public Works Director: Rex Buck

1.3.2 Engineer

Richardson Smith Gardner & Associates, Inc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
Phone: (919) 828-0577

Ms. Joan A. Smyth, P.G., Senior Hydrogeologist
email: joan@rsgengineers.com
Mr. Stacey A. Smith, P.E., Project Manager
email: stacey@rsgengineers.com

1.3.3 Solid Waste Regulatory Agency

North Carolina Department of Environment and Natural Resoures
Division of Waste Management:

Raleigh Central Office (RCO)
217 W Jones Street
Raleigh, North Carolina 27603
Phone: (919) 707-8200

Ms. Jaclynne Drummond, Hydrogeologist II
email: jaclynne.drummond@ncdenr.gov

Winston-Salem Regional Office (WRO)
585 Waughtown Street

Winston-Salem, NC 27107-2241
Phone: (336) 771-5000

Mr. Jason Watkins, Central District Supervisor (Solid Waste Section)
email: jason.watkins@ncdenr.gov
Mr. Hugh Jernigan, Environmental Senior Specialist (Solid Waste Section)
email: hugh.jernigan@ncdenr.gov

1.3.4 Air Quality Regulatory Agency

North Carolina Department of Environment and Natural Resources
Division of Air Quality:

Winston-Salem Regional Office
585 Waughtown Street
Winston-Salem, North Carolina 27107
Phone: (336) 771-5000

Ms. Margaret Love, Environmental Program Supervisor

1.4 EXISTING SITE CONDITIONS

The Phase 2 site includes the active Area 1 and proposed Area 2, leachate storage facility and scalehouse.

1.4.1 Topography

The Phase 2 landfill is located on 230 acres owned by Davidson County, bounded by the Norfolk Southern Railroad and Jimmy's Creek to the south, Rich Fork Creek to the west, Old Highway 29 to the north and a home and undeveloped land to the east. Existing ground surface elevations in the Phase 2 area generally range from El. 650 feet amsl[1] to El. 720 feet amsl. The surrounding area is used for various residential and agricultural purposes. The facility location is provided on **Figure 1**.

1.4.2 Adjacent Areas

The facility is divided by Southern Railway owned railroad tracks. The Phase I landfill, the C&D landfill, the unlined MSW landfill units and a leachate storage pond are located south of the railroad tracks. The recently constructed Phase 2 landfill, a leachate storage tank and the landfill office are located north of the tracks. Access to the Phase I landfill area is via Roy Lopp Road and access to the northern area is by Old Highway 29.

[1] feet amsl = feet above mean sea level

1.4.3 Site Geology

The Davidson County Landfill facility is located in the Piedmont Physiographic Province of North Carolina. According to the Geologic Map of North Carolina (1985) the site lies within, but at the western margin of, the Carolina Slate Belt; which is predominantly volcanic and sedimentary rocks of Late Proterozoic to Cambrian age that have been metamorphosed and intruded by numerous igneous plutons. The boundary zone between the Carolina Slate Belt and the adjacent Charlotte Belt is known as the Gold Hill/Silver Hill shear zone. Geological and geotechnical conditions at the proposed Phase 2 expansion site are typical of the North Carolina Piedmont physiographic province.

Mapping published by the US Geological Survey in the Geologic Map of Charlotte by Goldsmith, Milton and Horton (1988) indicates that the site vicinity is underlain by three stratigraphic units. Metavolcanic rocks include mafic, intermediate and felsic volcanic rocks, rocks from the Flat Swamp Member of the Cid Formation, and metavolcanic rocks of the Battleground Formation. The Battleground Formation is characterized as a quartz-sericite schist and phyllite and contains subordinate beds of quartz-pebble conglomerate, quartzite, kyanite or sillmanite quartzite and manganiferous schist. The felsic metavolcanic rocks (mvf) are fine to medium grained rhyolitic and rhyodacitic metatuffs; locally these are coarse-grained. This unit contains minor intermediate and mafic metavolcanic rocks and is probably correlative, at least in part, with felsic metavolcanic rocks of the Battleground Formation. Metamorphosed granitic plutons mapped in this area are megacrystic and well foliated.

Multiple intrusions of metagabbro and metabasalt dikes and conformable sheets are common throughout the region. The metagabbro typically crops out as round residual boulders that show no foliation except in the Gold Hill/Silver Hill shear zone.

Soils encountered include sandy silt and partially weathered rock. For the purposes of this report partially weathered rock is defined as soils with a standard penetration test blow count of 100+ blows per foot.

1.4.4 Local Groundwater Regime

In the uppermost aquifer, ground water elevations at the site generally flow within the soil overburden. Two perennial streams, Jimmy's Creek and Rich Fork Creek, serve as the ground water discharge features south, west and north-northwest for the proposed facility south of Old Highway 29. Davidson County is located in Yadkin-Pee Dee drainage basin. Based on the Phase 2 hydrogeological characterization study, there are two distinct hydrogeologic units present: unconfined surficial soils (uppermost aquifer) and a bedrock aquifer (fracture flow). The aquifer thickness in Area 2 ranges between 5 to 40 feet. The Phase 2 site has a ground water divide at its center. Ground water and surface water in Area 2 drain in a general west and northwestern direction ultimately discharging in Rich Fork Creek.

1.5 REGULATORY STATUS

The Davidson Phase 2 MSW Landfill is currently operating under permit #29-06. The current Solid Waste Permit No. 29-06 was issued was issued by North Carolina Department of

Environment and Natural Resources (NCDENR) Division of Waste Management (DWM) to operate Phase 1 of the Davidson County MSW Landfill. Air permitting rules applicable to this facility include the New Source Performance Standards (NSPS) and Emissions Guidelines (EG) for Municipal Solid Waste Landfills[2], and the Greenhouse Gas Mandatory Reporting Rule (MRR)[3].

The NSPS/EG air regulations are targeted at quantifying and controlling the emissions of Non-Methane Organic Compounds (NMOCs) to the atmosphere. The rule requires landfills that have a design capacity (including waste in place) equal to or exceeding 2.5 million cubic meters (m^3) and 2.5 million megagrams (Mg) to obtain a Title V air permit. Additionally, this triggers the requirement for landfills to design and install a landfill gas collection and control system, unless site-specific Tier 2 Non-Methane Organic Compound (NMOC) emissions are less than 50 Mg. A design capacity report[4] submitted following construction of Phase 2 Area 1 shows that while the landfill design capacity and waste in place exceeds 2.5 million m^3, it does not exceed 2.5 million Megagrams. The conclusions of this report were accepted as submitted by the permitting agency[5].

Construction of Phase 2 Area 2 is expected to trigger both thresholds, at which time Tier 2 NMOC emissions reporting will be performed. If emissions exceed NSPS thresholds (50 megagrams of NMOC), a landfill gas collection and control system design plan will be submitted to NCDENR Division of Air Quality (DAQ) for approval no later than one (1) year following the emissions report submittal.

On September 22, 2009, the EPA issued a final rule for mandatory reporting of greenhouse gases (GHGs) from large GHG emissions sources in the United States, including certain MSW landfills. According to the rule, if a site that accepted waste after January 1, 1980 and has emissions equal to or exceeding 25,000 metric tonnes of carbon dioxide equivalent (CO_2e), it must report under this rule. According to GHG reporting submitted via EPA's e-GGRT (electronic Greehouse Gas Reporting Tool), this reporting threshold was exceeded in 2010, therefore reporting was performed by the deadline. Reporting is expected to continue throughout operations of the landfill, and into the post-closure period.

---

[2] Standards of Performance for New Stationary Sources and Guidelines for Existing Sources: Municipal Solid Waste Landfills; Final Rule, 40 CFR Part 60, Subparts Cc and WWW (NSPS)

[3] Greenhouse Gas Mandatory Reporting Rule, 40 CFR Part 98, Subpart HH

[4] Design Capacity Volume Determination - MSW Landfill Facility Permit No. 29-06, Davidson County Landfill, to Mr. Booker Pullen, NC DENR, dated March 12, 2009

[5] Response to Design Capacity Report MSW Landfill Facility Permit No. 29-06, Davidson County Landfill, to Matthew Lamb, RSG, from Mr. William D. Willets, PE, dated March 31, 2009

SECTION 2.0
MONITORING PROGRAM

2.1 PERIMETER MONITORING NETWORK

2.1.1 Introduction

The LFG monitoring network for the Davidson County Phase 2 Landfill includes nine existing LFG monitoring wells (LFG-1 through LFG-9). No additional locations are proposed with the Area 2 expansion. The perimeter LFG monitoring system is designed with wells located to intercept potential migrating LFG.

LFG-1 is located northeast of Phase 2 Area 1, approximately 160 feet from the liner limit and slightly west of MW-2. LFG-2 is located approximately 160 feet north of Phase 2 Area 1, near cluster pairs MW-4/MW-4D and MW-3/MW-3D. LFG-3 is located approximately 480 feet northwest of Area 1. LFG-4 is located on the western side of Area 1, approximately 90 feet from the liner. LFG-5 is located approximately 145 south of Phase 2 near MW-6 and MW-6D. LFG-6 is located approximately 115 feet south of Area 1 near MW-8. LFG -7 is located north west of the proposed Area 3. LFG-8 is located north east of Phase 2. LFG-9 is located on the south east side of Phase 2.

Locations are shown on **Figure 2**.

2.1.2 Structure and Ambient Sampling

The Phase 2 scalehouse, located at the facility entrance, is sampled quarterly in accordance with the Guidance Document.

2.1.3 Well Placement Limitations

The LFG monitoring well locations were determined by the surrounding area condition, soil type, waste location and nearby water bodies.

2.1.4 LFG Monitoring Well Construction

The LFG monitoring wells were installed August 12-15, 2008 in accordance with 15A NCAC 2C. Wells were advanced using HSA drilling technology and constructed of two-inch diameter, manufactured PVC well screens with 10-slot per inch intake spacing and solid PVC riser pipe. A sand filter pack was placed around the screened interval, to a height of up to two feet above the screen, and a hydrated bentonite plug of two to five feet in thickness was positioned above the sand pack to seal each well. A protective steel casing and a cement pad for surface protection were also situated. Landfill gas well casings are distinguishable from ground water monitoring wells by reflective labeling outside of the well casing. Quick-connect fittings or stopcock valves were installed in accordance with SWS guidance on the PVC portion of the well or in the cap as a monitoring port.

Figure 3 depicts the landfill gas well construction details.

2.2 MONITORING AND REPORTING

Monitoring and reporting of LFG gas concentrations shall be performed in accordance with guidance by the Division of Waste Management document "Methane Monitoring Guidance" (www.wastenotnc.org/swhome/met_mon.html) and as outlined below.

2.2.1 Frequency

LFG monitoring will be conducted quarterly to insure that landfill gas does not exceed the lower explosive limit (LEL) at the facility property boundary and 25% LEL at facility structures. Modifications to monitoring frequency can be obtained through the SWS.

If methane readings exceed the specified limits, protection of human health is the primary objective. Within seven days the landfill gas levels detected will be recorded in the log with the steps taken to protect human health. Within 60 days a remediation plan that describes the nature and extent of the problem as well as the proposed solution will be implemented, a copy of the plan will be recorded in the log and the SWS will be notified.

2.2.2 Personnel

LFG monitoring will be performed by personnel trained in LFG hazards and explosive gas meter use. A designated landfill technician will be assigned to regular LFG monitoring duty. Annual training shall be performed and documented on the LFG monitoring training log (provided in **Appendix D**) to refresh personnel on site changes and/or plan updates.

2.2.3 Equipment

Davidson County rents a landfill gas instrument that meets the SWS Guidance requirements for methane, oxygen and carbon dioxide. Calibration will occur prior to instrument use; however, instrumentation will be checked before sampling begins to ensure compliance.

2.2.4 Procedures

Prior to each monitoring event, portable methane field instruments will be calibrated with a known calibration standard in accordance with manufacturer's recommendations. The equipment used calibration procedure and results for each sampling event will be indicated on the landfill gas sampling data sheet and will be included in the sampling report. An example data form is provided in **Appendix E**.

The following steps outline the procedure for the LFG well monitoring:

- Check calibration date on the meter and calibrate according to manufacturers instructions; allowing equipment to warm up properly, prior to use, per manufacturers direction.
- Purge sample tube for one minute before sampling.
- Connect instrument tubing to sample port on the monitoring well without removing the cap.

- Open the valve and record the stabilized reading. A stabilized reading will not vary more than 0.5 percent by volume on the instrument's scale. Recorded readings will include the oxygen concentration, at two percent per volume or less to indicate air is not being drawn into the system providing false readings, and barometric pressure.
- Record data on the monitoring log form provided in **Appendix E.**
- Turn off the valve and disconnect the tubing.
- If less than 50% LEL, move to next LFG monitoring well.

If deviation from the prescribed plan is warranted, sample integrity and adherence to the Guidance Document will be priority. Modifications will be noted on the sampling log.

If explosive gas concentrations **equal to or greater than 50%** of the LEL in a LFG monitoring well, personnel should implement the Precautionary Action Plan located in **Section 2.2.5**.

IF EXPLOSIVE GAS CONCENTRATIONS EQUAL TO OR GREATER THAN 100% OF THE LEL IN A LFG MONITORING WELLS, THE FOLLOWING ACTIONS SHALL BE IMPLEMENTED BY PERSONNEL:

(1) Recalibrate monitoring equipment and confirm results.
(2) If results are confirmed, **IMMEDIATELY** contact the Solid Waste Director.
(3) Implement the Compliance Action Plan located in **Section 3.2**.

2.2.5 Precautionary Action Plan

If explosive gas concentrations are **equal to or greater than 50%** of the LEL in a LFG monitoring well, personnel should perform the following additional steps at those locations:

- Measure gas pressure in the well head (in inches of water) using magnehelic gauge or other appropriate metering device.
- Record at least one additional gas concentration measurement, inside well just below the top of casing.
- Evaluate surrounding area for potential receptors to or signs of LFG migration. LFG can stress vegetation and can kill trees and grass by root asphyxiation. Note stressed/dead vegetation areas on the monitoring form.

Monitoring should be conducted in this manner for wells with concentrations equal to or greater than 50% LEL during monitoring events. Detailed procedure descriptions, actions performed and relevant sampling information should be recorded, kept in the operating record and reported to the Solid Waste Director and Engineer for further evaluation.

2.2.6 Record Keeping

Readings will be documented on the LFG monitoring log form provided in **Appendix E**. The Landfill Gas Monitoring Report Form will contain the facility name, permit number, type of landfill gas monitoring instrument used, instrument calibration date, landfill gas monitoring

event date, sample collector name, instrument pump rate, ambient air temperature, and general weather conditions. For each well the sampler will record the well location or well identification, barometric pressure, time pumped (sec), time reading collected, % LEL, % methane by volume, % oxygen, % carbon dioxide and notes, observations or comments relative to the sampling event.

Completed forms will be reviewed and initialed by the County Solid Waste Director following each monitoring event and placed in the landfill operating records. Landfill gas monitoring logs will remain on file in the landfill office at the Davidson County Landfill at 1242 Old Highway 29, Thomasville, NC. These readings should be available for review by NCDENR and EPA personnel on request. If readings above 100% LEL are measured at the property boundary, a copy of the LFG monitoring form and an Environmental Data Reporting Form shall be submitted to NCDENR with the implemented action.

2.2.7 Sampling Reports

The facility name, permit number, landfill gas monitoring instrument type, calibration date, landfill gas monitoring event date, sample collector name, instrumentation pump rate, ambient air temperature, and general weather conditions will be included at the top of landfill gas documentation. For each well the time pumped in seconds, barometric pressure, time stabilized reading collected, %LEL, % methane by volume, % oxygen, % carbon dioxide and observations or comments will be documented.

Documentation will be recorded on the Landfill Gas Monitoring Report Logs provided by NC Division of Waste Management – Solid Waste Section or logs established in the same fashion. An example log is included in **Appendix E**.

2.3 MAINTENANCE

Periodic maintenance and site observations shall be conducted routinely to address monitoring program components (at a minimum):

· Maintain access to monitoring well and gas well locations.
· Observe landfill cover conditions, potential erosion areas, landfill seeps, odors, etc.
· Monitoring well maintenance: operational locks, steel casing and concrete pad conditions, etc.

Note deficiencies on the monitoring forms and report to the Solid Waste Director for repair or replacement as necessary.

SECTION 3.0

CONTINGENCY PLAN

3.1 INTRODUCTION

In the event explosive gas concentrations exceed the SWS allowable limit (>100% LEL at the property boundary), a contingency plan is recommended and warranted. The contingency plan includes the specific step by step actions that should be implemented to protect human health and the environment.

3.2 COMPLIANCE ACTION PLAN

If explosive gas concentrations **equal to or greater than 100%** of the LEL in a LFG monitoring well, the following actions shall be enacted by Davidson County:

3.2.1 Immediate Action Plan

The Solid Waste Director will ensure the protection of human health and safety as follows:

(1) Determine nearby potential receptors.
(2) If warranted, check the LFG concentrations in structures near the high LFG concentration well.
(3) If the LFG concentration in structures is greater than 25% evacuate the area.
(4) Contact the County Fire Marshal.
(5) Verbally notify the County Manager.
(6) If the well with the explosive gas concentration above 100% LEL is located at the property boundary, verbally notify the Waste Management Specialist in the Winston-Salem Regional Office.
(7) Investigate and identify the potential source(s) and conduit(s) for LFG migration that may have caused the excessive readings (i.e. the path that the LFG is taking to the monitoring location).
(8) Identify the LFG extent using additional wells, bar hole punch sampling methodology or other applicable alternative method.
(9) As appropriate, begin remedy procedures to control LFG levels in building(s) surrounding the landfill site.

3.2.2 Reporting and Documentation

Following the **Immediate Action Plan**, within seven days the County must put the methane levels and a description of actions performed to protect human health in the operating record. Within sixty days an remediation plan, describing the nature and extent of the problem and proposed remedy, shall be implemented and a copy will be kept in the operating record and notify the division the plan has been implemented.

3.2.3 Remediation Plan

In the event the prolonged explosive gas concentrations exist and as identified during the **Immediate Action Plan**, the County shall prepare and implement a Remediation Plan to mitigate landfill gas migration off property. Extensions may be granted by the Division of Waste Management on written request and depending on severity of the situation.

SECTION 4.0

CONCLUSION

This report, included as part of the Design Hydrogeologic Report for the proposed Davidson County Landfill Phase 2, Area 2, meets the requirements as described in Rule 15A NCAC 13B .1626 (4). The landfill gas monitoring plan is designed to be effective in methane detection to protect the health and safety of North Carolina citizens from asphyxiation and explosive landfill gas hazards.

Figures

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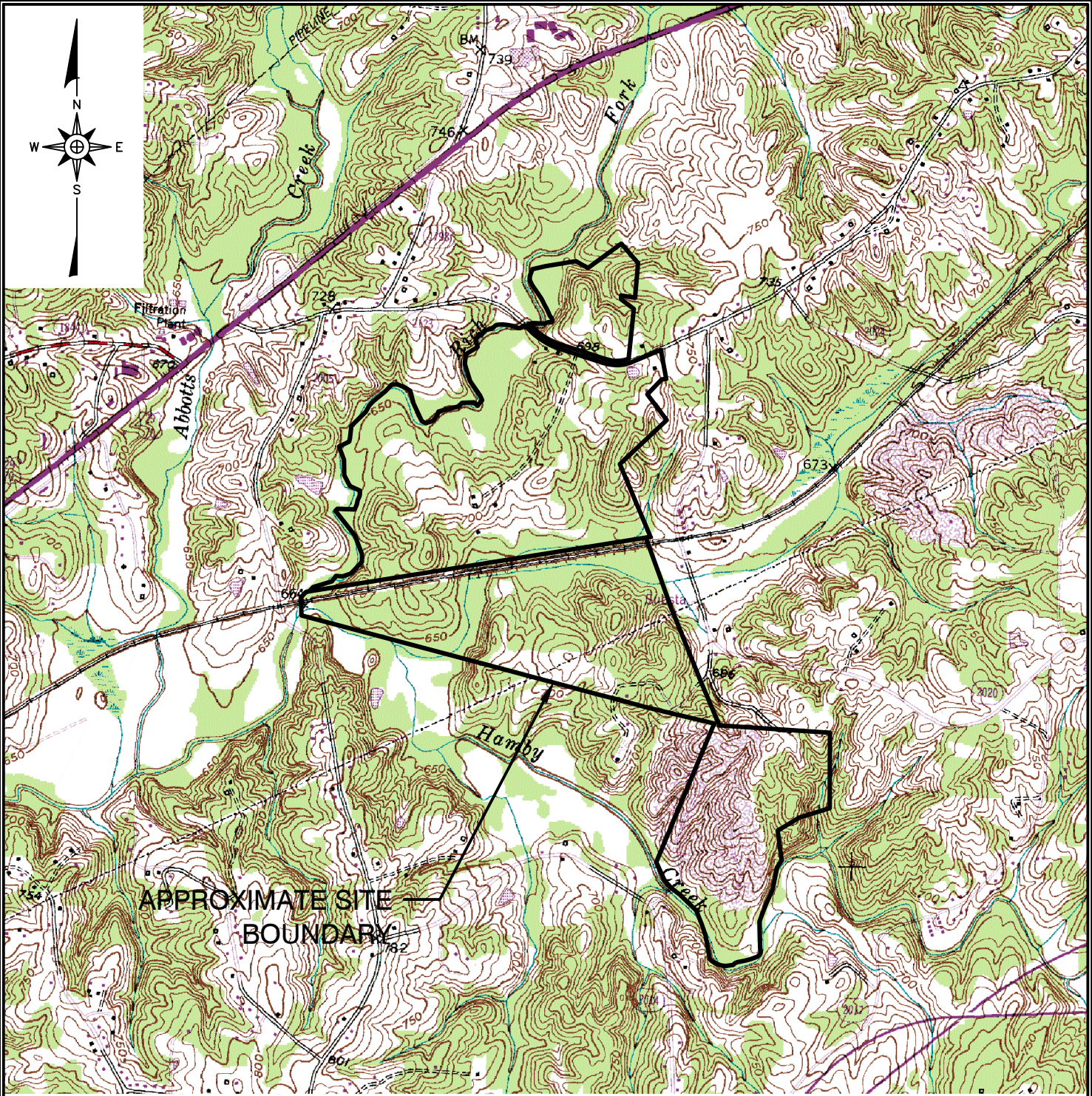

0 2000' 4000'

REFERENCE:
TOPOGRAPHY FROM U.S.G.S. 7.5 MIN. QUADRANGLE "LEXINGTON EAST, NC", DATED 1950, PHOTOREVISED 1994.

SITE VICINITY MAP
DAVIDSON COUNTY MSW LANDFILL

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
NC LIC. NO. C-0828 (Engineering)
www.rsgengineers.com
ph: 919-828-0577
fax: 919-828-3899

SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	FIGURE NO.	FILE NAME
AS SHOWN	J.A.L.		Mar. 2012	DAVDCO 10-5	1	DAVDCO-A0683

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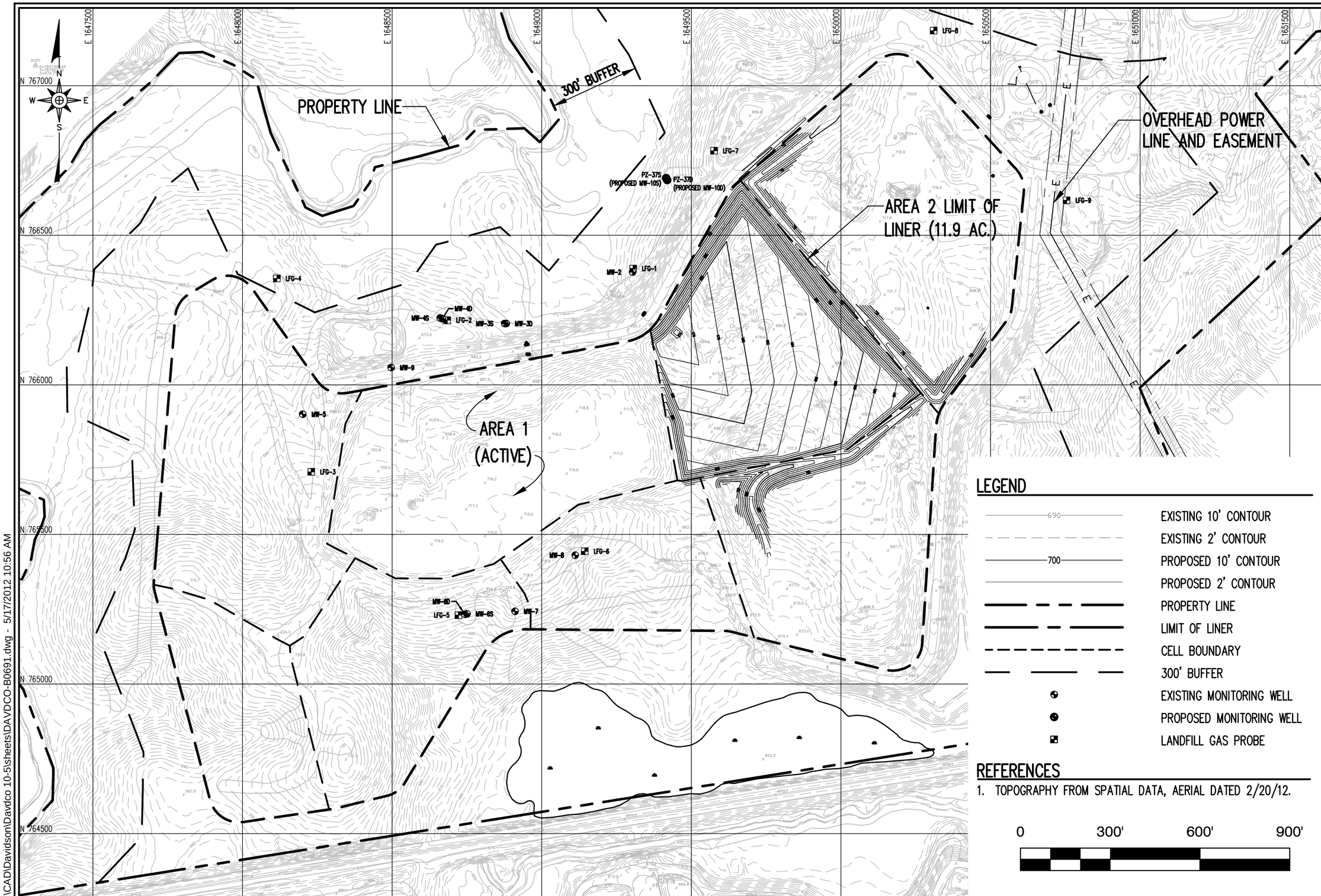

LEGEND

- EXISTING 10' CONTOUR (690)
- EXISTING 2' CONTOUR
- PROPOSED 10' CONTOUR (700)
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- LIMIT OF LINER
- CELL BOUNDARY
- 300' BUFFER
- EXISTING MONITORING WELL
- PROPOSED MONITORING WELL
- LANDFILL GAS PROBE

REFERENCES

1. TOPOGRAPHY FROM SPATIAL DATA, AERIAL DATED 2/20/12.

0 300' 600' 900'

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com
NC LICENSE C-0907 (Engineering)

FIGURE NO.	2
FILE NAME	DAVDCO-B0691
SCALE:	AS NOTED
PROJECT NO.	DAVDCO 10-5
CHECKED BY:	M.M.G.
DRAWN BY:	J.A.L.
DATE:	May. 2012

TITLE: SITE PLAN
DAVIDSON COUNTY
PHASE 2 MSW LANDFILL

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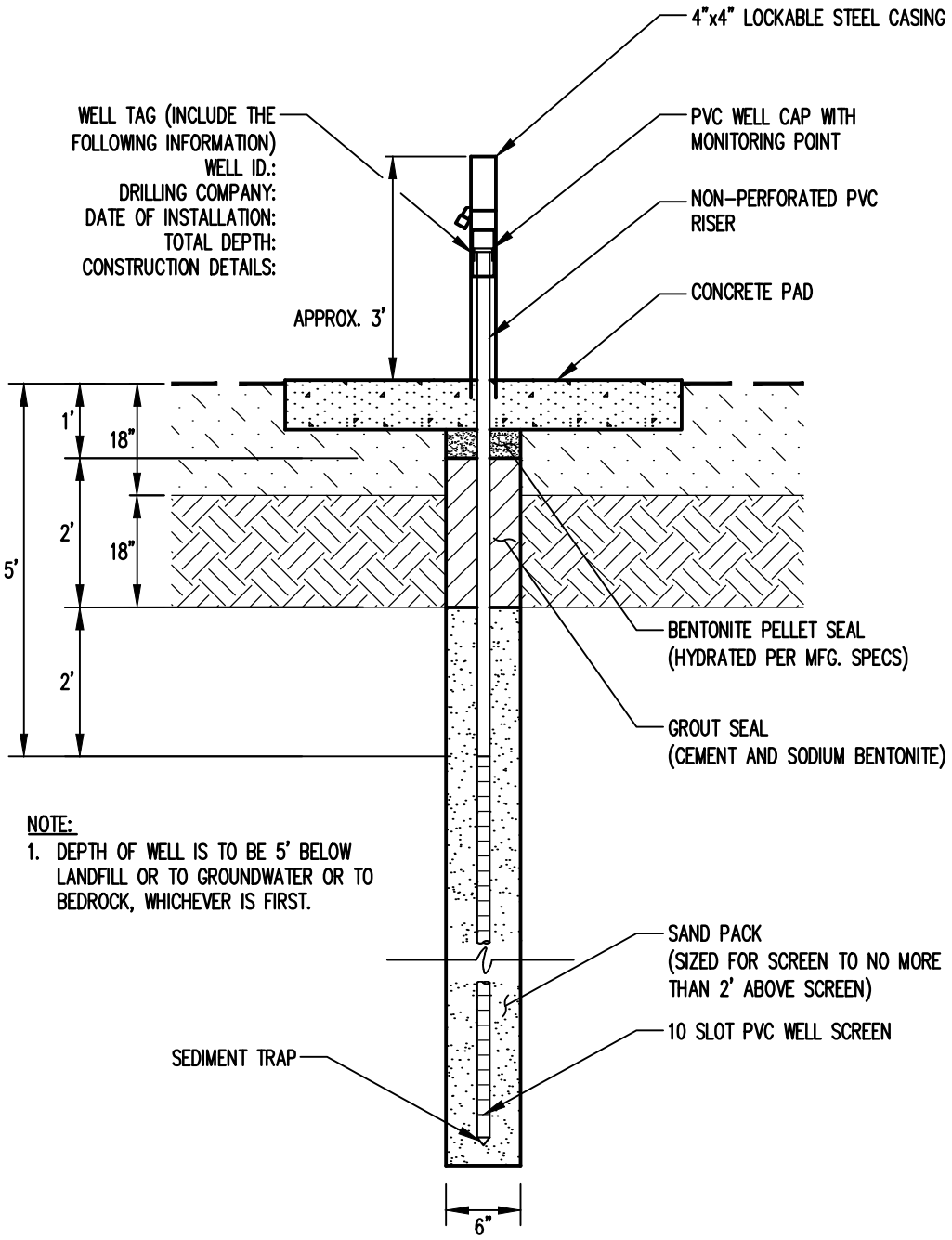

NOTE:

1. DEPTH OF WELL IS TO BE 5' BELOW LANDFILL OR TO GROUNDWATER OR TO BEDROCK, WHICHEVER IS FIRST.

DAVIDSON COUNTY LANDFILL
LFG MONITORING WELL DETAIL

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
NC LIC. NO. C-0828 (Engineering)
www.rsgengineers.com
ph: 919-828-0577
fax: 919-828-3899

SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	FIGURE NO.	FILE NAME
AS SHOWN	J.A.L.	M.M.G.	Mar. 2012	DAVDCO 10-5	3	DAVDCO-A0681

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Appendix A

Boring Logs

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Richardson Smith Gardner and Assoc
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-1**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/13/08** DATE COMPLETED: **8/13/08**

TOTAL DEPTH: **10**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILT: Dry light brown silt. B.T. at 10 feet.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	

Richardson Smith Gardner and Assoc
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(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-2**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/12/08** DATE COMPLETED: **8/13/08**

TOTAL DEPTH: **18 ft.**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILT: Dry medium brown silt. Reddish color with depth. B.T. at 18 feet.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab					15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	

Richardson Smith Gardner and Assoc
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-3**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/12/08** DATE COMPLETED: **8/13/08**

TOTAL DEPTH: **29**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SILT: Dry gray silt.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab			SILTY SAND: Dry gray/white colored silt with Fe horizontal banding.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0	13,15,21	SS	18"				15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	17,29,36	SS	18"				20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0	25, 50/4	SS	2"		SANDY SILT: Dry partially weathered diorite. A.R. at 29 feet.		25.0	
26.0							26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	

Richardson Smith Gardner and Assoc
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-4**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/15/08** DATE COMPLETED: **8/15/08**

TOTAL DEPTH: **25**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Dry brownish red sandy silt.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab					15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0		Grab			SILT: Slightly moist brownish gray silt. B.T. at 25 feet.		20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	

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(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-5**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/15/08** DATE COMPLETED: **8/15/08**

TOTAL DEPTH: **25**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Dry light brown sandy silt.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab					15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0		Grab			SILT: Moist gray silt. B.T. at 25 feet.		20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-6**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/15/08** DATE COMPLETED: **8/15/08**

TOTAL DEPTH: **20**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Dry light brown sandy silt		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab			SANDY SILT: Partially weathered diorite. B.T. at 20 feet.		15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0							20.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-7**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/13/08** DATE COMPLETED: **8/14/08**

TOTAL DEPTH: **35 ft.**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SAND: Dry light brown fine grained sand.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab			SANDY SILT: Dry mix of gray and brown sandy silt.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab			SILT: Dry light and dark gray fine silt, with minor Fe banding. Compacted silt with Fe banding, and partially weathered rock with depth. B.T. at 35 feet.		15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	24,39,45	Grab	18"				20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0	16,20,32	SS	16"				25.0	
26.0							26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	
30.0	19,24,32	SS	18"				30.0	
31.0							31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0							35.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-8**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/13/08** DATE COMPLETED: **8/13/08**

TOTAL DEPTH: **14.5**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Dry light brown sandy silt.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab			SANDY SILT: Dry partially weathered rock. A.R. at 14.5 feet.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **LFG-9**

PROJECT NAME: **Davidson County - Phase 2**
LOCATION: **Lexington, NC**
DRILLING CO: **RSG Engineers**
DRILLING METHOD: **HSA**
FIELD PARTY: **David Barron**
GEOLOGIST: **Clark Wipfield**
DATE BEGUN: **8/14/08** DATE COMPLETED: **8/15/08**

TOTAL DEPTH: **25**
GROUND SURFACE ELEVATION:
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (TOC)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SAND: Dry brown sand, darker color brown with depth.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab					15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	50/5	SS	5"		SANDY SILT: Dry partially weathered granitic rock. B.T. @ 25 feet.		20.0	
21.0							21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	

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Appendix B

Annual Training Logs

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LFG MONITORING TRAINING LOG
(This log must be completed annually)

DAVIDSON COUNTY LANDFILL
LEXINGTON, NORTH CAROLINA
NC SOLID WASTE PERMIT NO. 29-06

INSTRUCTOR INFORMATION:

Name(s):_____

Company:_____

Address: _____

_____

TRAINING INFORMATION:

Date(s) (MM/DD/YYYY):_____

Program Content: _____

_____

Instrument Type(s): _____

ATTENDANCE:

Name	Title	Training Date	Trainee Signature	Instructor Initials

Instructor Signature:_____ Date: _____

Davidson County Representative Signature: _____ Date: _____

Note: This form should be maintained in the landfill operating record.

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Appendix C

Monitoring Logs and Reporting Forms

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NC Division of Waste Management - Solid Waste Section

Landfill Gas Monitoring Data Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Facility Name: _____ Permit Number: _____

Date of Sampling: _____ NC Landfill Rule (.0500 or .1600): _____

Name and Position of Sample Collector: _____

Type and Serial Number of Gas Meter: _____ Calibration Date of Gas Meter: _____

Date and Time of Field Calibration: _____

Type of Field Calibration Gas (15/15 or 35/50): _____ Expiration Date of Field Calibration Gas Canister: _____

Pump Rate of Gas Meter: _____

Ambient Air Temperature: _____ Barometric Pressure: _____ General Weather Conditions: _____

Instructions: Under "Location or LFG Well" identify the monitoring wells or describe the location for other tests (e.g., inside buildings). A drawing showing the location of test must be attached. Report methane readings in both % LEL and % methane by volume. A reading in percent methane by volume can be converted to % LEL as follows: % methane by volume = % LEL/20

Location or LFG Well ID	Sample Tube Purge	Time	Time Pumped (s)	Initial %LEL	Stabilized %LEL	%CH4 by Volume	%O2	%CO2	Notes

If your facility has more gas monitoring locations than there is room on this form, please attach additional sheets listing the same information as contained on this form.

Certification
To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

_____ _____
SIGNATURE TITLE

DENR USE ONLY: ☐ Paper Report ☐ Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: _____ Phone: _____

E-mail: _____

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☐ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☐ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☐ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify) _____
☐ Other(specify) _____

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☐ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Facility Representative Name (Print) Title (Area Code) Telephone Number

Affix NC Licensed/ Professional Geologist Seal

Signature Date

Facility Representative Address

NC PE Firm License Number (if applicable effective May 1, 2009)

Revised 6/2009