APPENDIX G

SCA BASIN CALCULATIONS

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: Honeywell **Project:** Onondaga Lake SCA Basin Stability **Project/Proposal #:** GJ4299 **Task #:** 05/01

TITLE OF COMPUTATIONS **SLOPE STABILITY ANALYSES FOR SCA BASINS**

COMPUTATIONS BY:
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ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)
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DATE 9/19/2011
Printed Name and Title: Nick Yafrate/R. Kulasingam, Senior Staff Engineer/Senior Engineer

COMPUTATIONS CHECKED BY:
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DATE 9/19/2011
Printed Name and Title: Nick Yafrate/Fan Zhu, Senior Staff Engineers

COMPUTATIONS BACKCHECKED BY: (Originator)
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DATE 09/19/2011
Printed Name and Title: Young M. Cho, Senior Staff Engineer

APPROVED BY: (PM or Designate)
Signature [signature]
DATE 19 Sept 2011
Printed Name and Title: Jay Beech, Principal

STATE OF NEW YORK JOHN F. BEECH LICENSED PROFESSIONAL ENGINEER No. 063337

APPROVAL NOTES: ______

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

SLOPE STABILITY ANALYSES FOR SCA BASINS

INTRODUCTION

This package was prepared in support of the design of the Sediment Consolidation Area (SCA) for the Onondaga Lake Bottom Site, which will be constructed on Wastebed 13 (WB-13). Specifically, this package presents static slope stability analyses for the east and west basin areas abutting the SCA perimeter dike. The stability of the entire SCA was analyzed in the calculation package titled "Appendix G: Slope Stability Analyses for SCA Design" (SCA Slope Stability Package) as part of the Onondaga Lake SCA Civil and Geotechnical Final Design [Parsons and Geosyntec, 2011].

METHODOLOGY

Static Slope Stability

Static slope stability analyses were performed using Janbu's method [1973] and Spencer's method [1973], as implemented in the computer program SLIDE version 5.043 [Rocscience, 2009]. Two potential slip modes were considered in the analyses: (i) global circular slip surface mode and (ii) non-circular slip surface mode along the liner system and the bottom of dike. Spencer's method was used for global circular analyses because it satisfies force and moment equilibrium unlike other common analysis methods. Janbu's method was used for non-circular slip surface mode because Spencer's method often encounters numerical convergence difficulties during automatic searches for non-circular slip surfaces.

Seismic slope stability analyses were not performed because the site is not located in a seismic impact zone. A detailed explanation regarding the seismic impact zone assessment is presented in Attachment 1 of the SCA Slope Stability Package.

Target Factor of Safety

Different target factors of safety (FSs) were considered for slope stability of the proposed SCA basins depending on the construction or operation stage and the expected time duration of a particular stage. The construction and operation sequence assumed for the basins is presented in the calculation package titled "Appendix G: Settlement Analyses for the SCA Basins" (Settlement Package) included as part of the Onondaga Lake Sediment Management Final Design. Based on this sequence, a construction and an operation condition are selected for analyses. The construction condition is the condition after excavation of basin sumps adjacent to the SCA dikes and before placement of the liner system and drainage gravel in the basin sumps. The operation condition is after the liner system and drainage gravel in the basin sumps are placed and the SCA is fully constructed. To be conservative, it is also assumed that the SCA is capped. The target FSs for the conditions are as follows:

- During construction
  - Undrained condition FS ≥ 1.2
  - Drained condition FS ≥ 1.3
- During operation
  - Undrained condition FS ≥ 1.3
  - Drained condition FS ≥ 1.3

SUBSURFACE STRATIGRAPHY

Detailed information regarding the subsurface stratigraphy was presented in a calculation package titled "Appendix A: Subsurface Stratigraphy Model of WB-13 for the Design of Sediment Consolidation Area" as part of the Onondaga Lake SCA Civil and Geotechnical Final Design [Parsons and Geosyntec, 2011]. In summary, the subsurface stratigraphy consists primarily of three types of material: the Solvay waste (SOLW), the existing WB-13 perimeter dike soil, and the foundation soil.

ANALYZED CROSS-SECTIONS

SLIDE analyses were performed for the east and west basin areas as shown in Figure 1. Figure 2 shows the close-up plan view of the sump areas. At each basin sump area, two cross-sections were selected for slope stability analyses. Note that Sections ES-2 and WS-2 were assumed to have the same subsurface stratigraphy as used in Section B-B in the SCA Slope Stability Package (also shown in Figure 1); while Sections ES-1 and WS-1 were cross sections running through the middle of the sumps approximately from north to south. The slopes of the sumps are 2.5H:1V (22 degrees).

MATERIAL PROPERTIES

Material properties used in the calculation package were presented in the SCA Slope Stability Package. The initial undrained shear strength profile for the SOLW is shown in Figure 3. The proposed construction sequence presented in the Settlement Package assumed a 5-ft high preload application in the basin sump area. As shown in Figure 3, the 5-ft earth preload on the basin sump area would increase the undrained shear strength of the SOLW foundation. The undrained shear strength parameters of the SOLW foundation were considered to vary depending on the consolidation progress. The undrained shear strength was estimated using the SHANSEP method developed by Ladd and Foott [1974] based on the results of the laboratory consolidated-undrained triaxial compression tests and consolidation tests. A detailed explanation of undrained shear strength estimation is provided in the SCA Slope Stability Package. The following assumptions were made in the slope stability analyses presented in this calculation package:

- An average degree of consolidation of 75% (i.e., U=75%) under the 5-ft preload was assumed for the SOLW under the basin sump area, SCA dike sideslope adjacent to the basin sump, and SCA dike top deck;
- The undrained shear strength of the SOLW beneath the inner sideslope of the SCA dike was assumed to be the average strength under the U=0% and U=75% consolidation conditions; and
- The undrained shear strength of the SOLW where neither preload nor a dike is constructed was assumed to be under the U=0% consolidation condition.

The above assumptions for undrained shear strength parameters are illustrated in Figure 4. The drained shear strength parameters were selected as described in the SCA Slope Stability Package.

RESULTS AND DISCUSSION

The results of the slope stability analyses are summarized in Tables 1 and 2. The figures of the representative stability analysis result for each condition are provided in Figures 5 through 22. The associated detailed results of the SLIDE runs are presented in Attachment 1 of this package.

The calculation results for the west basin sump area are summarized in Table 1 and indicate that the calculated FS values for the analyzed conditions (i.e., the drained/undrained and construction/operation conditions) satisfy the target FSs. For WS-1, the calculated minimum FS values are 1.66 and 1.67 during the construction and operation conditions, respectively. The minimum calculated FS for WS-2 are 1.67 and 1.55 during construction and operation conditions, respectively. The results are consistent with the global FS for Section B-B of the SCA Slope Stability Package, under the undrained loading with U=0% after completion of construction, for which a 1.40 FS was calculated. The slight increase in calculated FS is attributed to preloading in sump area to U=75% and replacement of the SOLW in the sump area with gravel. The calculated FS for sliding along the liner system and the bottom of dike of WS-2 is 2.05, which exceeds the target FS.

Similar to the slope stability analysis results for the west basin sump, the east basin sump analysis results indicate that the calculated FS values for the analyzed conditions satisfy the target FSs (Table 2). The minimum calculated FS values for ES-1 are 1.67 and 1.72 during the construction and operation conditions, respectively. For ES-2, the minimum calculated FS values for global circular stability during and after construction are 1.63 and 1.54, respectively. The calculated FS for sliding along the liner system and the bottom of dike of ES-2 is 2.08, which exceeds the target FS.

SUMMARY AND CONCLUSIONS

This calculation package presents the static slope stability analysis results for the basin areas of the proposed SCA. Two potential slip modes were considered in the analyses: (i) global circular slip surface mode and (ii) non-circular slip surface mode along the liner system and the bottom of dike.

The analysis results indicate that the minimum calculated FS is 1.55 for the east and west basin sump areas for the analyzed slip modes and, therefore, satisfy the selected target FSs for the construction and operation conditions. It should be noted that the analyses were conducted with the assumption that a 5-ft high earth preload will be constructed in the basin sump areas and the SOLW material would achieve stronger shear strength with consolidation due to the preload.

REFERENCES

Janbu, N., "Slope Stability Computations," Embankment Dam Engineering, Casagrande Memorial Volume, R. C. Hirschfield and S. J. Poulos, Eds., John Wiley, New York, 1973, pp. 47-86.

Ladd, C. C and Foott, R., "New Design Procedure for Stability of Soft Clays." Journal of the Geotechnical Engineering Division, American Society of Civil Engineers, Vol. 100, No. GT7, July 1974.

Parsons and Geosyntec, "Onondaga Lake Sediment Consolidation Area (SCA) Civil and Geotechnical Final Design", 2011.

Rocscience, "SLIDE – 2-D Limit Equilibrium Slope Stability for Soil and Rock Slopes," User's Guide, Rocscience Software, Inc., Toronto, Ontario, Canada, 2009.

Spencer, E., "The Thrust Line Criterion in Embankment Stability Analysis," Géotechnique, Vol. 23, No. 1, pp. 85-100, March 1973.

Tables

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

Table 1. Summary of Onondaga Lake West Basin Stability Analysis Results

Section	Construction conditions	Drainage conditions	Slip Mode	Target FS	Calculated FS (Janbu's Method)	Calculated FS (Spencer's Method)	Figure Number
WS-1	Construction	Drained	Global Circular	1.3	--	1.66	5
WS-1	Construction	Undrained	Global Circular	1.2	--	1.85	6
WS-1	Operation	Drained	Global Circular	1.3	--	1.67	7
WS-1	Operation	Undrained	Global Circular	1.3	--	1.79	8
WS-2	Construction	Drained	Global Circular	1.3	--	1.67	9
WS-2	Construction	Undrained	Global Circular	1.2	--	1.83	10
WS-2	Operation	Drained	Global Circular	1.3	--	1.62	11
WS-2	Operation	Undrained	Global Circular	1.3	--	1.55	12
WS-2	Operation	NA	Liner Waste Block	1.3	2.05	--	13

Note: The primary difference between the construction and operation conditions is that during the construction condition the basin sumps will remain open resulting in a taller free-standing dike slope; whereas during the operation condition, gravel will be placed in the sump, thus reducing the height of the free-standing dike slope.

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**

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Table 2. Summary of Onondaga Lake East Basin Stability Analysis Results

Section	Construction conditions	Drainage conditions	Slip Mode	Target FS	Calculated FS (Janbu's Method)	Calculated FS (Spencer's Method)	Figure Number
ES-1	Construction	Drained	Global Circular	1.3	--	1.67	14
ES-1	Construction	Undrained	Global Circular	1.2	--	1.77	15
ES-1	Operation	Drained	Global Circular	1.3	--	1.72	16
ES-1	Operation	Undrained	Global Circular	1.3	--	1.75	17
ES-2	Construction	Drained	Global Circular	1.3	--	1.63	18
ES-2	Construction	Undrained	Global Circular	1.2	--	1.70	19
ES-2	Operation	Drained	Global Circular	1.3	--	1.66	20
ES-2	Operation	Undrained	Global Circular	1.3	--	1.54	21
ES-2	Operation	NA	Liner Waste Block	1.3	2.08	--	22

Note: The primary difference between the construction and operation conditions is that during the construction condition the basin sumps will remain open resulting in a taller free-standing dike slope; whereas during the operation condition, gravel will be placed in the sump, thus reducing the height of the free-standing dike slope.

Figures

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake SCA Basin Stability**	Project/ Proposal No.:	**GJ4299**	Task No.:	**05/01**

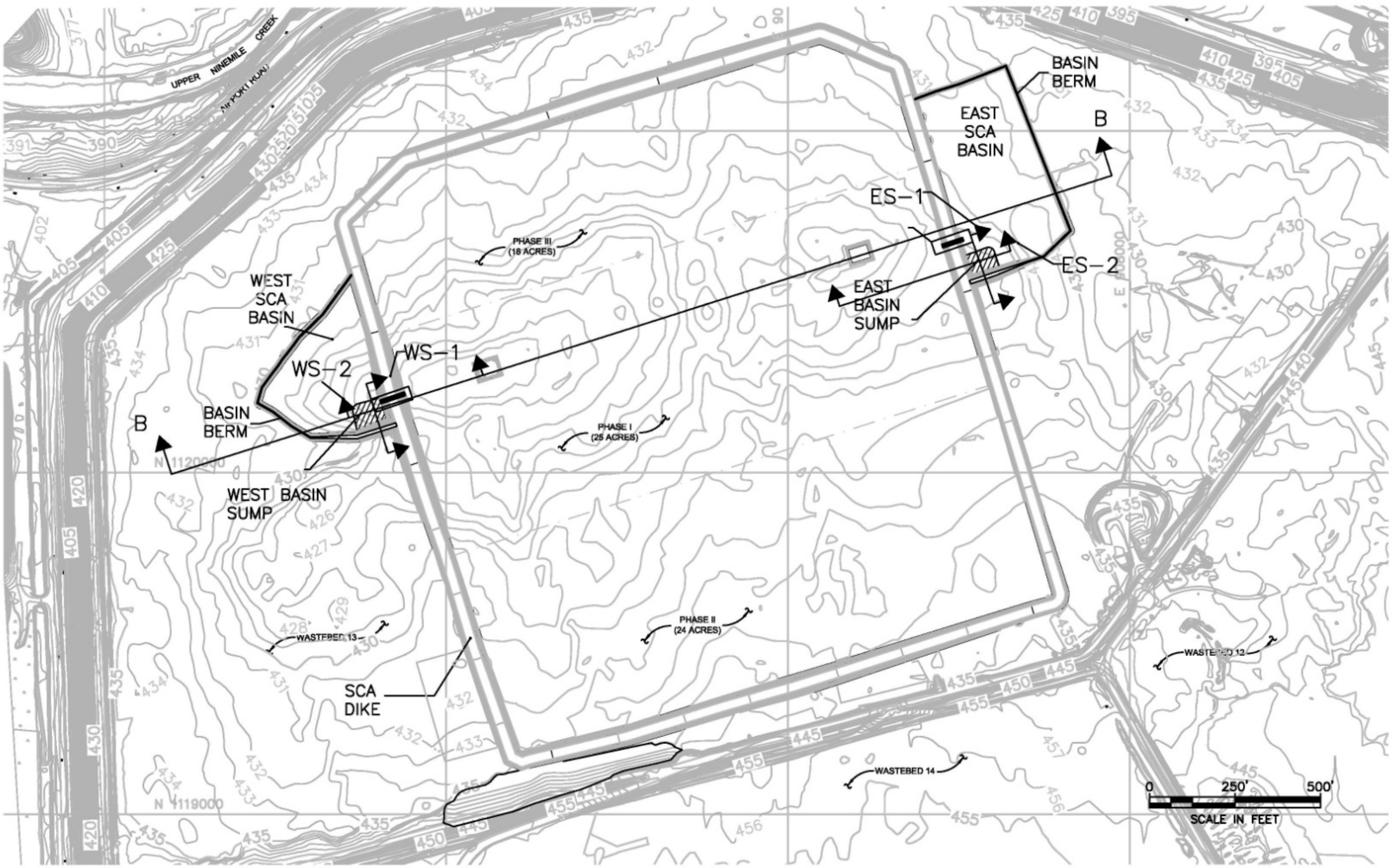

Figure 1. Plan View of SCA Site and Locations of Analyzed Cross Sections

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

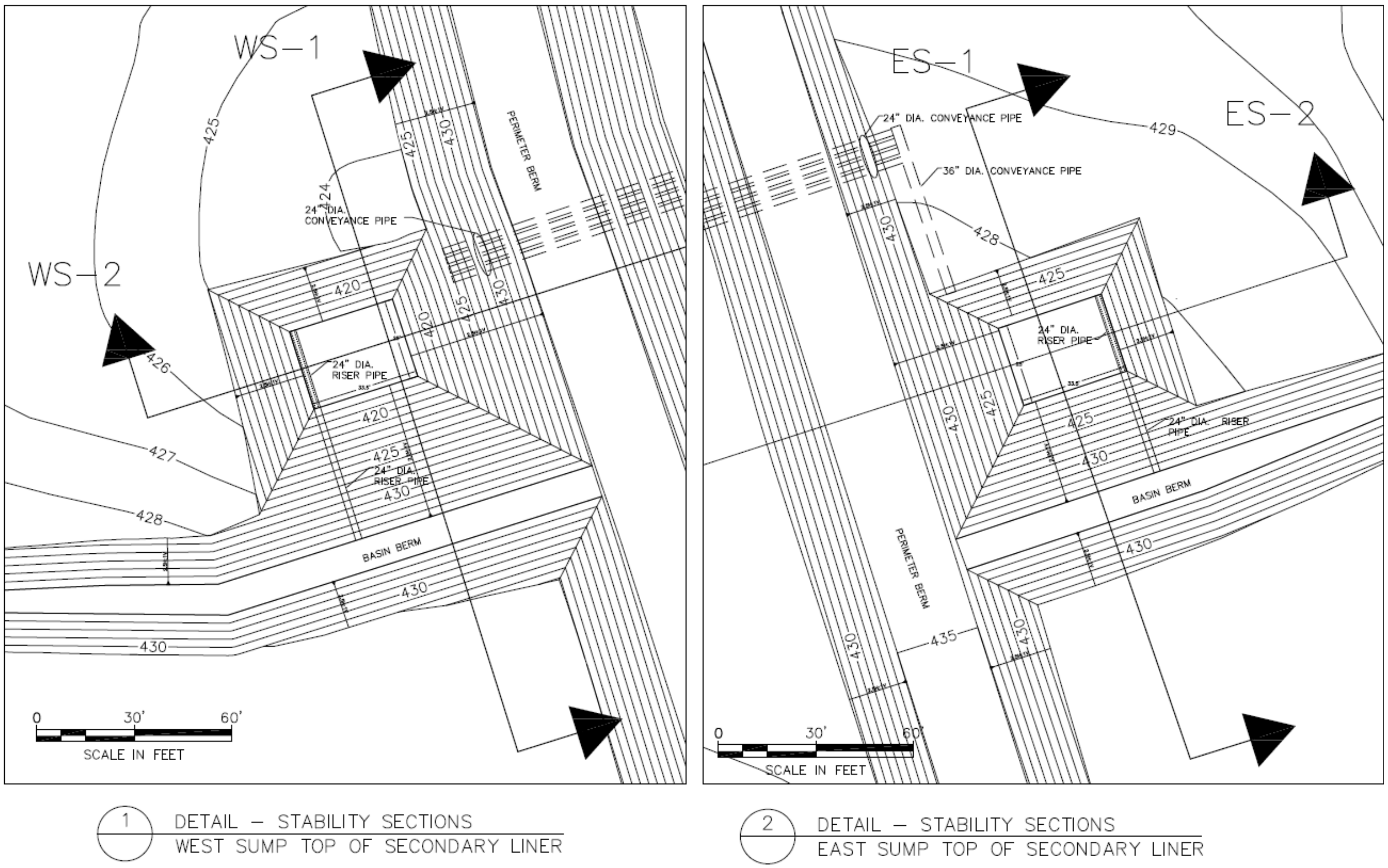

Figure 2. Close-up Plan Views of SCA Basin Sumps: West Basin Sump (left) and East Basin Sump (right)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

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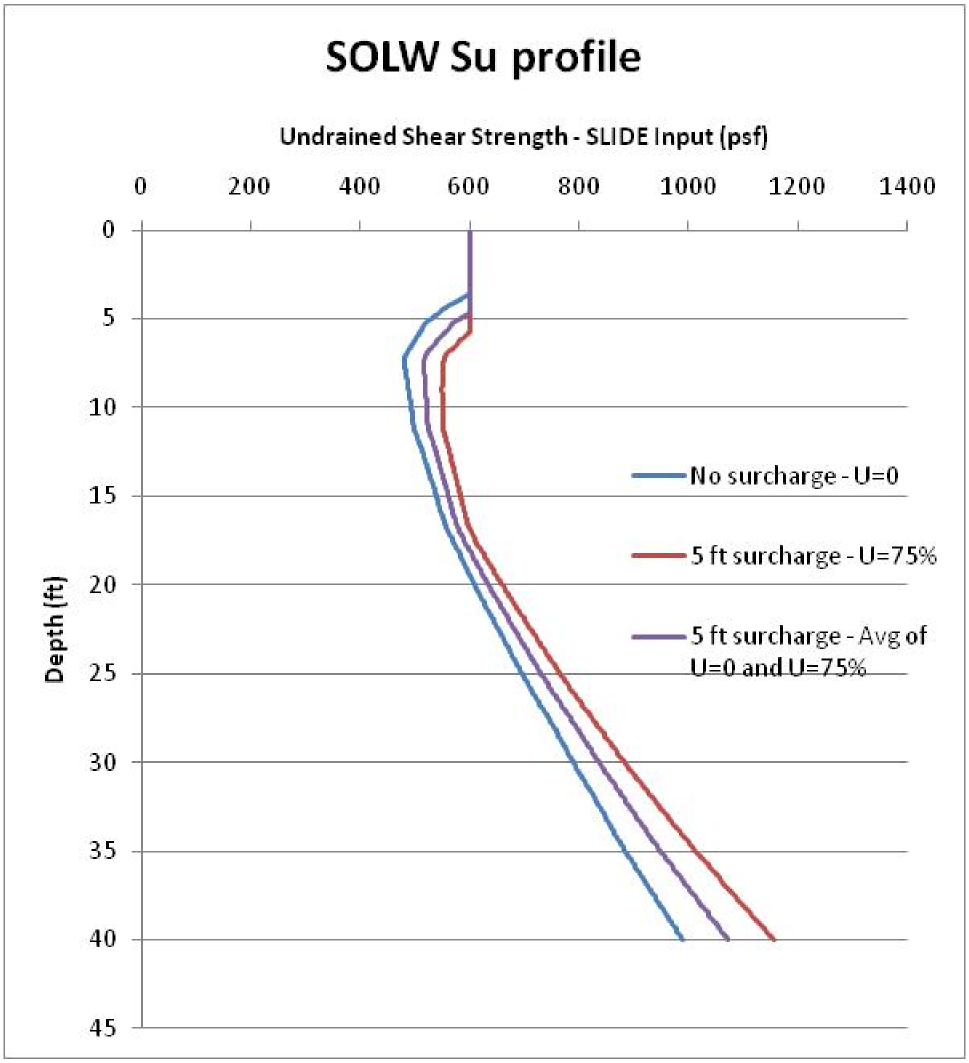

Figure 3. Undrained Shear Strength Profiles of SOLW
(modified from the SCA Slope Stability Package to consider the shear strength gain due to the 5-ft preload)

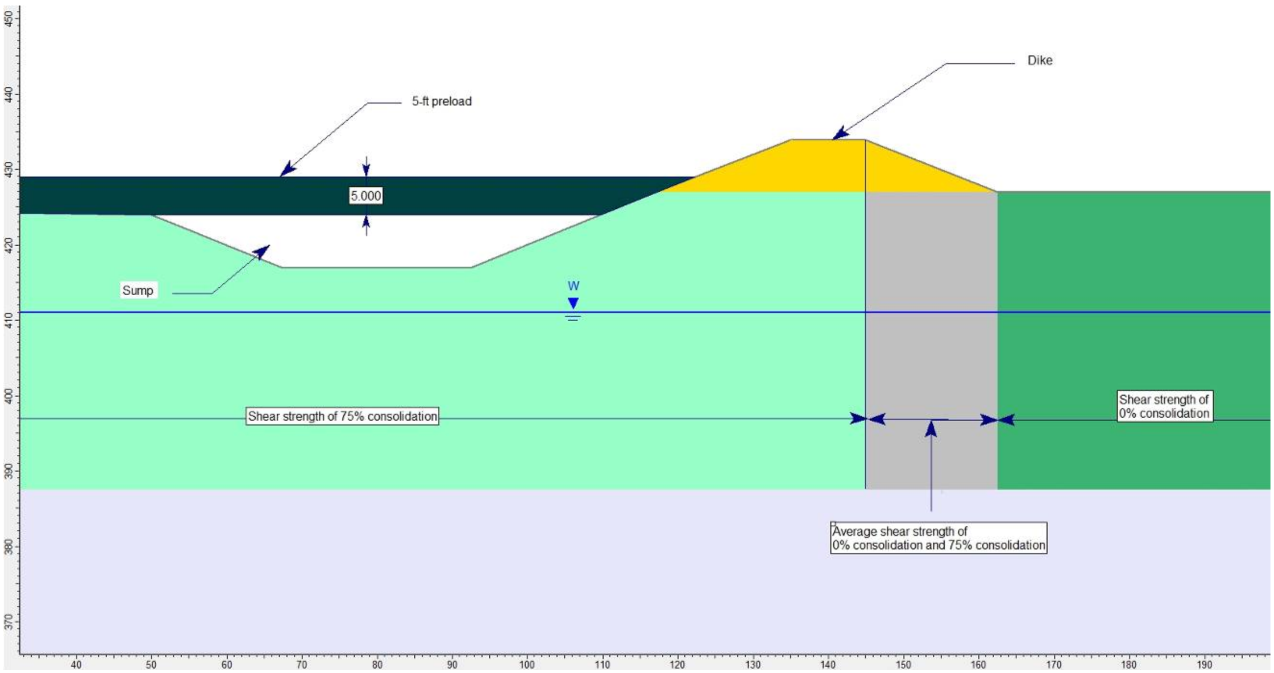

Figure 4. Undrained Shear Strength of SOLW Assumed in Slope Stability Analyses (using Cross Section WS-1 as an example)

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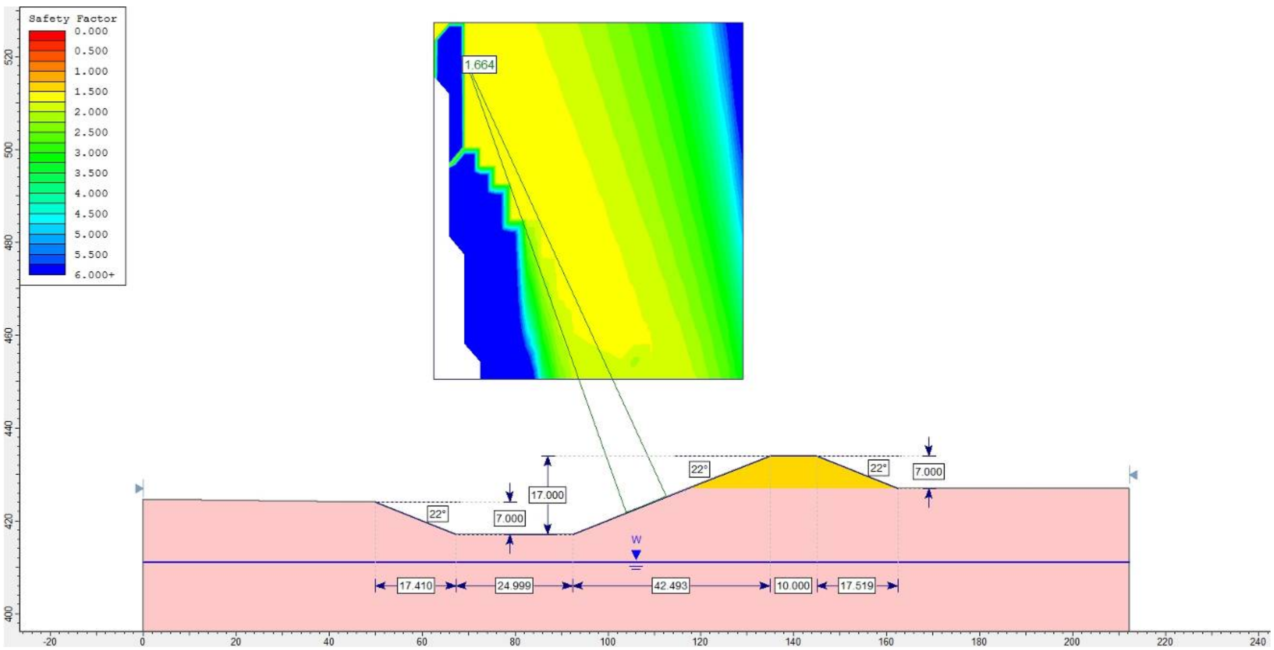

Figure 5. Slope Stability Analysis Result for Cross Section WS-1
(Global Circular_Drained_Construction Condition)

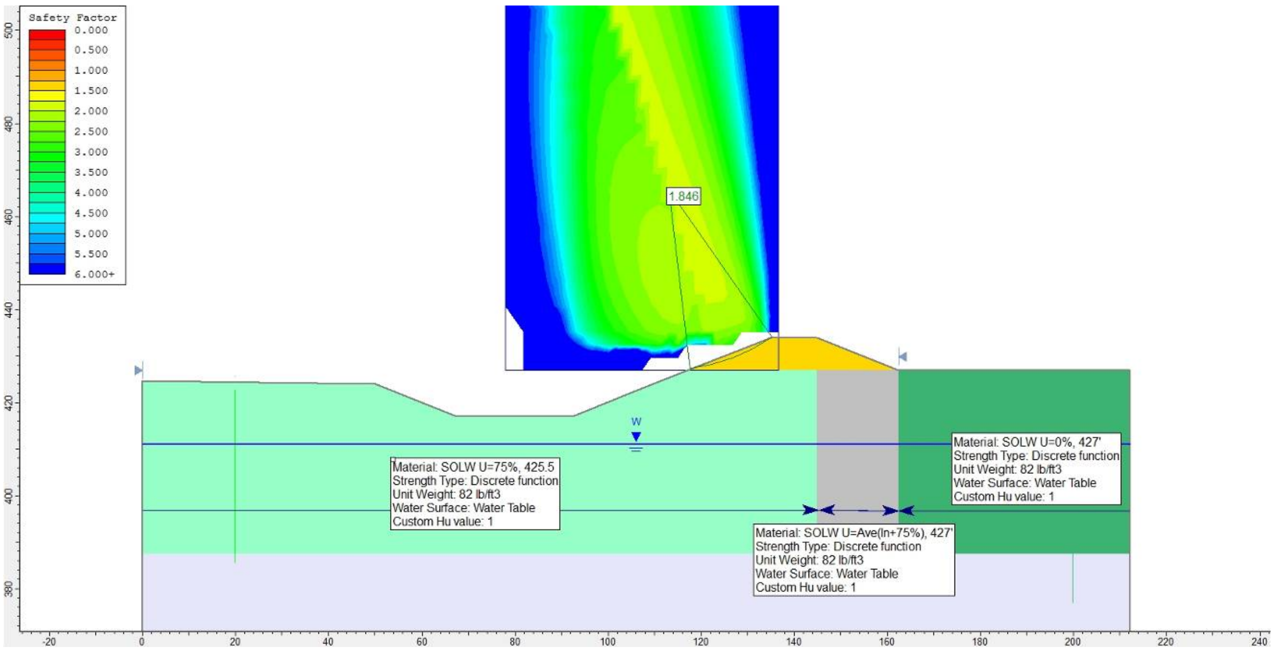

Figure 6. Slope Stability Analysis Result for Cross Section WS-1
(Global Circular_Undrained_Construction Condition)

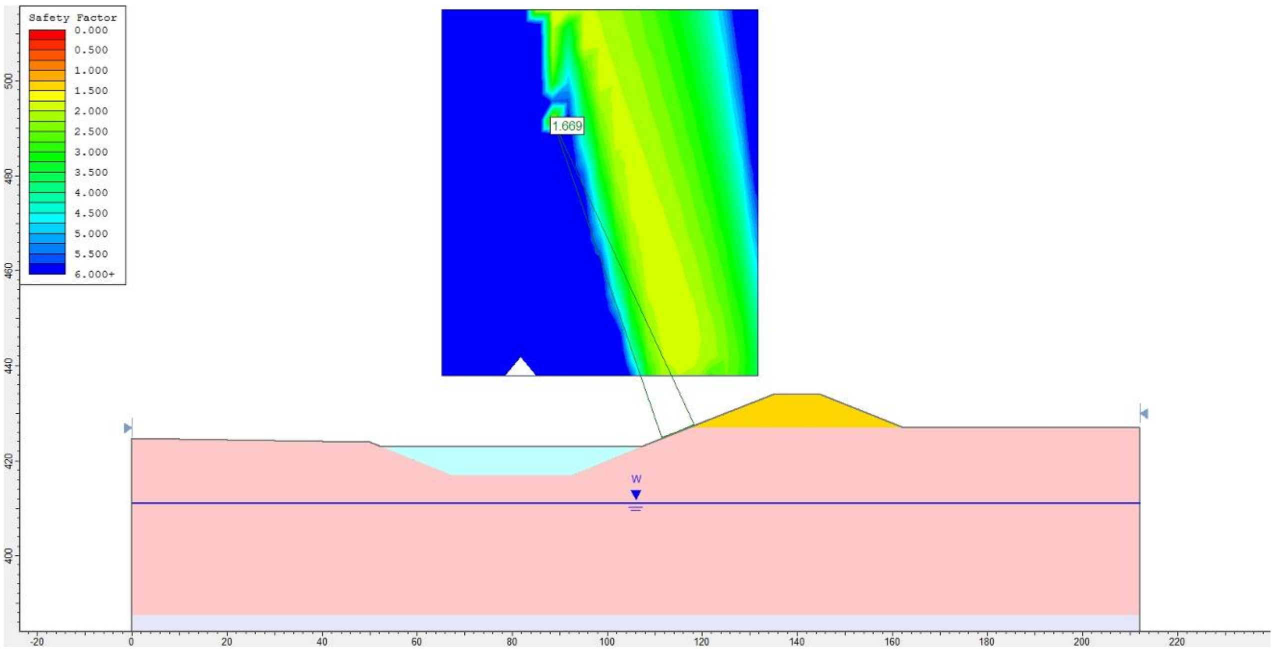

Figure 7. Slope Stability Analysis Result for Cross Section WS-1
(Global Circular_Drained_Operation Condition)

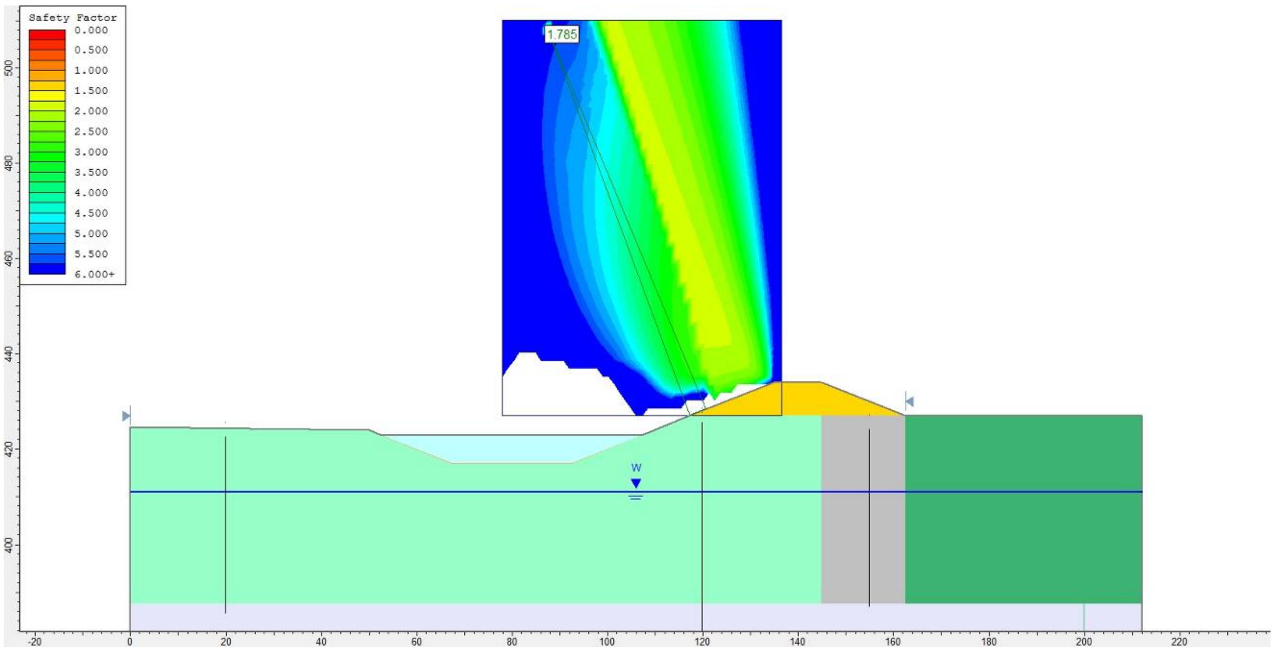

Figure 8. Slope Stability Analysis Result for the Cross Section WS-1
(Global Circular_Undrained_Operation Condition)

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

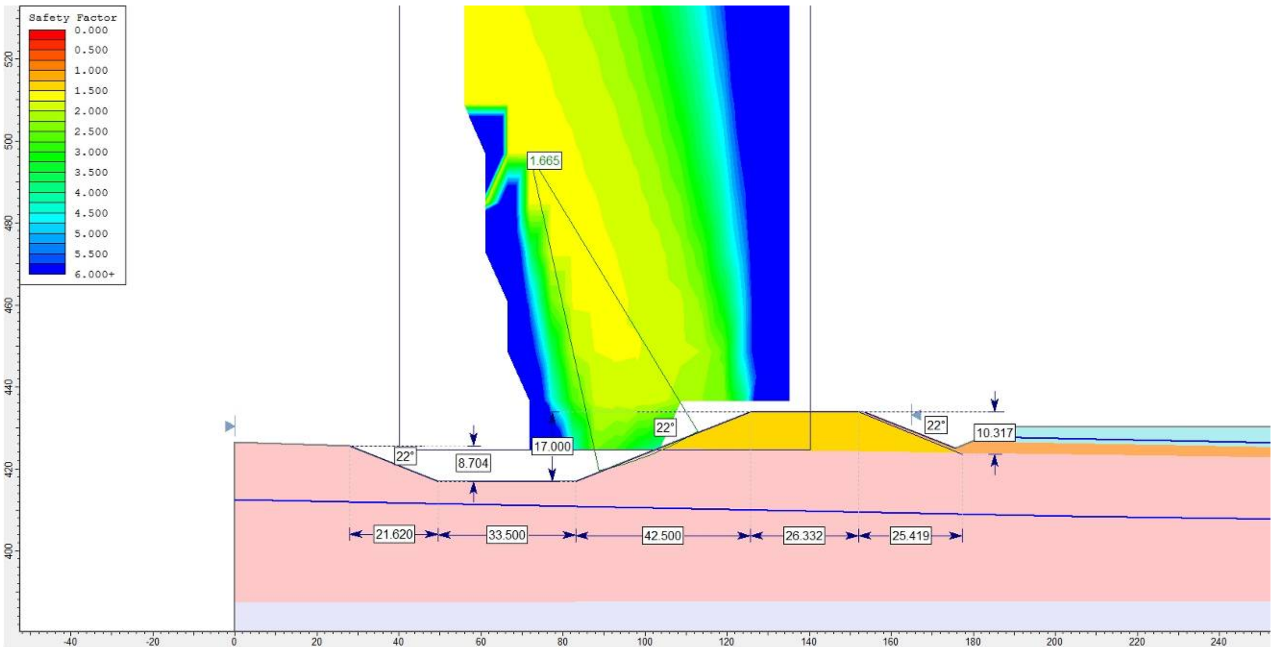

Figure 9. Slope Stability Analysis Result for Cross-Section WS-2
(Global Circular_Drained_Construction Condition)

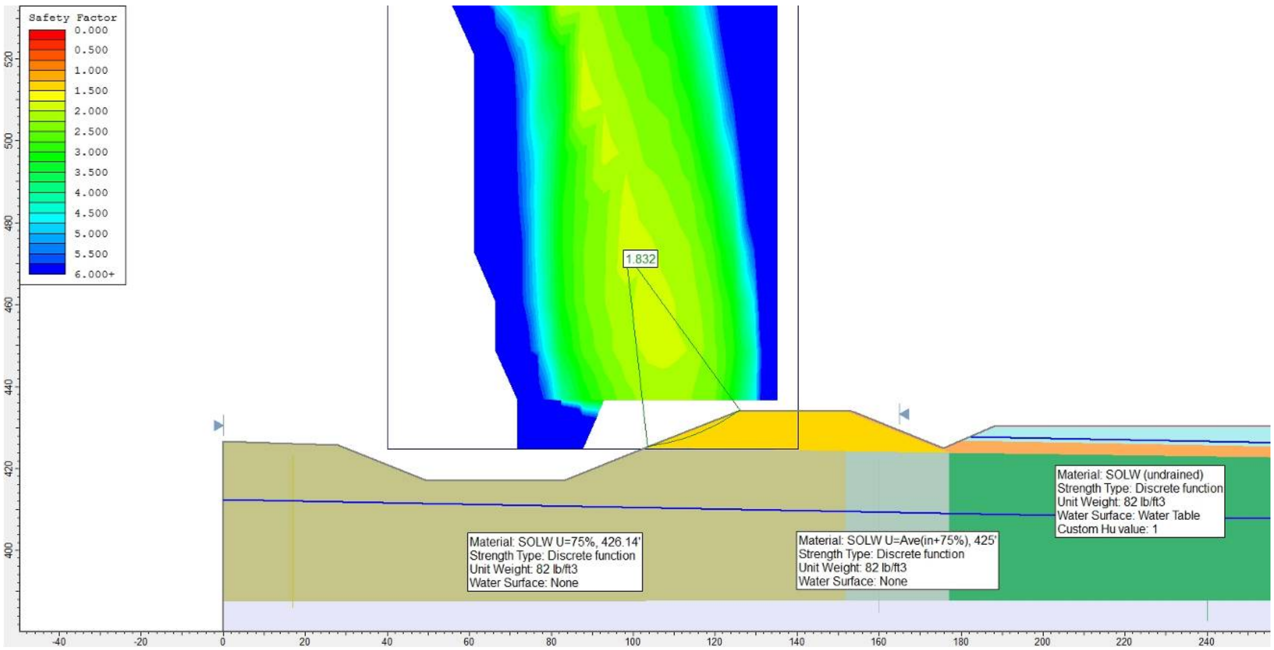

Figure 10. Slope Stability Analysis Result for Cross Section WS-2
(Global Circular_Undrained_Construction Condition)

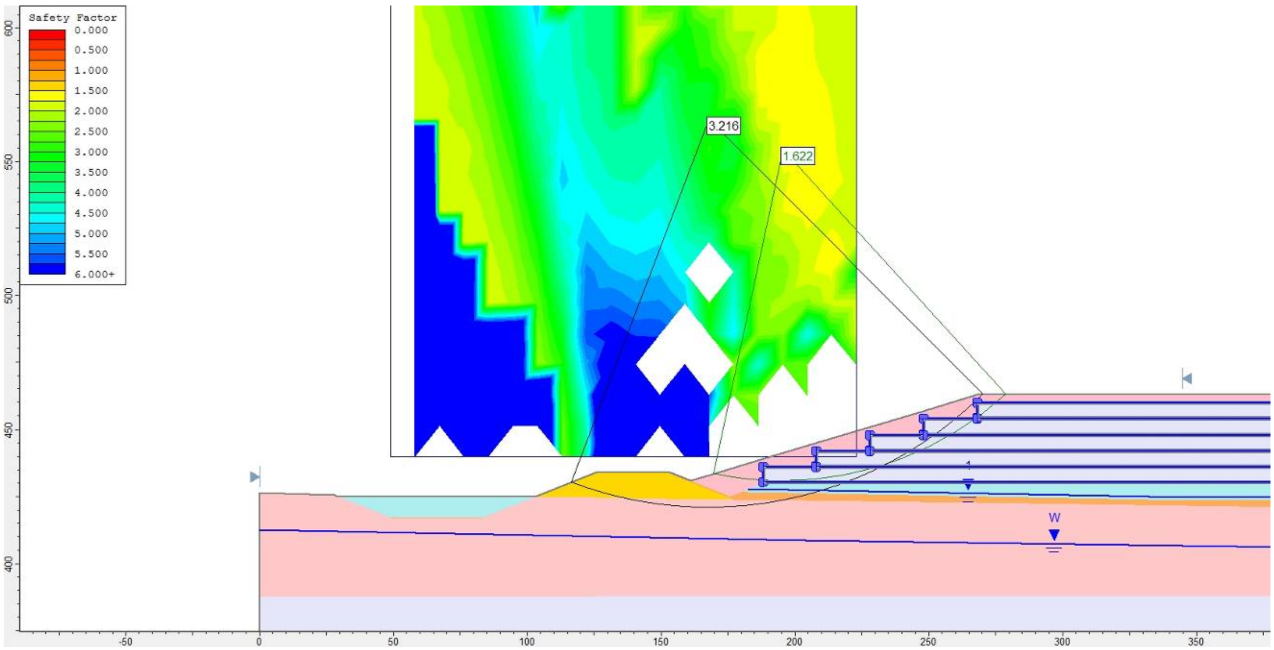

Figure 11. Slope Stability Analysis Result for Cross Section WS-2
(Global Circular_Drained_Operation Condition)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

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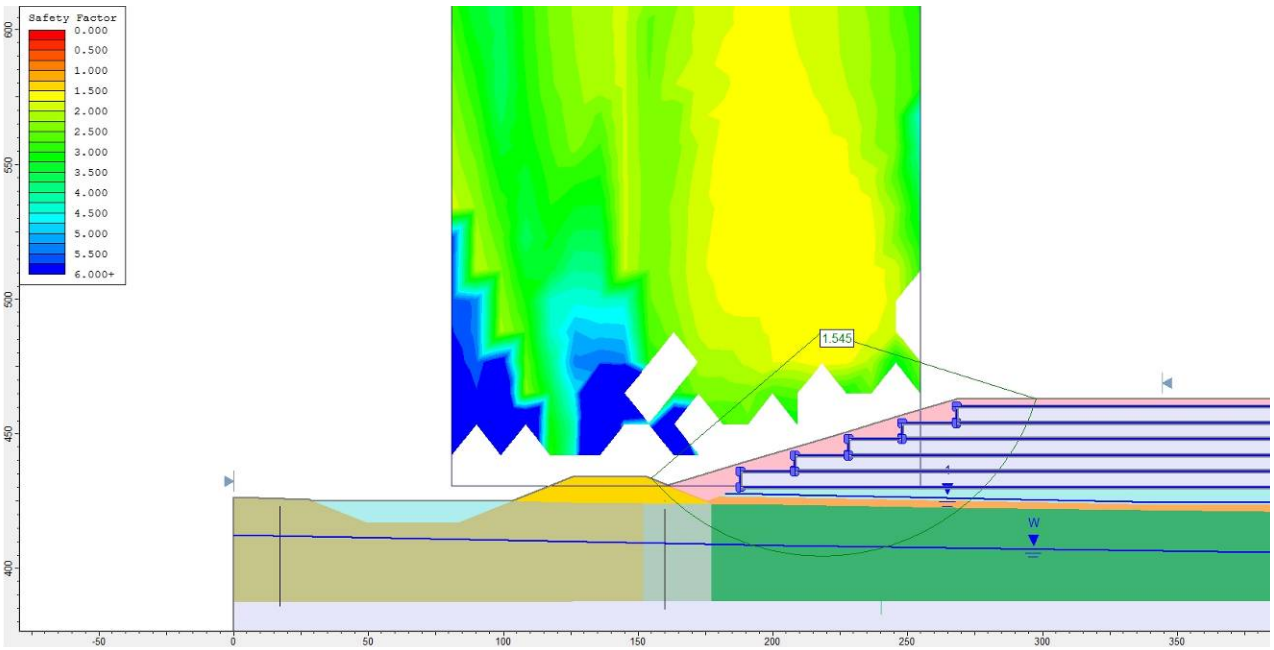

Figure 12. Slope Stability Analysis Result for Cross Section WS-2
(Global Circular_Undrained_Operation Condition)

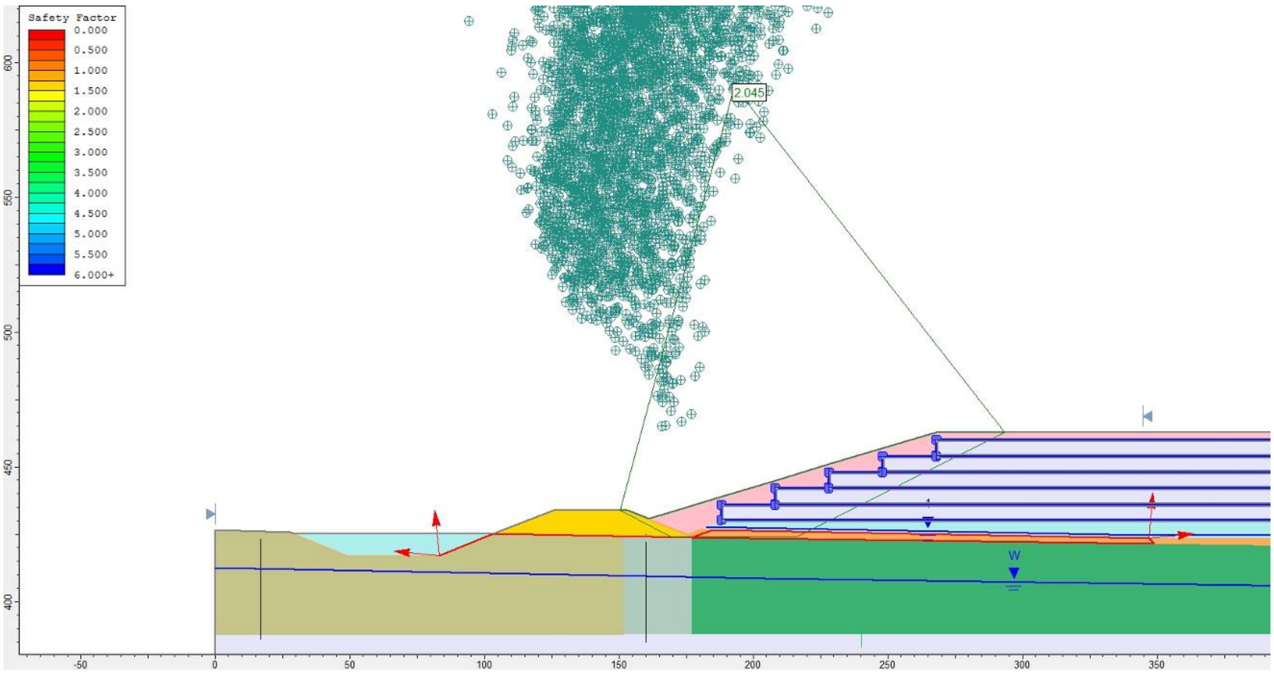

Figure 13. Slope Stability Analysis Result for Cross Section WS-2
(Global Block_Undrained_Operation Condition)

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

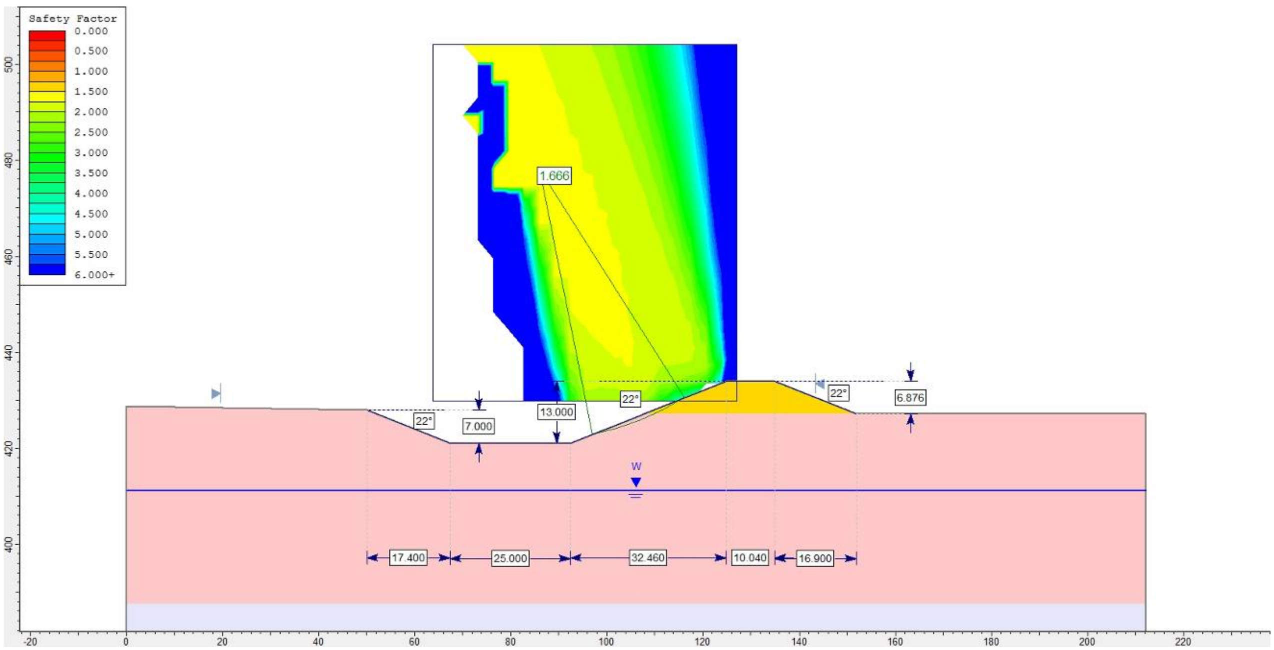

Figure 14. Slope Stability Analysis Result for Cross Section ES-1
(Global Circular_Drained_Construction Condition)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

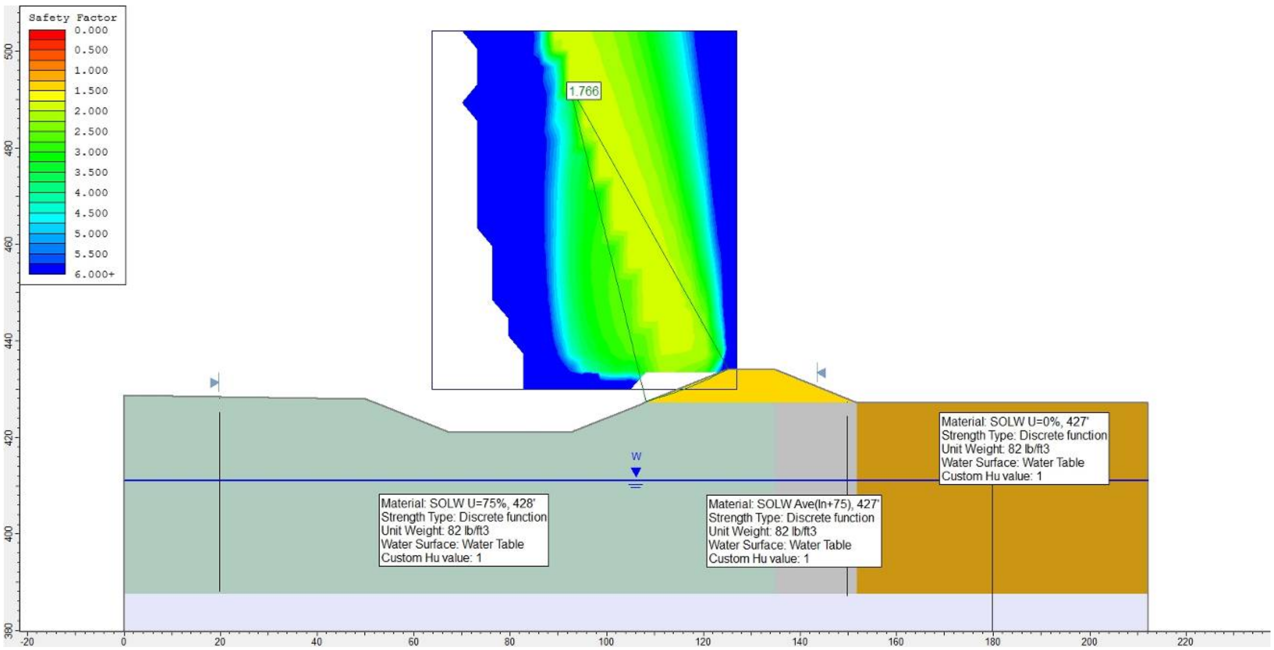

Figure 15. Slope Stability Analysis Result for Cross Section ES-1
(Global Circular_Undrained_Construction Condition)

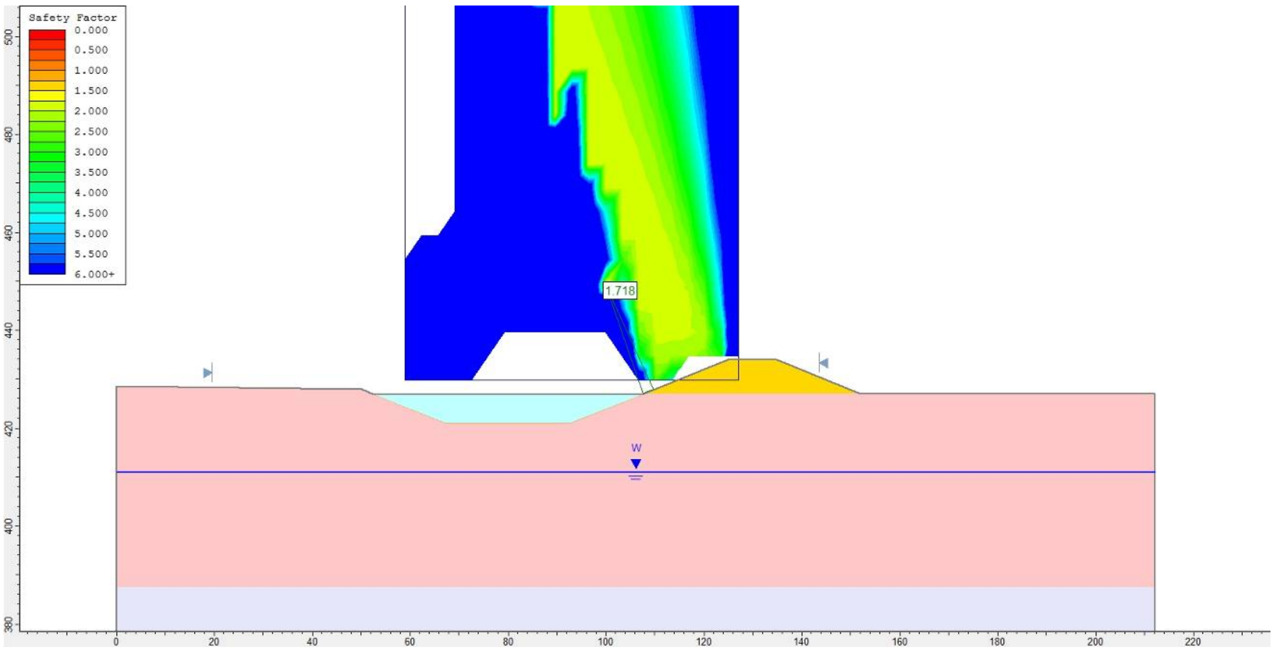

Figure 16. Slope Stability Analysis Result for Cross Section ES-1
(Global Circular_Drained_Operation Condition)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

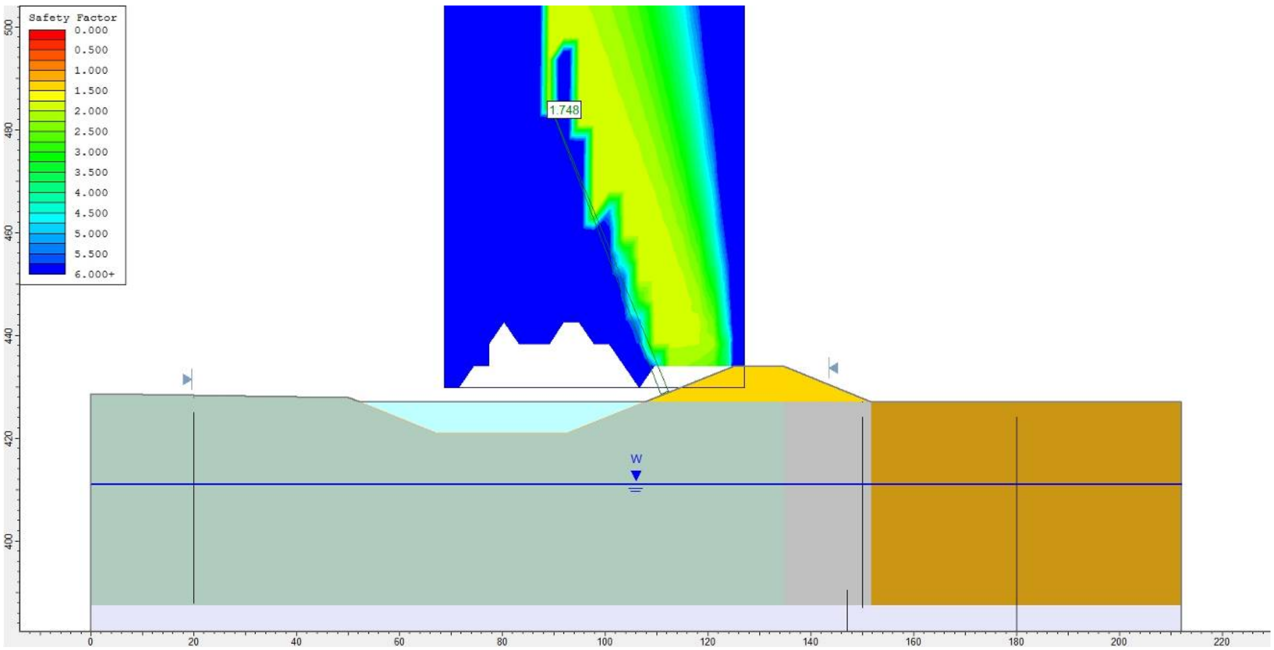

Figure 17. Slope Stability Analysis Result for Cross Section ES-1
(Global Circular_Undrained_Operation Condition)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

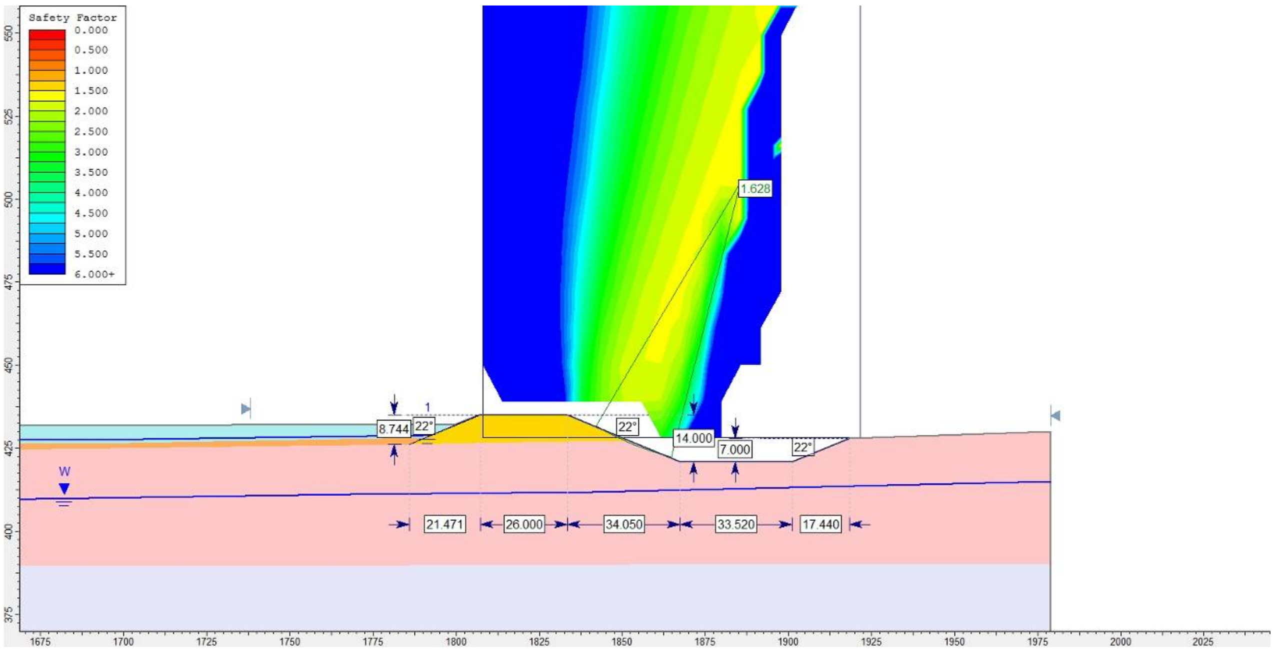

Figure 18. Slope Stability Analysis Result for Cross Section ES-2
(Global Circular_Drained_Construction Condition)

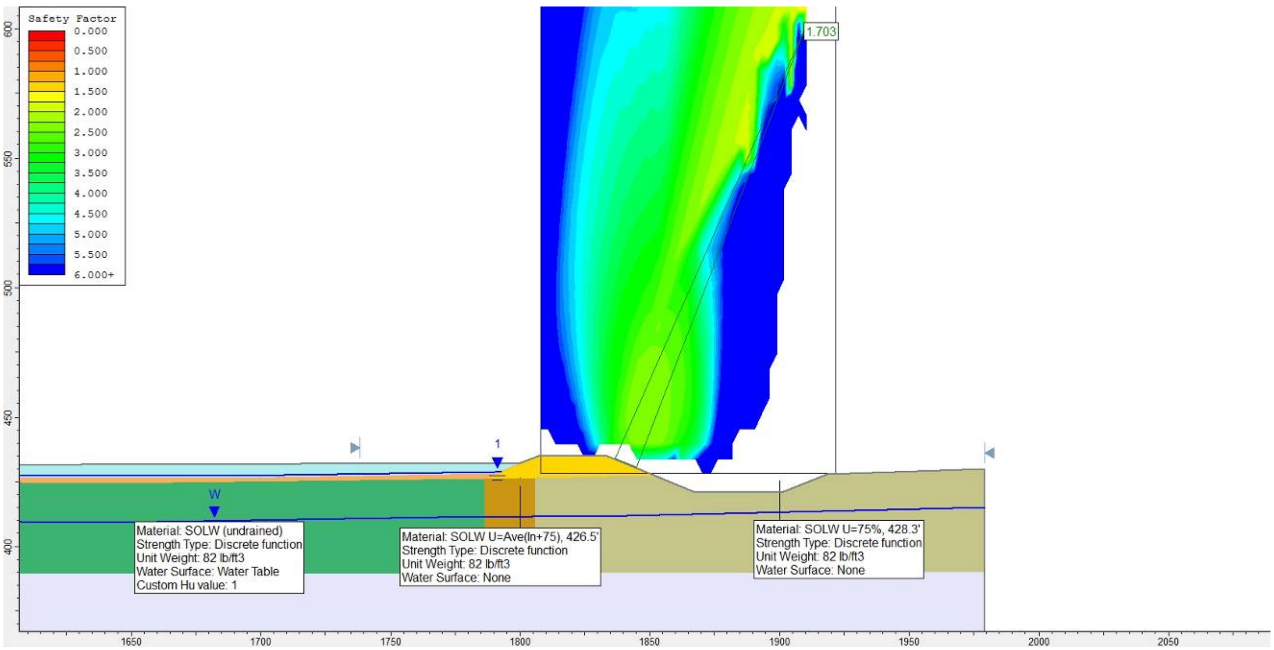

Figure 19. Slope Stability Analysis Result for Cross Section ES-2
(Global Circular_Undrained_Construction Condition)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

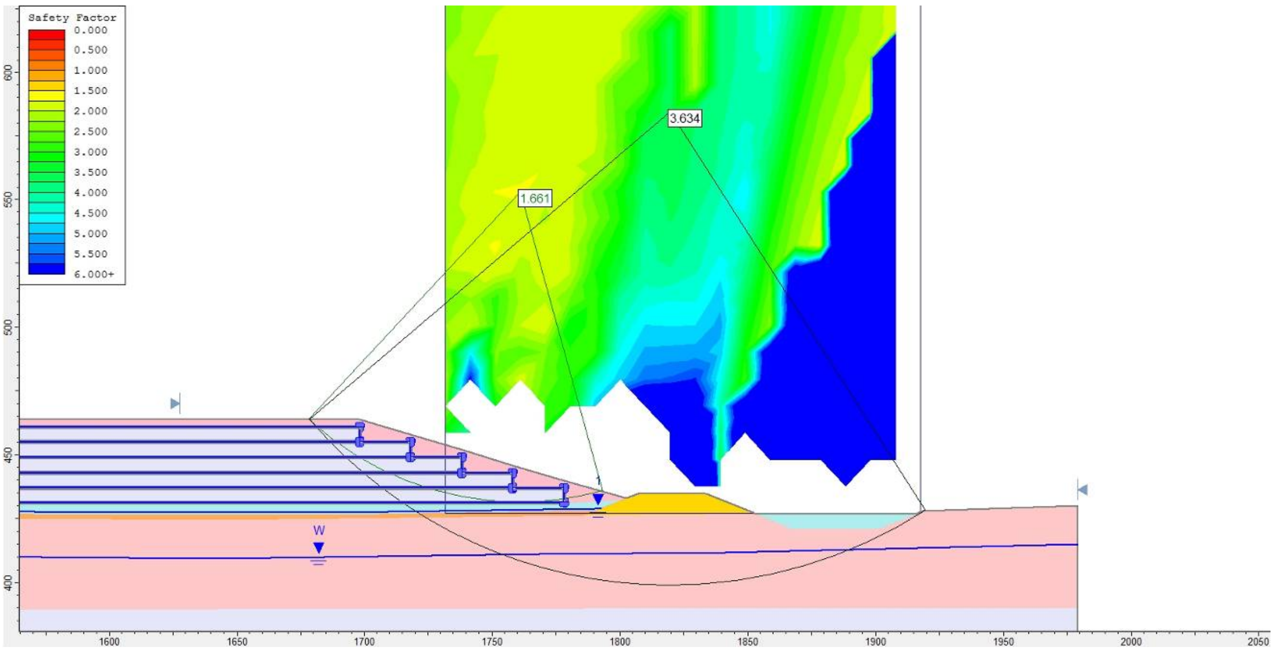

Figure 20. Slope Stability Analysis Result for Cross Section ES-2
(Global Circular_Drained_Operation Condition)

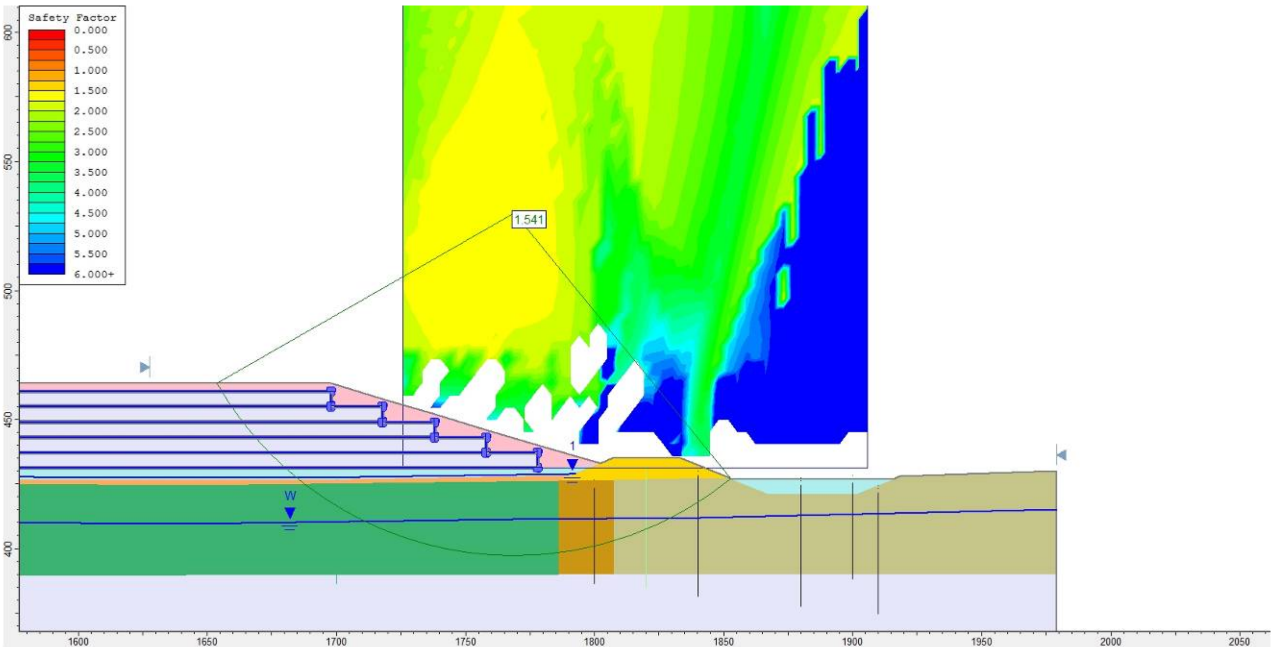

Figure 21. Slope Stability Analysis Result for Cross Section ES-2
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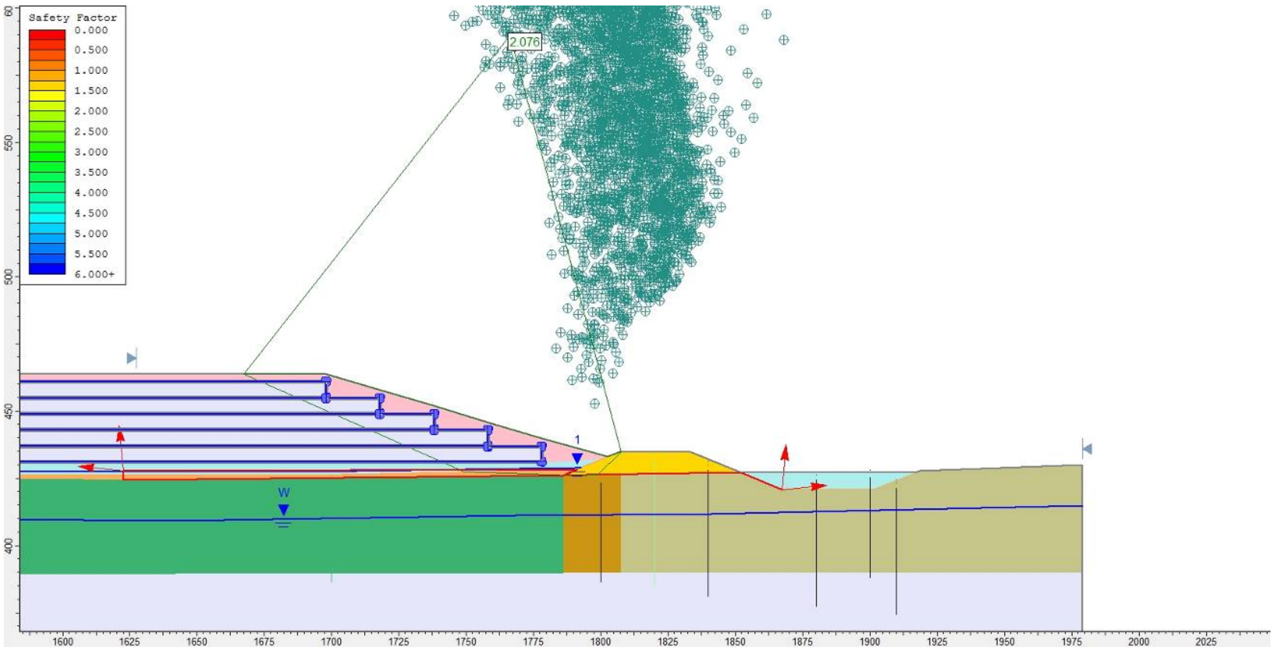

Figure 22. Slope Stability Analysis Result for Cross Section ES-2
(Global Block_Undrained_Operation Condition)

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake SCA Basin Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Attachment 1
SLIDE Output Files

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake SCA Basin Stability** Project/ Proposal No.: **GJ4299** Task No.: **05/01**

Note

The error messages in the output files are a result of invalid slip surfaces generated by the SLIDE program during the automatic search for the most critical slip surface. The invalid slip surfaces included surfaces that are beyond the defined model boundaries, surfaces that are kinematically not feasible, and surfaces that mathematically do not converge to a solution. The invalid slip surfaces do not affect the valid slip surfaces from which the critical slip surface is identified. A list of error codes identifying the meaning of each message is included immediately after this notes page.

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**

Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Cross Section WS-1
Global/Circular/Drained/Construction Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: WS-1C-D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.645720
Center: 99.149, 469.745
Radius: 49.470
Left Slip Surface Endpoint: 100.529, 420.294
Right Slip Surface Endpoint: 132.209, 432.943
Resisting Horizontal Force=3872.47 lb
Driving Horizontal Force=2353.06 lb

Method: spencer
FS: 1.663590
Center: 69.223, 519.732
Radius: 104.016
Left Slip Surface Endpoint: 103.995, 421.700
Right Slip Surface Endpoint: 112.578, 425.182
Resisting Moment=3390.87 lb-ft
Driving Moment=2038.29 lb-ft
Resisting Horizontal Force=30.2143 lb
Driving Horizontal Force=18.1621 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 4158
Number of Invalid Surfaces: 693

Error Codes:
Error Code -103 reported for 1 surface
Error Code -107 reported for 688 surfaces
Error Code -108 reported for 4 surfaces

Method: spencer
Number of Valid Surfaces: 4099
Number of Invalid Surfaces: 752
Error Codes:
Error Code -103 reported for 1 surface
Error Code -107 reported for 688 surfaces
Error Code -108 reported for 62 surfaces
Error Code -111 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

List of All Coordinates

Search Grid

62.573	450.519
129.075	450.519
129.075	527.422
62.573	527.422

Material Boundary

0.000	387.500
212.080	387.500

Material Boundary

117.060	427.000
117.310	427.000
162.421	427.000

External Boundary

212.080	348.000
212.080	387.500
212.080	427.000
162.421	427.000
144.902	434.000
134.902	434.000
117.060	427.000
92.410	417.000
67.410	417.000
50.000	424.000
0.000	424.715
0.000	387.500
0.000	348.000

Water Table

0.000	411.097
212.080	411.097

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section WS-1
Global/Circular/Undrained/Construction Condition

Slide Analysis Information

Document Name

File Name: WS-1C-U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 30
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: SOLW U=0%, 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 425.5
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=Ave(In+75%), 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.818780
Center: 115.025, 460.202
Radius: 32.962
Left Slip Surface Endpoint: 118.018, 427.376
Right Slip Surface Endpoint: 135.025, 434.000
Resisting Horizontal Force=1179.46 lb
Driving Horizontal Force=648.49 lb

Method: spencer
FS: 1.845790
Center: 113.072, 465.735
Radius: 38.777
Left Slip Surface Endpoint: 117.643, 427.229
Right Slip Surface Endpoint: 135.355, 434.000

Resisting Moment=50367.8 lb-ft
Driving Moment=27288 lb-ft
Resisting Horizontal Force=1206.94 lb
Driving Horizontal Force=653.887 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 26655
Number of Invalid Surfaces: 3136
Error Codes:
Error Code -107 reported for 225 surfaces
Error Code -108 reported for 412 surfaces
Error Code -111 reported for 586 surfaces
Error Code -112 reported for 34 surfaces
Error Code -114 reported for 1879 surfaces

Method: spencer
Number of Valid Surfaces: 26569
Number of Invalid Surfaces: 3222
Error Codes:
Error Code -107 reported for 225 surfaces
Error Code -108 reported for 455 surfaces
Error Code -111 reported for 598 surfaces
Error Code -112 reported for 65 surfaces
Error Code -114 reported for 1879 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

77.909	427.000
136.514	427.000
136.514	510.004
77.909	510.004

Material Boundary

0.000	387.500
50.000	387.500
67.410	387.500
92.410	387.500
107.188	387.500
134.902	387.500
144.902	387.500
162.421	387.500
212.080	387.500

Material Boundary

117.060	427.000
117.310	427.000
134.902	427.000
144.902	427.000
162.421	427.000

Material Boundary

50.000	387.500
50.000	423.900

Material Boundary

134.902	387.500
134.902	427.000

Material Boundary

144.902	387.500
144.902	427.000

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**

Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01

Material Boundary

162.421	387.500
162.421	427.000

Material Boundary

107.188	387.500
107.188	422.895
107.188	422.995

External Boundary

92.410	417.000
67.410	417.000
52.499	422.995
50.000	424.000
0.000	424.715
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500
212.080	427.000
162.421	427.000
144.902	434.000
134.902	434.000
117.060	427.000
107.188	422.995

Water Table

0.000	411.097
212.080	411.097

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section WS-1
Global/Circular/Drained/Operation Condition

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: WS-1F-D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.668600
Center: 88.423, 491.850

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Radius: 70.959
Left Slip Surface Endpoint: 111.568, 424.772
Right Slip Surface Endpoint: 118.283, 427.480
Resisting Horizontal Force=24.2857 lb
Driving Horizontal Force=14.5546 lb

Method: spencer
FS: 1.668630
Center: 88.423, 491.850
Radius: 70.959
Left Slip Surface Endpoint: 111.568, 424.772
Right Slip Surface Endpoint: 118.283, 427.480
Resisting Moment=1859.41 lb-ft
Driving Moment=1114.34 lb-ft
Resisting Horizontal Force=24.2846 lb
Driving Horizontal Force=14.5536 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 4513
Number of Invalid Surfaces: 338
Error Codes:
Error Code -103 reported for 24 surfaces
Error Code -107 reported for 102 surfaces
Error Code -108 reported for 176 surfaces
Error Code -111 reported for 15 surfaces
Error Code -112 reported for 21 surfaces

Method: spencer
Number of Valid Surfaces: 4248
Number of Invalid Surfaces: 603
Error Codes:
Error Code -103 reported for 24 surfaces
Error Code -107 reported for 102 surfaces
Error Code -108 reported for 297 surfaces
Error Code -111 reported for 151 surfaces
Error Code -112 reported for 29 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List of All Coordinates

Search Grid

65.147	438.018
131.649	438.018
131.649	514.921
65.147	514.921

Material Boundary

0.000	387.500
212.080	387.500

Material Boundary

117.060	427.000
117.310	427.000
117.405	427.000
117.655	427.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

162.421 427.000

Material Boundary

52.488	423.000
67.410	417.000

Material Boundary

50.000	424.000
50.000	423.900
67.410	416.900
92.410	416.900
117.655	427.000
134.902	433.900
134.902	434.000

Material Boundary

92.410	417.000
107.199	423.000

Material Boundary

50.000	424.000
67.410	417.000
92.410	417.000
117.405	427.000
134.886	433.993

External Boundary

52.488	423.000
50.000	424.000
0.000	424.715
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500
212.080	427.000
162.421	427.000
144.902	434.000
134.902	434.000
134.902	434.000
134.886	433.993
117.060	427.000
107.199	423.000

Water Table

0.000	411.097
212.080	411.097

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section WS-1
Global/Circular/Undrained/Operation Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: WS-1F-U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 30
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: SOLW U=0%, 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 425.5
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 428.5'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.784940
Center: 87.286, 508.344
Radius: 86.618
Left Slip Surface Endpoint: 117.225, 427.065
Right Slip Surface Endpoint: 120.603, 428.390
Resisting Horizontal Force=3.34167 lb
Driving Horizontal Force=1.87215 lb

Method: spencer
FS: 1.784960
Center: 87.286, 508.344
Radius: 86.618
Left Slip Surface Endpoint: 117.225, 427.065
Right Slip Surface Endpoint: 120.603, 428.390
Resisting Moment=310.91 lb-ft
Driving Moment=174.183 lb-ft
Resisting Horizontal Force=3.34165 lb
Driving Horizontal Force=1.87211 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 69298
Number of Invalid Surfaces: 11333
Error Codes:
Error Code -107 reported for 1734 surfaces
Error Code -108 reported for 2579 surfaces
Error Code -111 reported for 1642 surfaces
Error Code -112 reported for 729 surfaces
Error Code -114 reported for 4649 surfaces

Method: spencer
Number of Valid Surfaces: 68432
Number of Invalid Surfaces: 12199
Error Codes:
Error Code -107 reported for 1734 surfaces
Error Code -108 reported for 3147 surfaces
Error Code -111 reported for 1684 surfaces
Error Code -112 reported for 985 surfaces
Error Code -114 reported for 4649 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

77.909	427.000
136.514	427.000
136.514	510.004
77.909	510.004

Material Boundary

0.000	387.500
50.000	387.500
67.410	387.500
92.410	387.500
107.188	387.500
134.902	387.500

144.902	387.500
162.421	387.500
212.080	387.500

Material Boundary

117.060	427.000
117.310	427.000
134.902	427.000
144.902	427.000
162.421	427.000

Material Boundary

50.000	387.500
50.000	423.900

Material Boundary

134.902	387.500
134.902	427.000

Material Boundary

144.902	387.500
144.902	427.000

Material Boundary

162.421	387.500
162.421	427.000

Material Boundary

50.000	424.000
50.000	423.900
67.410	416.900
67.410	416.900
92.410	416.900
92.410	416.900
107.188	422.895
117.060	426.900
117.060	427.000

Material Boundary

52.499	422.995
67.410	417.000
92.410	417.000
107.188	422.995

Material Boundary

107.188	387.500
107.188	422.895
107.188	422.995

External Boundary

52.499	422.995
50.000	424.000
0.000	424.715
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500
212.080	427.000
162.421	427.000
144.902	434.000
134.902	434.000
117.060	427.000
107.188	422.995

Water Table

0.000	411.097
212.080	411.097

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section WS-2
Global/Circular/Drained/Construction Condition

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

Slide Analysis Information

Document Name

File Name: WS_2C_D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified

FS: 1.641350
Center: 87.585, 460.792
Radius: 41.142
Left Slip Surface Endpoint: 89.813, 419.711
Right Slip Surface Endpoint: 114.339, 429.537
Resisting Horizontal Force=2128.62 lb
Driving Horizontal Force=1296.87 lb

Method: spencer
FS: 1.665030
Center: 71.771, 496.863
Radius: 79.395
Left Slip Surface Endpoint: 88.881, 419.334
Right Slip Surface Endpoint: 112.974, 428.997
Resisting Moment=89394.8 lb-ft
Driving Moment=53689.7 lb-ft
Resisting Horizontal Force=1040.69 lb
Driving Horizontal Force=625.028 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 3407
Number of Invalid Surfaces: 1433
Error Codes:
Error Code -103 reported for 1 surface
Error Code -105 reported for 1 surface
Error Code -106 reported for 77 surfaces
Error Code -107 reported for 1113 surfaces
Error Code -108 reported for 123 surfaces
Error Code -111 reported for 42 surfaces
Error Code -112 reported for 76 surfaces

Method: spencer
Number of Valid Surfaces: 3391
Number of Invalid Surfaces: 1449
Error Codes:
Error Code -103 reported for 1 surface
Error Code -105 reported for 1 surface
Error Code -106 reported for 77 surfaces
Error Code -107 reported for 1113 surfaces
Error Code -108 reported for 132 surfaces
Error Code -111 reported for 42 surfaces
Error Code -112 reported for 83 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

List of All Coordinates

Search Grid

40.143	424.722
140.299	424.722
140.299	677.216
40.143	677.216

Material Boundary

103.116	425.094
125.614	424.734
151.946	424.313
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1805.788	426.613
1833.462	427.072
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000

Material Boundary

507.700	430.250
824.000	430.250
824.200	430.252

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
125.614	387.662
151.946	387.696
177.171	387.728
268.000	387.845
1786.163	389.802
1805.788	389.827
1833.462	389.873
1851.997	389.904
1867.512	389.947
1901.032	389.969
1918.427	390.050
1979.000	390.050

Material Boundary

180.062	426.825
182.423	427.769
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

175.665	425.068
180.062	426.825

Material Boundary

151.946	434.000
177.171	423.910

Material Boundary

180.062	426.825
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500
1689.000	426.500

Material Boundary

1786.163	426.261
1807.462	435.000

Material Boundary

27.994	387.564

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

27.994 425.704

Material Boundary
49.614 387.564
49.614 417.000

Material Boundary
83.114 387.607
83.114 417.000

Material Boundary
177.171 387.728
177.171 423.910

Material Boundary
1851.997 389.904
1851.997 427.379

Material Boundary
1867.512 389.947
1867.512 421.000

Material Boundary
1901.032 389.969
1901.032 421.000

Material Boundary
1918.427 390.050
1918.472 428.000

Material Boundary
1400.000 431.000
1798.537 432.039

Material Boundary
1805.788 389.827
1805.788 426.613

Material Boundary
1798.537 432.039
1799.545 432.039

Material Boundary
1689.000 426.500
1790.268 428.336

Material Boundary
1790.268 428.336
1799.545 432.039
1800.123 432.269

Material Boundary
1833.462 389.873
1833.462 427.072
1833.462 435.000

Material Boundary
151.946 387.696
151.946 424.313
151.946 434.000

Material Boundary
125.614 387.662
125.614 424.734
125.614 434.000

External Boundary
1800.123 432.269
1461.784 431.250
1460.199 431.250
1400.000 431.250
1236.000 432.250
1161.000 433.250
1143.812 433.097
1142.148 433.082
1125.724 432.936
1095.091 432.663
825.700 430.265
824.200 430.252
507.700 430.250
506.200 430.250
188.000 430.250
175.665 425.068
153.335 434.000
151.946 434.000
125.614 434.000
103.116 425.094
83.114 417.000
49.614 417.000
27.994 425.704
0.000 426.569
0.000 387.500
0.000 347.500
1979.000 350.000
1979.000 390.050
1979.000 430.050

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

1918.472	428.000
1901.032	421.000
1867.512	421.000
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Cross Section WS-2
Global/Circular/Undrained/Construction Condition

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Slide Analysis Information

Document Name

File Name: WS_2C_U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 1

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=Ave(in+75%), 425'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 426.14'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Global Minimums

Method: janbu simplified
FS: 1.729850
Center: 103.400, 448.769
Radius: 39.348
Left Slip Surface Endpoint: 80.183, 417.000
Right Slip Surface Endpoint: 139.871, 434.000
Resisting Horizontal Force=32818.3 lb
Driving Horizontal Force=18971.7 lb

Method: spencer
FS: 1.831520
Center: 98.128, 472.816
Radius: 47.878
Left Slip Surface Endpoint: 103.479, 425.238
Right Slip Surface Endpoint: 126.157, 434.000
Resisting Moment=105319 lb-ft
Driving Moment=57503.4 lb-ft
Resisting Horizontal Force=2042.06 lb
Driving Horizontal Force=1114.96 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 3312
Number of Invalid Surfaces: 1528
Error Codes:
Error Code -103 reported for 1 surface
Error Code -106 reported for 8 surfaces
Error Code -107 reported for 1142 surfaces
Error Code -108 reported for 175 surfaces
Error Code -111 reported for 30 surfaces
Error Code -112 reported for 1 surface
Error Code -115 reported for 171 surfaces

Method: spencer
Number of Valid Surfaces: 3296
Number of Invalid Surfaces: 1544
Error Codes:
Error Code -103 reported for 1 surface
Error Code -106 reported for 8 surfaces
Error Code -107 reported for 1142 surfaces
Error Code -108 reported for 183 surfaces
Error Code -111 reported for 30 surfaces
Error Code -112 reported for 9 surfaces
Error Code -115 reported for 171 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-115 = Surface too shallow, below the minimum depth.

List of All Coordinates

Search Grid

40.143	424.722
140.299	424.722
140.299	677.216
40.143	677.216

Material Boundary

103.116	425.094
125.614	424.734
151.946	424.313
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1805.788	426.613
1833.462	427.072
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000

Material Boundary

507.700	430.250
824.000	430.250
824.200	430.252

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
125.614	387.662
151.946	387.696
177.171	387.728
268.000	387.845
1786.163	389.802
1805.788	389.827
1833.462	389.873
1851.997	389.904
1867.512	389.947
1901.032	389.969
1918.427	390.050
1979.000	390.050

Material Boundary

180.062	426.825
182.423	427.769
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

175.665	425.068
180.062	426.825

Material Boundary

151.946	434.000
177.171	423.910

Material Boundary

180.062	426.825
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date: 12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

1689.000 426.500

Material Boundary
1786.163 426.261
1807.462 435.000

Material Boundary
177.171 387.728
177.171 423.910

Material Boundary
1851.997 389.904
1851.997 427.379

Material Boundary
1867.512 389.947
1867.512 421.000

Material Boundary
1901.032 389.969
1901.032 421.000

Material Boundary
1918.427 390.050
1918.472 428.000

Material Boundary
1400.000 431.000
1798.537 432.039

Material Boundary
1805.788 389.827
1805.788 426.613

Material Boundary
1798.537 432.039
1799.545 432.039

Material Boundary
1689.000 426.500
1790.268 428.336

Material Boundary
1790.268 428.336
1799.545 432.039
1800.123 432.269

Material Boundary
1833.462 389.873
1833.462 427.072
1833.462 435.000

Material Boundary
151.946 387.696
151.946 424.313
151.946 434.000

External Boundary
1800.123 432.269
1461.784 431.250
1460.199 431.250
1400.000 431.250
1236.000 432.250
1161.000 433.250
1143.812 433.097
1142.148 433.082
1125.724 432.936
1095.091 432.663
825.700 430.265
824.200 430.252
507.700 430.250
506.200 430.250
188.000 430.250
175.665 425.068
153.335 434.000
151.946 434.000
125.614 434.000
103.116 425.094
83.114 417.000
49.614 417.000
27.994 425.704
0.000 426.569
0.000 387.500
0.000 347.500
1979.000 350.000
1979.000 390.050
1979.000 430.050
1918.472 428.000
1901.032 421.000
1867.512 421.000
1851.997 427.379
1833.462 435.000
1807.462 435.000
1806.964 435.000

Piezo Line

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date: 12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section WS-2
Global/Circular/Drained/Operation Condition

Slide Analysis Information

Document Name

File Name: WS_2F_D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dredge Material
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Tube Interface (Horizontal)
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tub-Tube Interface (Vertical)
Strength Type: Mohr-Coulomb
Unit Weight: 43 lb/ft3

Cohesion: 0 psf
Friction Angle: 0.1 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Gravel Interface
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geotube
Geotube
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Tangent to Slip Surface
Anchorage: Both Ends
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1600 lb/ft
Pullout Strength Adhesion: 5 lb/ft2
Pullout Strength Friction Angle: 40 degrees

Global Minimums

Method: janbu simplified
FS: 1.647670
Center: 195.335, 554.530
Radius: 123.840
Left Slip Surface Endpoint: 169.503, 433.414
Right Slip Surface Endpoint: 278.753, 463.000
Resisting Horizontal Force=47382 lb
Driving Horizontal Force=28756.9 lb

Method: spencer
FS: 1.621650
Center: 195.335, 554.530
Radius: 123.840
Left Slip Surface Endpoint: 169.503, 433.414
Right Slip Surface Endpoint: 278.753, 463.000
Resisting Moment=6.32163e+006 lb-ft
Driving Moment=3.89826e+006 lb-ft
Resisting Horizontal Force=47236.3 lb
Driving Horizontal Force=29128.5 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 2424
Number of Invalid Surfaces: 2416
Error Codes:
Error Code -103 reported for 185 surfaces
Error Code -106 reported for 9 surfaces
Error Code -107 reported for 168 surfaces
Error Code -108 reported for 171 surfaces
Error Code -110 reported for 1717 surfaces
Error Code -112 reported for 26 surfaces
Error Code -114 reported for 140 surfaces

Method: spencer
Number of Valid Surfaces: 1982
Number of Invalid Surfaces: 2858
Error Codes:
Error Code -103 reported for 185 surfaces
Error Code -106 reported for 9 surfaces
Error Code -107 reported for 168 surfaces
Error Code -108 reported for 180 surfaces
Error Code -110 reported for 1717 surfaces
Error Code -111 reported for 430 surfaces
Error Code -112 reported for 29 surfaces
Error Code -114 reported for 140 surfaces

Error Codes

The following errors were encountered during the computation:

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-106 = Average slice width is less than
0.0001 * (maximum horizontal extent of soil region).
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-107 = Total driving moment or
total driving force is negative. This will occur
if the wrong failure direction is specified,
or if high external or anchor loads are applied
against the failure direction.

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-110 = The water table or a piezoline
does not span the slip region for a given slip
surface, when Water Surfaces is specified as
the method of pore pressure calculation. If this
error occurs, check that the water table or
piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F)
< 0.2 for the final iteration of the safety factor calculation. This screens out
some slip surfaces which may not be valid in the context of the analysis, in
particular, deep seated slip surfaces with many high negative base angle
slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

48.850	440.073
222.801	440.073
222.801	680.432
48.850	680.432

Material Boundary

103.116	425.094
125.614	424.602
151.946	424.248
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000
1778.100	431.000

Material Boundary

188.000	430.250
506.200	430.250
507.700	430.250
824.000	430.250
824.200	430.252
825.700	430.265
1142.148	433.082

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

1143.812	433.097
1161.000	433.250
1236.000	432.250
1400.000	431.250
1460.199	431.250
1461.784	431.250
1778.100	431.250

Material Boundary

208.000	436.000
506.200	436.000
507.700	436.000
824.000	436.000
824.200	436.002
825.700	436.015
1142.148	438.832
1143.812	438.847
1161.000	439.000
1236.000	438.000
1400.000	437.000
1460.199	437.000
1461.784	437.000
1758.000	437.000

Material Boundary

208.000	436.250
466.200	436.250
467.700	436.250
724.201	436.250
725.697	436.250
824.000	436.250
982.197	437.658
983.718	437.672
1161.000	439.250
1236.000	438.250
1240.193	438.224
1241.724	438.215
1400.000	437.250
1498.182	437.250
1499.766	437.250
1758.000	437.250

Material Boundary

228.000	442.000
466.200	442.000
467.700	442.000
724.201	442.000
725.697	442.000
824.000	442.000
982.197	443.408
983.718	443.422
1161.000	445.000
1236.000	444.000
1240.193	443.974
1241.724	443.965
1400.000	443.000
1498.182	443.000
1499.766	443.000
1738.000	443.000

Material Boundary

228.000	442.250
530.200	442.250
531.700	442.250
824.000	442.250
832.191	442.323
833.715	442.336
1134.188	445.011
1135.719	445.025
1161.000	445.250
1236.000	444.250
1400.000	443.250
1436.205	443.250
1437.780	443.250
1738.000	443.250

Material Boundary

248.000	448.000
530.200	448.000
531.700	448.000
824.000	448.000
832.191	448.073
833.715	448.086
1134.188	450.761
1135.719	450.775
1161.000	451.000
1236.000	450.000
1400.000	449.000
1436.205	449.000
1437.780	449.000
1718.000	449.000

Material Boundary

248.000	448.250
493.200	448.250
494.700	448.250

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

738.195 448.250
739.701 448.250
824.000 448.250
983.182 449.667
984.724 449.681
1161.000 451.250
1228.192 450.354
1229.723 450.334
1236.000 450.250
1400.000 449.250
1473.204 449.250
1474.788 449.250
1718.000 449.250

Material Boundary
268.000 454.000
493.200 454.000
494.700 454.000
738.195 454.000
739.701 454.000
824.000 454.000
983.182 455.417
984.724 455.431
1161.000 457.000
1228.192 456.104
1229.723 456.084
1236.000 456.000
1400.000 455.000
1473.204 455.000
1474.788 455.000
1698.000 455.000

Material Boundary
268.000 454.250
554.200 454.250
555.700 454.250
824.000 454.250
840.193 454.394
841.706 454.408
1126.178 456.940
1127.707 456.954
1161.000 457.250
1236.000 456.250
1400.000 455.250
1412.195 455.250
1413.743 455.250
1698.000 455.250

Material Boundary
506.200 430.250
506.200 436.000

Material Boundary
507.700 430.250
507.700 436.000

Material Boundary
466.200 436.250
466.200 442.000

Material Boundary
467.700 436.250
467.700 442.000

Material Boundary
530.200 442.250
530.200 448.000

Material Boundary
531.700 442.250
531.700 448.000

Material Boundary
493.200 448.250
493.200 454.000

Material Boundary
494.700 448.250
494.700 454.000

Material Boundary
554.200 454.250
554.200 460.000

Material Boundary
555.700 454.250
555.700 460.000

Material Boundary
824.200 430.252
824.200 436.002

Material Boundary
825.700 430.265
825.700 436.015

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Material Boundary
724.201 436.250
724.201 442.000

Material Boundary
725.697 436.250
725.697 442.000

Material Boundary
738.195 448.250
738.195 454.000

Material Boundary
739.701 448.250
739.701 454.000

Material Boundary
840.193 454.394
840.193 460.144

Material Boundary
841.706 454.408
841.706 460.158

Material Boundary
832.191 442.323
832.191 448.073

Material Boundary
833.715 442.336
833.715 448.086

Material Boundary
982.197 437.658
982.197 443.408

Material Boundary
983.182 449.667
983.182 455.417

Material Boundary
983.718 437.672
983.718 443.422

Material Boundary
984.724 449.681
984.724 455.431

Material Boundary
1134.188 445.011
1134.188 450.761

Material Boundary
1135.719 445.025
1135.719 450.775

Material Boundary
1436.205 443.250
1436.205 449.000

Material Boundary
1437.780 443.250
1437.780 449.000

Material Boundary
1126.178 456.940
1126.178 462.690

Material Boundary
1127.707 456.954
1127.707 462.704

Material Boundary
1142.148 433.082
1142.148 438.832

Material Boundary
1143.812 433.097
1143.812 438.847

Material Boundary
1228.192 450.354
1228.192 456.104

Material Boundary
1229.723 450.334
1229.723 456.084

Material Boundary
1240.193 438.224
1240.193 443.974

Material Boundary
1241.724 438.215
1241.724 443.965

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

1412.195	455.250
1412.195	461.000

Material Boundary

1413.743	455.250
1413.743	461.000

Material Boundary

1460.199	431.250
1460.199	437.000

Material Boundary

1461.784	431.250
1461.784	437.000

Material Boundary

1498.182	437.250
1498.182	443.000

Material Boundary

1499.766	437.250
1499.766	443.000

Material Boundary

1473.204	449.250
1473.204	455.000

Material Boundary

1474.788	449.250
1474.788	455.000

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
125.614	387.662
151.946	387.696
268.000	387.845
1642.000	389.616
1786.163	389.802
1848.701	389.882
1867.512	389.969
1901.032	389.969
1916.339	389.969
1979.000	390.050

Material Boundary

268.000	462.000
268.000	460.000
554.200	460.000
555.700	460.000
824.000	460.000
840.193	460.144
841.706	460.158
1126.178	462.690
1127.707	462.704
1161.000	463.000
1236.000	462.000
1400.000	461.000
1412.195	461.000
1413.743	461.000
1698.000	461.000

Material Boundary

1698.000	463.000
1698.000	461.000
1698.000	455.250
1698.000	455.000
1718.000	455.000
1718.000	449.250
1718.000	449.000
1738.000	449.000
1738.000	443.250
1738.000	443.000
1758.000	443.000
1758.000	437.250
1758.000	437.000
1778.100	437.000
1778.100	431.250
1778.100	431.000

Material Boundary

180.062	426.825
180.500	427.000
182.423	427.769
183.000	428.000
185.500	429.000
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

161.101	430.894
175.665	425.068
180.062	426.825

Material Boundary

151.946	434.000
177.171	423.910

Material Boundary

180.062	426.825
182.423	426.779
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500
1689.000	426.500
1790.268	428.336

Material Boundary

188.000	430.000
188.000	430.250
188.000	436.000
208.000	436.000
208.000	436.250
208.000	442.000
228.000	442.000
228.000	442.250
228.000	448.000
248.000	448.000
248.000	448.250
248.000	454.000
268.000	454.000
268.000	454.250
268.000	460.000

Material Boundary

1786.163	426.261
1807.462	435.000

Material Boundary

27.994	387.564
27.994	425.566

Material Boundary

49.614	387.564
49.614	416.900
49.614	417.000

Material Boundary

83.114	387.607
83.114	416.900
83.114	417.000

Material Boundary

27.994	425.704
27.994	425.566
49.614	416.900
83.114	416.900
103.116	424.994
103.116	424.994
103.116	425.094
103.116	425.094
83.114	417.000
49.614	417.000

Material Boundary

83.114	417.000
103.116	425.094

Material Boundary

1642.000	389.616
1642.000	424.450

Material Boundary

1786.163	426.261
1786.163	389.802

Material Boundary

125.614	387.662
125.614	424.602
125.614	434.000

Material Boundary

151.946	387.696
151.946	424.248
151.946	434.000

Material Boundary

29.509	425.094
49.614	417.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

1798.640	432.124
1800.121	432.269
1800.123	432.269

Material Boundary

1778.100	431.000
1798.640	432.124

Material Boundary

1790.268	428.336
1800.121	432.269
1800.129	432.272
1802.376	433.169

Material Boundary

1851.997	427.379
1851.997	427.279
1867.512	420.900
1901.032	420.900
1918.472	427.900
1918.472	428.000

Material Boundary

1851.997	427.379
1867.512	421.000
1901.032	421.000
1916.925	427.379

External Boundary

1778.100	440.000
1758.000	446.000
1738.000	452.000
1718.000	458.000
1698.000	464.000
1400.000	464.000
1236.000	465.000
1161.000	466.000
824.000	463.000
268.000	463.000
248.000	457.000
228.000	451.000
208.000	445.000
188.000	439.000
171.455	434.000
161.101	430.894
153.335	434.000
151.946	434.000
125.614	434.000
103.116	425.094
29.509	425.094
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000
1916.925	427.379
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000
1802.376	433.169

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date: 12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

1979.000 415.050

Support
554.200 454.250
554.200 460.000

Support
554.200 460.000
268.000 460.000

Support
268.000 454.000
248.000 454.000

Support
248.000 454.000
248.000 448.250

Support
248.000 448.250
493.200 448.250

Support
493.200 454.000
493.200 448.250

Support
268.000 460.000
268.000 454.250

Support
268.000 454.250
554.200 454.250

Support
555.700 454.250
555.700 460.000

Support
555.700 460.000
824.000 460.000

Support
824.000 460.000
840.193 460.144

Support
840.193 460.144
840.193 454.394

Support
840.193 454.394
824.000 454.250

Support
824.000 454.250
555.700 454.250

Support
738.195 454.000
738.195 448.250

Support
739.701 454.000
739.701 448.250

Support
738.195 454.000
494.700 454.000

Support
494.700 454.000
494.700 448.250

Support
494.700 448.250
738.195 448.250

Support
724.201 442.000
724.201 436.250

Support
724.201 436.250
467.700 436.250

Support
467.700 436.250
467.700 442.000

Support
467.700 442.000
724.201 442.000

Support
228.000 448.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

228.000 442.250

Support
248.000 448.000
530.200 448.000

Support
530.200 448.000
530.200 442.250

Support
531.700 442.250
531.700 448.000

Support
530.200 442.250
228.000 442.250

Support
228.000 448.000
248.000 448.000

Support
208.000 436.250
208.000 442.000

Support
208.000 442.000
228.000 442.000

Support
228.000 442.000
466.200 442.000

Support
466.200 442.000
466.200 436.250

Support
466.200 436.250
208.000 436.250

Support
188.000 430.250
188.000 436.000

Support
188.000 436.000

208.000 436.000

Support
208.000 436.000
506.200 436.000

Support
507.700 436.000
507.700 430.250

Support
506.200 436.000
506.200 430.250

Support
506.200 430.250
188.000 430.250

Support
507.700 430.250
824.200 430.252

Support
824.200 430.252
824.200 436.002

Support
824.200 436.002
507.700 436.000

Support
832.191 442.323
832.191 448.073

Support
833.715 442.336
833.715 448.086

Support
832.191 448.073
824.000 448.000

Support
824.000 448.000
531.700 448.000

Support
531.700 442.250

824.000 442.250

Support
824.000 442.250
832.191 442.323

Support
841.706 460.158
841.706 454.408

Support
825.700 436.015
825.700 430.265

Support
725.697 442.000
725.697 436.250

Support
725.697 436.250
824.000 436.250

Support
824.000 436.250
982.197 437.658

Support
982.197 437.658
982.197 443.408

Support
982.197 443.408
824.000 442.000

Support
824.000 442.000
725.697 442.000

Support
739.701 448.250
824.000 448.250

Support
824.000 448.250
983.182 449.667

Support
983.182 449.667

983.182 455.417

Support
983.182 455.417
824.000 454.000

Support
824.000 454.000
739.701 454.000

Support
841.706 454.408
1126.178 456.940

Support
1126.178 456.940
1126.178 462.690

Support
1126.178 462.690
841.706 460.158

Support
833.715 448.086
1134.188 450.761

Support
1134.188 450.761
1134.188 445.011

Support
1134.188 445.011
833.715 442.336

Support
825.700 436.015
1142.148 438.832

Support
1142.148 438.832
1142.148 433.082

Support
1142.148 433.082
825.700 430.265

Support
984.724 455.431

984.724 449.681

Support
983.718 443.422
983.718 437.672

Support
983.718 437.672
1161.000 439.250

Support
1161.000 439.250
1236.000 438.250

Support
1236.000 438.250
1240.193 438.224

Support
1240.193 438.224
1240.193 443.974

Support
1240.193 443.974
1236.000 444.000

Support
1236.000 444.000
1161.000 445.000

Support
1161.000 445.000
983.718 443.422

Support
984.724 455.431
1161.000 457.000

Support
1161.000 457.000
1228.192 456.104

Support
1228.192 456.104
1228.192 450.354

Support
1228.192 450.354

1161.000 451.250

Support
1161.000 451.250
984.724 449.681

Support
268.000 454.000
493.200 454.000

Support
1127.707 462.704
1127.707 456.954

Support
1127.707 462.704
1161.000 463.000

Support
1161.000 463.000
1236.000 462.000

Support
1236.000 462.000
1400.000 461.000

Support
1400.000 461.000
1412.195 461.000

Support
1412.195 461.000
1412.195 455.250

Support
1412.195 455.250
1400.000 455.250

Support
1400.000 455.250
1236.000 456.250

Support
1236.000 456.250
1161.000 457.250

Support
1161.000 457.250

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1127.707 456.954

Support
1135.719 450.775
1135.719 445.025

Support
1135.719 450.775
1161.000 451.000

Support
1161.000 445.250
1135.719 445.025

Support
1161.000 445.250
1236.000 444.250

Support
1236.000 444.250
1400.000 443.250

Support
1400.000 443.250
1436.205 443.250

Support
1436.205 443.250
1436.205 449.000

Support
1437.780 449.000
1437.780 443.250

Support
1436.205 449.000
1400.000 449.000

Support
1400.000 449.000
1236.000 450.000

Support
1236.000 450.000
1161.000 451.000

Support
1229.723 456.084

1229.723 450.334

Support
1229.723 450.334
1236.000 450.250

Support
1236.000 456.000
1229.723 456.084

Support
1236.000 456.000
1400.000 455.000

Support
1400.000 455.000
1473.204 455.000

Support
1473.204 455.000
1473.204 449.250

Support
1474.788 449.250
1474.788 455.000

Support
1473.204 449.250
1400.000 449.250

Support
1400.000 449.250
1236.000 450.250

Support
1241.724 438.215
1241.724 443.965

Support
1143.812 438.847
1143.812 433.097

Support
1143.812 433.097
1161.000 433.250

Support
1161.000 439.000

1143.812 438.847

Support
1161.000 439.000
1236.000 438.000

Support
1236.000 438.000
1400.000 437.000

Support
1400.000 437.000
1460.199 437.000

Support
1460.199 437.000
1460.199 431.250

Support
1461.784 431.250
1461.784 437.000

Support
1460.199 431.250
1400.000 431.250

Support
1400.000 431.250
1236.000 432.250

Support
1236.000 432.250
1161.000 433.250

Support
1241.724 438.215
1400.000 437.250

Support
1400.000 437.250
1498.182 437.250

Support
1498.182 443.000
1498.182 437.250

Support
1499.766 437.250

1499.766 443.000

Support
1498.182 443.000
1400.000 443.000

Support
1400.000 443.000
1241.724 443.965

Support
1413.743 461.000
1413.743 455.250

Support
1413.743 461.000
1698.000 461.000

Support
1698.000 461.000
1698.000 455.250

Support
1698.000 455.250
1413.743 455.250

Support
1474.788 449.250
1718.000 449.250

Support
1718.000 449.250
1718.000 455.000

Support
1698.000 455.000
1474.788 455.000

Support
1461.784 431.250
1778.100 431.250

Support
1778.100 431.250
1778.100 437.000

Support
1758.000 437.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1461.784 437.000

Support
1437.780 443.250
1738.000 443.250

Support
1738.000 443.250
1738.000 449.000

Support
1718.000 449.000
1437.780 449.000

Support
1499.766 437.250
1758.000 437.250

Support
1758.000 437.250
1758.000 443.000

Support
1738.000 443.000
1499.766 443.000

Support
1718.000 455.000
1698.000 455.000

Support
1718.000 449.000
1738.000 449.000

Support
1738.000 443.000
1758.000 443.000

Support
1758.000 437.000
1778.100 437.000

Cross Section WS-2
Global/Circular/Undrained/Operation Condition

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: WS_2F_U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Dredge Material
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Tube Interface (Horizontal)
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tub-Tube Interface (Vertical)
Strength Type: Mohr-Coulomb
Unit Weight: 43 lb/ft3
Cohesion: 0 psf
Friction Angle: 0.1 degrees

Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Gravel Interface
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=Ave(in+75%), 425'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 426.14'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Support Properties

Support: Geotube
Geotube
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Tangent to Slip Surface
Anchorage: Both Ends
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1600 lb/ft
Pullout Strength Adhesion: 5 lb/ft2
Pullout Strength Friction Angle: 40 degrees

Global Minimums

Method: janbu simplified
FS: 1.483860
Center: 190.615, 522.334
Radius: 129.738
Left Slip Surface Endpoint: 104.231, 425.536
Right Slip Surface Endpoint: 305.990, 463.000
Resisting Horizontal Force=144384 lb
Driving Horizontal Force=97302.4 lb

Method: spencer
FS: 1.544810
Center: 218.081, 487.997
Radius: 83.588
Left Slip Surface Endpoint: 154.761, 433.430
Right Slip Surface Endpoint: 297.844, 463.000
Resisting Moment=9.32402e+006 lb-ft
Driving Moment=6.03569e+006 lb-ft
Resisting Horizontal Force=88348 lb
Driving Horizontal Force=57190.1 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 2789
Number of Invalid Surfaces: 2051
Error Codes:
Error Code -103 reported for 269 surfaces
Error Code -107 reported for 22 surfaces
Error Code -108 reported for 21 surfaces
Error Code -110 reported for 1388 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 44 surfaces
Error Code -114 reported for 306 surfaces

Method: spencer
Number of Valid Surfaces: 2046
Number of Invalid Surfaces: 2794
Error Codes:
Error Code -103 reported for 269 surfaces
Error Code -107 reported for 22 surfaces
Error Code -108 reported for 24 surfaces
Error Code -110 reported for 1388 surfaces
Error Code -111 reported for 732 surfaces

Written by: Y. Cho Date: 12/07/2010 Reviewed by: N. Yafrate/R. Kulasingam Date: 12/08/2010

Client: Honeywell Project: Onondaga Lake Sump Stability Project/ Proposal No.: GJ4299 Task No.: 05/01

Error Code -112 reported for 53 surfaces
Error Code -114 reported for 306 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

80.751	430.769
254.702	430.769
254.702	671.128
80.751	671.128

Material Boundary

103.116	425.094
125.614	424.602
151.946	424.248
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000
1778.100	431.000

Material Boundary

188.000	430.250
506.200	430.250
507.700	430.250
824.000	430.250
824.200	430.252
825.700	430.265
1142.148	433.082
1143.812	433.097

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Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

1161.000	433.250
1236.000	432.250
1400.000	431.250
1460.199	431.250
1461.784	431.250
1778.100	431.250

Material Boundary

208.000	436.000
506.200	436.000
507.700	436.000
824.000	436.000
824.200	436.002
825.700	436.015
1142.148	438.832
1143.812	438.847
1161.000	439.000
1236.000	438.000
1400.000	437.000
1460.199	437.000
1461.784	437.000
1758.000	437.000

Material Boundary

208.000	436.250
466.200	436.250
467.700	436.250
724.201	436.250
725.697	436.250
824.000	436.250
982.197	437.658
983.718	437.672
1161.000	439.250
1236.000	438.250
1240.193	438.224
1241.724	438.215
1400.000	437.250
1498.182	437.250
1499.766	437.250
1758.000	437.250

Material Boundary

228.000	442.000
466.200	442.000
467.700	442.000
724.201	442.000
725.697	442.000
824.000	442.000
982.197	443.408
983.718	443.422
1161.000	445.000
1236.000	444.000
1240.193	443.974
1241.724	443.965
1400.000	443.000
1498.182	443.000
1499.766	443.000
1738.000	443.000

Material Boundary

228.000	442.250
530.200	442.250
531.700	442.250
824.000	442.250
832.191	442.323
833.715	442.336
1134.188	445.011
1135.719	445.025
1161.000	445.250
1236.000	444.250
1400.000	443.250
1436.205	443.250
1437.780	443.250
1738.000	443.250

Material Boundary

248.000	448.000
530.200	448.000
531.700	448.000
824.000	448.000
832.191	448.073
833.715	448.086
1134.188	450.761
1135.719	450.775
1161.000	451.000
1236.000	450.000
1400.000	449.000
1436.205	449.000
1437.780	449.000
1718.000	449.000

Material Boundary

248.000	448.250
493.200	448.250
494.700	448.250
738.195	448.250

739.701	448.250
824.000	448.250
983.182	449.667
984.724	449.681
1161.000	451.250
1228.192	450.354
1229.723	450.334
1236.000	450.250
1400.000	449.250
1473.204	449.250
1474.788	449.250
1718.000	449.250

Material Boundary

268.000	454.000
493.200	454.000
494.700	454.000
738.195	454.000
739.701	454.000
824.000	454.000
983.182	455.417
984.724	455.431
1161.000	457.000
1228.192	456.104
1229.723	456.084
1236.000	456.000
1400.000	455.000
1473.204	455.000
1474.788	455.000
1698.000	455.000

Material Boundary

268.000	454.250
554.200	454.250
555.700	454.250
824.000	454.250
840.193	454.394
841.706	454.408
1126.178	456.940
1127.707	456.954
1161.000	457.250
1236.000	456.250
1400.000	455.250
1412.195	455.250
1413.743	455.250
1698.000	455.250

Material Boundary

506.200	430.250
506.200	436.000

Material Boundary

507.700	430.250
507.700	436.000

Material Boundary

466.200	436.250
466.200	442.000

Material Boundary

467.700	436.250
467.700	442.000

Material Boundary

530.200	442.250
530.200	448.000

Material Boundary

531.700	442.250
531.700	448.000

Material Boundary

493.200	448.250
493.200	454.000

Material Boundary

494.700	448.250
494.700	454.000

Material Boundary

554.200	454.250
554.200	460.000

Material Boundary

555.700	454.250
555.700	460.000

Material Boundary

824.200	430.252
824.200	436.002

Material Boundary

825.700	430.265
825.700	436.015

Material Boundary

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

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724.201 436.250
724.201 442.000

Material Boundary
725.697 436.250
725.697 442.000

Material Boundary
738.195 448.250
738.195 454.000

Material Boundary
739.701 448.250
739.701 454.000

Material Boundary
840.193 454.394
840.193 460.144

Material Boundary
841.706 454.408
841.706 460.158

Material Boundary
832.191 442.323
832.191 448.073

Material Boundary
833.715 442.336
833.715 448.086

Material Boundary
982.197 437.658
982.197 443.408

Material Boundary
983.182 449.667
983.182 455.417

Material Boundary
983.718 437.672
983.718 443.422

Material Boundary
984.724 449.681
984.724 455.431

Material Boundary

1134.188 445.011
1134.188 450.761

Material Boundary
1135.719 445.025
1135.719 450.775

Material Boundary
1436.205 443.250
1436.205 449.000

Material Boundary
1437.780 443.250
1437.780 449.000

Material Boundary
1126.178 456.940
1126.178 462.690

Material Boundary
1127.707 456.954
1127.707 462.704

Material Boundary
1142.148 433.082
1142.148 438.832

Material Boundary
1143.812 433.097
1143.812 438.847

Material Boundary
1228.192 450.354
1228.192 456.104

Material Boundary
1229.723 450.334
1229.723 456.084

Material Boundary
1240.193 438.224
1240.193 443.974

Material Boundary
1241.724 438.215
1241.724 443.965

Material Boundary

1412.195	455.250
1412.195	461.000

Material Boundary

1413.743	455.250
1413.743	461.000

Material Boundary

1460.199	431.250
1460.199	437.000

Material Boundary

1461.784	431.250
1461.784	437.000

Material Boundary

1498.182	437.250
1498.182	443.000

Material Boundary

1499.766	437.250
1499.766	443.000

Material Boundary

1473.204	449.250
1473.204	455.000

Material Boundary

1474.788	449.250
1474.788	455.000

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
125.614	387.662
151.946	387.756
177.171	387.845
268.000	387.845
1642.000	389.616
1786.163	389.802
1848.701	389.882
1867.512	389.969
1901.032	389.969
1916.339	389.969
1979.000	390.050

Material Boundary

268.000	462.000
268.000	460.000
554.200	460.000
555.700	460.000
824.000	460.000
840.193	460.144
841.706	460.158
1126.178	462.690
1127.707	462.704
1161.000	463.000
1236.000	462.000
1400.000	461.000
1412.195	461.000
1413.743	461.000
1698.000	461.000

Material Boundary

1698.000	463.000
1698.000	461.000
1698.000	455.250
1698.000	455.000
1718.000	455.000
1718.000	449.250
1718.000	449.000
1738.000	449.000
1738.000	443.250
1738.000	443.000
1758.000	443.000
1758.000	437.250
1758.000	437.000
1778.100	437.000
1778.100	431.250
1778.100	431.000

Material Boundary

180.062	426.825
180.500	427.000
182.423	427.769
183.000	428.000
185.500	429.000
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

161.101	430.894
175.665	425.068
180.062	426.825

Material Boundary

180.062	426.825
182.423	426.779
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500
1689.000	426.500
1790.268	428.336

Material Boundary

188.000	430.000
188.000	430.250
188.000	436.000
208.000	436.000
208.000	436.250
208.000	442.000
228.000	442.000
228.000	442.250
228.000	448.000
248.000	448.000
248.000	448.250
248.000	454.000
268.000	454.000
268.000	454.250
268.000	460.000

Material Boundary

1786.163	426.261
1807.462	435.000

Material Boundary

27.994	387.564
27.994	425.566

Material Boundary

27.994	425.704
27.994	425.566
49.614	416.900
83.114	416.900
103.116	424.994
103.116	424.994

Material Boundary

83.114	417.000
103.116	425.094

Material Boundary

1642.000	389.616
1642.000	424.450

Material Boundary

1786.163	426.261
1786.163	389.802

Material Boundary

151.946	434.000
177.171	423.910
177.171	387.845

Material Boundary

29.509	425.094
49.614	417.000

Material Boundary

1798.640	432.124
1800.121	432.269
1800.123	432.269

Material Boundary

1778.100	431.000
1798.640	432.124

Material Boundary

1790.268	428.336
1800.121	432.269
1800.129	432.272
1802.376	433.169

Material Boundary

1851.997	427.379
1851.997	427.279
1867.512	420.900
1901.032	420.900
1918.472	427.900
1918.472	428.000

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Material Boundary

1851.997	427.379
1867.512	421.000
1901.032	421.000
1916.925	427.379

Material Boundary

103.116	387.633
103.116	424.994
103.116	425.094

Material Boundary

49.614	417.000
83.114	417.000
103.116	425.094
103.116	425.094

Material Boundary

83.114	387.607
83.114	416.900
83.114	417.000

Material Boundary

49.614	387.564
49.614	416.900

Material Boundary

151.946	387.756
151.946	424.248
151.946	434.000

External Boundary

1778.100	440.000
1758.000	446.000
1738.000	452.000
1718.000	458.000
1698.000	464.000
1400.000	464.000
1236.000	465.000
1161.000	466.000
824.000	463.000
268.000	463.000
248.000	457.000
228.000	451.000
208.000	445.000
188.000	439.000
171.455	434.000
161.101	430.894
153.335	434.000
151.946	434.000
125.614	434.000
103.116	425.094
29.509	425.094
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000
1916.925	427.379
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000
1802.376	433.169

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

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1642.000 409.450
1768.160 411.260
1841.123 411.953
1979.000 415.050

Support
554.200 454.250
554.200 460.000

Support
554.200 460.000
268.000 460.000

Support
268.000 454.000
248.000 454.000

Support
248.000 454.000
248.000 448.250

Support
248.000 448.250
493.200 448.250

Support
493.200 454.000
493.200 448.250

Support
268.000 460.000
268.000 454.250

Support
268.000 454.250
554.200 454.250

Support
555.700 454.250
555.700 460.000

Support
555.700 460.000
824.000 460.000

Support
824.000 460.000
840.193 460.144

Support
840.193 460.144
840.193 454.394

Support
840.193 454.394
824.000 454.250

Support
824.000 454.250
555.700 454.250

Support
738.195 454.000
738.195 448.250

Support
739.701 454.000
739.701 448.250

Support
738.195 454.000
494.700 454.000

Support
494.700 454.000
494.700 448.250

Support
494.700 448.250
738.195 448.250

Support
724.201 442.000
724.201 436.250

Support
724.201 436.250
467.700 436.250

Support
467.700 436.250
467.700 442.000

Support
467.700 442.000
724.201 442.000

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Support
228.000 448.000
228.000 442.250

Support
248.000 448.000
530.200 448.000

Support
530.200 448.000
530.200 442.250

Support
531.700 442.250
531.700 448.000

Support
530.200 442.250
228.000 442.250

Support
228.000 448.000
248.000 448.000

Support
208.000 436.250
208.000 442.000

Support
208.000 442.000
228.000 442.000

Support
228.000 442.000
466.200 442.000

Support
466.200 442.000
466.200 436.250

Support
466.200 436.250
208.000 436.250

Support
188.000 430.250
188.000 436.000

Support
188.000 436.000
208.000 436.000

Support
208.000 436.000
506.200 436.000

Support
507.700 436.000
507.700 430.250

Support
506.200 436.000
506.200 430.250

Support
506.200 430.250
188.000 430.250

Support
507.700 430.250
824.200 430.252

Support
824.200 430.252
824.200 436.002

Support
824.200 436.002
507.700 436.000

Support
832.191 442.323
832.191 448.073

Support
833.715 442.336
833.715 448.086

Support
832.191 448.073
824.000 448.000

Support
824.000 448.000
531.700 448.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Support
531.700 442.250
824.000 442.250

Support
824.000 442.250
832.191 442.323

Support
841.706 460.158
841.706 454.408

Support
825.700 436.015
825.700 430.265

Support
725.697 442.000
725.697 436.250

Support
725.697 436.250
824.000 436.250

Support
824.000 436.250
982.197 437.658

Support
982.197 437.658
982.197 443.408

Support
982.197 443.408
824.000 442.000

Support
824.000 442.000
725.697 442.000

Support
739.701 448.250
824.000 448.250

Support
824.000 448.250
983.182 449.667

Support
983.182 449.667
983.182 455.417

Support
983.182 455.417
824.000 454.000

Support
824.000 454.000
739.701 454.000

Support
841.706 454.408
1126.178 456.940

Support
1126.178 456.940
1126.178 462.690

Support
1126.178 462.690
841.706 460.158

Support
833.715 448.086
1134.188 450.761

Support
1134.188 450.761
1134.188 445.011

Support
1134.188 445.011
833.715 442.336

Support
825.700 436.015
1142.148 438.832

Support
1142.148 438.832
1142.148 433.082

Support
1142.148 433.082
825.700 430.265

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

Support
984.724 455.431
984.724 449.681

Support
983.718 443.422
983.718 437.672

Support
983.718 437.672
1161.000 439.250

Support
1161.000 439.250
1236.000 438.250

Support
1236.000 438.250
1240.193 438.224

Support
1240.193 438.224
1240.193 443.974

Support
1240.193 443.974
1236.000 444.000

Support
1236.000 444.000
1161.000 445.000

Support
1161.000 445.000
983.718 443.422

Support
984.724 455.431
1161.000 457.000

Support
1161.000 457.000
1228.192 456.104

Support
1228.192 456.104
1228.192 450.354

Support
1228.192 450.354
1161.000 451.250

Support
1161.000 451.250
984.724 449.681

Support
268.000 454.000
493.200 454.000

Support
1127.707 462.704
1127.707 456.954

Support
1127.707 462.704
1161.000 463.000

Support
1161.000 463.000
1236.000 462.000

Support
1236.000 462.000
1400.000 461.000

Support
1400.000 461.000
1412.195 461.000

Support
1412.195 461.000
1412.195 455.250

Support
1412.195 455.250
1400.000 455.250

Support
1400.000 455.250
1236.000 456.250

Support
1236.000 456.250
1161.000 457.250

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Support
1161.000 457.250
1127.707 456.954

Support
1135.719 450.775
1135.719 445.025

Support
1135.719 450.775
1161.000 451.000

Support
1161.000 445.250
1135.719 445.025

Support
1161.000 445.250
1236.000 444.250

Support
1236.000 444.250
1400.000 443.250

Support
1400.000 443.250
1436.205 443.250

Support
1436.205 443.250
1436.205 449.000

Support
1437.780 449.000
1437.780 443.250

Support
1436.205 449.000
1400.000 449.000

Support
1400.000 449.000
1236.000 450.000

Support
1236.000 450.000
1161.000 451.000

Support
1229.723 456.084
1229.723 450.334

Support
1229.723 450.334
1236.000 450.250

Support
1236.000 456.000
1229.723 456.084

Support
1236.000 456.000
1400.000 455.000

Support
1400.000 455.000
1473.204 455.000

Support
1473.204 455.000
1473.204 449.250

Support
1474.788 449.250
1474.788 455.000

Support
1473.204 449.250
1400.000 449.250

Support
1400.000 449.250
1236.000 450.250

Support
1241.724 438.215
1241.724 443.965

Support
1143.812 438.847
1143.812 433.097

Support
1143.812 433.097
1161.000 433.250

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Support
1161.000 439.000
1143.812 438.847

Support
1161.000 439.000
1236.000 438.000

Support
1236.000 438.000
1400.000 437.000

Support
1400.000 437.000
1460.199 437.000

Support
1460.199 437.000
1460.199 431.250

Support
1461.784 431.250
1461.784 437.000

Support
1460.199 431.250
1400.000 431.250

Support
1400.000 431.250
1236.000 432.250

Support
1236.000 432.250
1161.000 433.250

Support
1241.724 438.215
1400.000 437.250

Support
1400.000 437.250
1498.182 437.250

Support
1498.182 443.000
1498.182 437.250

Support
1499.766 437.250
1499.766 443.000

Support
1498.182 443.000
1400.000 443.000

Support
1400.000 443.000
1241.724 443.965

Support
1413.743 461.000
1413.743 455.250

Support
1413.743 461.000
1698.000 461.000

Support
1698.000 461.000
1698.000 455.250

Support
1698.000 455.250
1413.743 455.250

Support
1474.788 449.250
1718.000 449.250

Support
1718.000 449.250
1718.000 455.000

Support
1698.000 455.000
1474.788 455.000

Support
1461.784 431.250
1778.100 431.250

Support
1778.100 431.250
1778.100 437.000

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Support
1758.000 437.000
1461.784 437.000

Support
1437.780 443.250
1738.000 443.250

Support
1738.000 443.250
1738.000 449.000

Support
1718.000 449.000
1437.780 449.000

Support
1499.766 437.250
1758.000 437.250

Support
1758.000 437.250
1758.000 443.000

Support
1738.000 443.000
1499.766 443.000

Support
1718.000 455.000
1698.000 455.000

Support
1718.000 449.000
1738.000 449.000

Support
1738.000 443.000
1758.000 443.000

Support
1758.000 437.000
1778.100 437.000

Cross Section WS-2
Liner Waste Block/Operation Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: WS_2F_U_LWB

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 175
Right Projection Angle (Start Angle): 5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Dredge Material
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Tube Interface (Horizontal)
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tub-Tube Interface (Vertical)
Strength Type: Mohr-Coulomb

Unit Weight: 43 lb/ft3
Cohesion: 0 psf
Friction Angle: 0.1 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Gravel Interface
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=Ave(in+75%), 425'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 426.14'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Support Properties

Support: Geotube
Geotube
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Tangent to Slip Surface
Anchorage: Both Ends
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1600 lb/ft
Pullout Strength Adhesion: 5 lb/ft2
Pullout Strength Friction Angle: 40 degrees

Global Minimums

Method: janbu simplified
FS: 2.045000
Axis Location: 192.736, 591.414
Left Slip Surface Endpoint: 150.279, 434.000
Right Slip Surface Endpoint: 293.193, 463.000
Resisting Horizontal Force=86025 lb
Driving Horizontal Force=42066.1 lb

Method: spencer
FS: 2.077590
Axis Location: 192.736, 591.414
Left Slip Surface Endpoint: 150.279, 434.000
Right Slip Surface Endpoint: 293.193, 463.000
Resisting Moment=1.50971e+007 lb-ft
Driving Moment=7.26664e+006 lb-ft
Resisting Horizontal Force=86236.1 lb
Driving Horizontal Force=41507.7 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 1993
Number of Invalid Surfaces: 3007
Error Codes:
Error Code -105 reported for 1722 surfaces
Error Code -108 reported for 503 surfaces
Error Code -110 reported for 262 surfaces
Error Code -111 reported for 4 surfaces
Error Code -112 reported for 512 surfaces
Error Code -1000 reported for 4 surfaces

Method: spencer
Number of Valid Surfaces: 407
Number of Invalid Surfaces: 4593
Error Codes:
Error Code -105 reported for 1722 surfaces
Error Code -108 reported for 624 surfaces
Error Code -110 reported for 262 surfaces
Error Code -111 reported for 1408 surfaces
Error Code -112 reported for 573 surfaces

Error Code -1000 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

List of All Coordinates

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Block Search Polyline

83.114	417.000
103.116	425.094
177.171	423.910

Material Boundary

103.116	425.094
125.614	424.602
151.946	424.248
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1851.997	427.379

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000
1778.100	431.000

Material Boundary

188.000	430.250
506.200	430.250
507.700	430.250
824.000	430.250
824.200	430.252
825.700	430.265
1142.148	433.082
1143.812	433.097
1161.000	433.250
1236.000	432.250
1400.000	431.250
1460.199	431.250
1461.784	431.250
1778.100	431.250

Material Boundary

208.000	436.000
506.200	436.000
507.700	436.000
824.000	436.000
824.200	436.002
825.700	436.015
1142.148	438.832
1143.812	438.847
1161.000	439.000
1236.000	438.000
1400.000	437.000
1460.199	437.000
1461.784	437.000
1758.000	437.000

Material Boundary

208.000	436.250
466.200	436.250
467.700	436.250
724.201	436.250
725.697	436.250
824.000	436.250
982.197	437.658
983.718	437.672
1161.000	439.250
1236.000	438.250
1240.193	438.224
1241.724	438.215
1400.000	437.250
1498.182	437.250
1499.766	437.250
1758.000	437.250

Material Boundary

228.000	442.000
466.200	442.000
467.700	442.000
724.201	442.000
725.697	442.000
824.000	442.000
982.197	443.408
983.718	443.422
1161.000	445.000
1236.000	444.000
1240.193	443.974
1241.724	443.965
1400.000	443.000
1498.182	443.000
1499.766	443.000
1738.000	443.000

Material Boundary

228.000	442.250
530.200	442.250
531.700	442.250
824.000	442.250
832.191	442.323
833.715	442.336
1134.188	445.011
1135.719	445.025
1161.000	445.250
1236.000	444.250
1400.000	443.250
1436.205	443.250
1437.780	443.250
1738.000	443.250

Material Boundary

248.000	448.000
530.200	448.000

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

531.700	448.000
824.000	448.000
832.191	448.073
833.715	448.086
1134.188	450.761
1135.719	450.775
1161.000	451.000
1236.000	450.000
1400.000	449.000
1436.205	449.000
1437.780	449.000
1718.000	449.000

Material Boundary

248.000	448.250
493.200	448.250
494.700	448.250
738.195	448.250
739.701	448.250
824.000	448.250
983.182	449.667
984.724	449.681
1161.000	451.250
1228.192	450.354
1229.723	450.334
1236.000	450.250
1400.000	449.250
1473.204	449.250
1474.788	449.250
1718.000	449.250

Material Boundary

268.000	454.000
493.200	454.000
494.700	454.000
738.195	454.000
739.701	454.000
824.000	454.000
983.182	455.417
984.724	455.431
1161.000	457.000
1228.192	456.104
1229.723	456.084
1236.000	456.000
1400.000	455.000
1473.204	455.000
1474.788	455.000
1698.000	455.000

Material Boundary

268.000	454.250
554.200	454.250
555.700	454.250
824.000	454.250
840.193	454.394
841.706	454.408
1126.178	456.940
1127.707	456.954
1161.000	457.250
1236.000	456.250
1400.000	455.250
1412.195	455.250
1413.743	455.250
1698.000	455.250

Material Boundary

506.200	430.250
506.200	436.000

Material Boundary

507.700	430.250
507.700	436.000

Material Boundary

466.200	436.250
466.200	442.000

Material Boundary

467.700	436.250
467.700	442.000

Material Boundary

530.200	442.250
530.200	448.000

Material Boundary

531.700	442.250
531.700	448.000

Material Boundary

493.200	448.250
493.200	454.000

Material Boundary

494.700	448.250
494.700	454.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Material Boundary
554.200 454.250
554.200 460.000

Material Boundary
555.700 454.250
555.700 460.000

Material Boundary
824.200 430.252
824.200 436.002

Material Boundary
825.700 430.265
825.700 436.015

Material Boundary
724.201 436.250
724.201 442.000

Material Boundary
725.697 436.250
725.697 442.000

Material Boundary
738.195 448.250
738.195 454.000

Material Boundary
739.701 448.250
739.701 454.000

Material Boundary
840.193 454.394
840.193 460.144

Material Boundary
841.706 454.408
841.706 460.158

Material Boundary
832.191 442.323
832.191 448.073

Material Boundary
833.715 442.336
833.715 448.086

Material Boundary
982.197 437.658
982.197 443.408

Material Boundary
983.182 449.667
983.182 455.417

Material Boundary
983.718 437.672
983.718 443.422

Material Boundary
984.724 449.681
984.724 455.431

Material Boundary
1134.188 445.011
1134.188 450.761

Material Boundary
1135.719 445.025
1135.719 450.775

Material Boundary
1436.205 443.250
1436.205 449.000

Material Boundary
1437.780 443.250
1437.780 449.000

Material Boundary
1126.178 456.940
1126.178 462.690

Material Boundary
1127.707 456.954
1127.707 462.704

Material Boundary
1142.148 433.082
1142.148 438.832

Material Boundary
1143.812 433.097
1143.812 438.847

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Material Boundary

1228.192	450.354
1228.192	456.104

Material Boundary

1229.723	450.334
1229.723	456.084

Material Boundary

1240.193	438.224
1240.193	443.974

Material Boundary

1241.724	438.215
1241.724	443.965

Material Boundary

1412.195	455.250
1412.195	461.000

Material Boundary

1413.743	455.250
1413.743	461.000

Material Boundary

1460.199	431.250
1460.199	437.000

Material Boundary

1461.784	431.250
1461.784	437.000

Material Boundary

1498.182	437.250
1498.182	443.000

Material Boundary

1499.766	437.250
1499.766	443.000

Material Boundary

1473.204	449.250
1473.204	455.000

Material Boundary

1474.788	449.250
1474.788	455.000

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
125.614	387.662
151.946	387.756
177.171	387.845
268.000	387.845
1642.000	389.616
1786.163	389.802
1848.701	389.882
1867.512	389.969
1901.032	389.969
1916.339	389.969
1979.000	390.050

Material Boundary

268.000	462.000
268.000	460.000
554.200	460.000
555.700	460.000
824.000	460.000
840.193	460.144
841.706	460.158
1126.178	462.690
1127.707	462.704
1161.000	463.000
1236.000	462.000
1400.000	461.000
1412.195	461.000
1413.743	461.000
1698.000	461.000

Material Boundary

1698.000	463.000
1698.000	461.000
1698.000	455.250
1698.000	455.000
1718.000	455.000
1718.000	449.250
1718.000	449.000
1738.000	449.000
1738.000	443.250
1738.000	443.000
1758.000	443.000

1758.000	437.250
1758.000	437.000
1778.100	437.000
1778.100	431.250
1778.100	431.000

Material Boundary

180.062	426.825
180.500	427.000
182.423	427.769
183.000	428.000
185.500	429.000
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

161.101	430.894
175.665	425.068
180.062	426.825

Material Boundary

180.062	426.825
182.423	426.779
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500
1689.000	426.500
1790.268	428.336

Material Boundary

188.000	430.000
188.000	430.250
188.000	436.000
208.000	436.000
208.000	436.250
208.000	442.000
228.000	442.000
228.000	442.250
228.000	448.000
248.000	448.000
248.000	448.250
248.000	454.000
268.000	454.000
268.000	454.250
268.000	460.000

Material Boundary

1786.163	426.261
1807.462	435.000

Material Boundary

27.994	387.564
27.994	425.566

Material Boundary

27.994	425.704
27.994	425.566
49.614	416.900
83.114	416.900
103.116	424.994
103.116	424.994

Material Boundary

83.114	417.000
103.116	425.094

Material Boundary

1642.000	389.616
1642.000	424.450

Material Boundary

1786.163	426.261
1786.163	389.802

Material Boundary

151.946	434.000
177.171	423.910
177.171	387.845

Material Boundary

29.509	425.094
49.614	417.000

Material Boundary

1798.640	432.124
1800.121	432.269
1800.123	432.269

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

1778.100	431.000
1798.640	432.124

Material Boundary

1790.268	428.336
1800.121	432.269
1800.129	432.272
1802.376	433.169

Material Boundary

1851.997	427.379
1851.997	427.279
1867.512	420.900
1901.032	420.900
1918.472	427.900
1918.472	428.000

Material Boundary

1851.997	427.379
1867.512	421.000
1901.032	421.000
1916.925	427.379

Material Boundary

103.116	387.633
103.116	424.994
103.116	425.094

Material Boundary

49.614	417.000
83.114	417.000
103.116	425.094
103.116	425.094

Material Boundary

83.114	387.607
83.114	416.900
83.114	417.000

Material Boundary

49.614	387.564
49.614	416.900

Material Boundary

151.946	387.756
151.946	424.248
151.946	434.000

External Boundary

1778.100	440.000
1758.000	446.000
1738.000	452.000
1718.000	458.000
1698.000	464.000
1400.000	464.000
1236.000	465.000
1161.000	466.000
824.000	463.000
268.000	463.000
248.000	457.000
228.000	451.000
208.000	445.000
188.000	439.000
171.455	434.000
161.101	430.894
153.335	434.000
151.946	434.000
125.614	434.000
103.116	425.094
29.509	425.094
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000
1916.925	427.379
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000
1802.376	433.169

Focus/Block Search Window

184.774	426.734
177.171	423.910
348.778	421.533
347.000	423.600

Support

554.200	454.250
554.200	460.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Support
554.200 460.000
268.000 460.000

Support
268.000 454.000
248.000 454.000

Support
248.000 454.000
248.000 448.250

Support
248.000 448.250
493.200 448.250

Support
493.200 454.000
493.200 448.250

Support
268.000 460.000
268.000 454.250

Support
268.000 454.250
554.200 454.250

Support
555.700 454.250
555.700 460.000

Support
555.700 460.000
824.000 460.000

Support
824.000 460.000
840.193 460.144

Support
840.193 460.144
840.193 454.394

Support
840.193 454.394
824.000 454.250

Support
824.000 454.250
555.700 454.250

Support
738.195 454.000
738.195 448.250

Support
739.701 454.000
739.701 448.250

Support
738.195 454.000
494.700 454.000

Support
494.700 454.000
494.700 448.250

Support
494.700 448.250
738.195 448.250

Support
724.201 442.000
724.201 436.250

Support
724.201 436.250
467.700 436.250

Support
467.700 436.250
467.700 442.000

Support
467.700 442.000
724.201 442.000

Support
228.000 448.000
228.000 442.250

Support
248.000 448.000
530.200 448.000

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**
Date:	**12/08/2010**				

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Support
530.200 448.000
530.200 442.250

Support
531.700 442.250
531.700 448.000

Support
530.200 442.250
228.000 442.250

Support
228.000 448.000
248.000 448.000

Support
208.000 436.250
208.000 442.000

Support
208.000 442.000
228.000 442.000

Support
228.000 442.000
466.200 442.000

Support
466.200 442.000
466.200 436.250

Support
466.200 436.250
208.000 436.250

Support
188.000 430.250
188.000 436.000

Support
188.000 436.000
208.000 436.000

Support
208.000 436.000
506.200 436.000

Support
507.700 436.000
507.700 430.250

Support
506.200 436.000
506.200 430.250

Support
506.200 430.250
188.000 430.250

Support
507.700 430.250
824.200 430.252

Support
824.200 430.252
824.200 436.002

Support
824.200 436.002
507.700 436.000

Support
832.191 442.323
832.191 448.073

Support
833.715 442.336
833.715 448.086

Support
832.191 448.073
824.000 448.000

Support
824.000 448.000
531.700 448.000

Support
531.700 442.250
824.000 442.250

Support
824.000 442.250
832.191 442.323

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Support
841.706 460.158
841.706 454.408

Support
825.700 436.015
825.700 430.265

Support
725.697 442.000
725.697 436.250

Support
725.697 436.250
824.000 436.250

Support
824.000 436.250
982.197 437.658

Support
982.197 437.658
982.197 443.408

Support
982.197 443.408
824.000 442.000

Support
824.000 442.000
725.697 442.000

Support
739.701 448.250
824.000 448.250

Support
824.000 448.250
983.182 449.667

Support
983.182 449.667
983.182 455.417

Support
983.182 455.417
824.000 454.000

Support
824.000 454.000
739.701 454.000

Support
841.706 454.408
1126.178 456.940

Support
1126.178 456.940
1126.178 462.690

Support
1126.178 462.690
841.706 460.158

Support
833.715 448.086
1134.188 450.761

Support
1134.188 450.761
1134.188 445.011

Support
1134.188 445.011
833.715 442.336

Support
825.700 436.015
1142.148 438.832

Support
1142.148 438.832
1142.148 433.082

Support
1142.148 433.082
825.700 430.265

Support
984.724 455.431
984.724 449.681

Support
983.718 443.422
983.718 437.672

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Support
983.718 437.672
1161.000 439.250

Support
1161.000 439.250
1236.000 438.250

Support
1236.000 438.250
1240.193 438.224

Support
1240.193 438.224
1240.193 443.974

Support
1240.193 443.974
1236.000 444.000

Support
1236.000 444.000
1161.000 445.000

Support
1161.000 445.000
983.718 443.422

Support
984.724 455.431
1161.000 457.000

Support
1161.000 457.000
1228.192 456.104

Support
1228.192 456.104
1228.192 450.354

Support
1228.192 450.354
1161.000 451.250

Support
1161.000 451.250
984.724 449.681

Support
268.000 454.000
493.200 454.000

Support
1127.707 462.704
1127.707 456.954

Support
1127.707 462.704
1161.000 463.000

Support
1161.000 463.000
1236.000 462.000

Support
1236.000 462.000
1400.000 461.000

Support
1400.000 461.000
1412.195 461.000

Support
1412.195 461.000
1412.195 455.250

Support
1412.195 455.250
1400.000 455.250

Support
1400.000 455.250
1236.000 456.250

Support
1236.000 456.250
1161.000 457.250

Support
1161.000 457.250
1127.707 456.954

Support
1135.719 450.775
1135.719 445.025

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Support
1135.719 450.775
1161.000 451.000

Support
1161.000 445.250
1135.719 445.025

Support
1161.000 445.250
1236.000 444.250

Support
1236.000 444.250
1400.000 443.250

Support
1400.000 443.250
1436.205 443.250

Support
1436.205 443.250
1436.205 449.000

Support
1437.780 449.000
1437.780 443.250

Support
1436.205 449.000
1400.000 449.000

Support
1400.000 449.000
1236.000 450.000

Support
1236.000 450.000
1161.000 451.000

Support
1229.723 456.084
1229.723 450.334

Support
1229.723 450.334
1236.000 450.250

Support
1236.000 456.000
1229.723 456.084

Support
1236.000 456.000
1400.000 455.000

Support
1400.000 455.000
1473.204 455.000

Support
1473.204 455.000
1473.204 449.250

Support
1474.788 449.250
1474.788 455.000

Support
1473.204 449.250
1400.000 449.250

Support
1400.000 449.250
1236.000 450.250

Support
1241.724 438.215
1241.724 443.965

Support
1143.812 438.847
1143.812 433.097

Support
1143.812 433.097
1161.000 433.250

Support
1161.000 439.000
1143.812 438.847

Support
1161.000 439.000
1236.000 438.000

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date: **12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01

Support
1236.000 438.000
1400.000 437.000

Support
1400.000 437.000
1460.199 437.000

Support
1460.199 437.000
1460.199 431.250

Support
1461.784 431.250
1461.784 437.000

Support
1460.199 431.250
1400.000 431.250

Support
1400.000 431.250
1236.000 432.250

Support
1236.000 432.250
1161.000 433.250

Support
1241.724 438.215
1400.000 437.250

Support
1400.000 437.250
1498.182 437.250

Support
1498.182 443.000
1498.182 437.250

Support
1499.766 437.250
1499.766 443.000

Support
1498.182 443.000
1400.000 443.000

Support
1400.000 443.000
1241.724 443.965

Support
1413.743 461.000
1413.743 455.250

Support
1413.743 461.000
1698.000 461.000

Support
1698.000 461.000
1698.000 455.250

Support
1698.000 455.250
1413.743 455.250

Support
1474.788 449.250
1718.000 449.250

Support
1718.000 449.250
1718.000 455.000

Support
1698.000 455.000
1474.788 455.000

Support
1461.784 431.250
1778.100 431.250

Support
1778.100 431.250
1778.100 437.000

Support
1758.000 437.000
1461.784 437.000

Support
1437.780 443.250
1738.000 443.250

Support
1738.000 443.250
1738.000 449.000

Support
1718.000 449.000
1437.780 449.000

Support
1499.766 437.250
1758.000 437.250

Support
1758.000 437.250
1758.000 443.000

Support
1738.000 443.000
1499.766 443.000

Support
1718.000 455.000
1698.000 455.000

Support
1718.000 449.000
1738.000 449.000

Support
1738.000 443.000
1758.000 443.000

Support
1758.000 437.000
1778.100 437.000

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section ES-1
Global/Circular/Drained/Construction Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES-1C-D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.638200
Center: 95.359, 459.631
Radius: 37.765
Left Slip Surface Endpoint: 94.582, 421.874
Right Slip Surface Endpoint: 121.985, 432.849
Resisting Horizontal Force=3301.78 lb
Driving Horizontal Force=2015.49 lb

Method: spencer
FS: 1.665610
Center: 85.873, 478.201
Radius: 56.489
Left Slip Surface Endpoint: 96.883, 422.795
Right Slip Surface Endpoint: 116.152, 430.512
Resisting Moment=44936.4 lb-ft
Driving Moment=26978.9 lb-ft
Resisting Horizontal Force=735.097 lb
Driving Horizontal Force=441.338 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 3641
Number of Invalid Surfaces: 1210

Error Codes:
Error Code -107 reported for 987 surfaces
Error Code -108 reported for 109 surfaces
Error Code -111 reported for 82 surfaces
Error Code -112 reported for 32 surfaces

Method: spencer
Number of Valid Surfaces: 3587
Number of Invalid Surfaces: 1264
Error Codes:
Error Code -107 reported for 987 surfaces
Error Code -108 reported for 146 surfaces
Error Code -111 reported for 85 surfaces
Error Code -112 reported for 46 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List of All Coordinates

Search Grid

63.738	429.919
126.980	429.919
126.980	504.200
63.738	504.200

Material Boundary

0.000	387.500
50.000	387.500
67.400	387.500
92.400	387.500
124.860	387.500
151.800	387.500
212.080	387.500

Material Boundary

107.691	427.124
107.941	427.124
124.860	427.124
151.800	427.124

Material Boundary

50.000	387.500
50.000	428.000

Material Boundary

67.400	387.500
67.400	421.000

Material Boundary

92.400	387.500
92.400	421.000

Material Boundary

124.860	387.500
124.860	427.124
124.860	434.000

Material Boundary

151.800	387.500
151.800	427.124

External Boundary

50.000	428.000
0.000	428.700
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date: **12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01

212.080	427.124
151.800	427.124
134.900	434.000
124.860	434.000
107.691	427.124
106.635	426.701
92.400	421.000
67.400	421.000
53.229	426.701

Water Table

0.000	411.097
212.080	411.097

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section ES-1
Global/Circular/Undrained/Construction Condition

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES-1C-U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW Ave(In+75), 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 428'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=0%, 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.761540
Center: 98.521, 474.487
Radius: 48.152
Left Slip Surface Endpoint: 108.152, 427.308
Right Slip Surface Endpoint: 124.120, 433.703
Resisting Horizontal Force=644.267 lb
Driving Horizontal Force=365.742 lb

Method: spencer
FS: 1.766460
Center: 92.197, 493.057
Radius: 67.662
Left Slip Surface Endpoint: 108.119, 427.295
Right Slip Surface Endpoint: 125.218, 434.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Resisting Moment=46814.5 lb-ft
Driving Moment=26501.8 lb-ft
Resisting Horizontal Force=643.398 lb
Driving Horizontal Force=364.23 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 3519
Number of Invalid Surfaces: 1332
Error Codes:
Error Code -107 reported for 982 surfaces
Error Code -108 reported for 67 surfaces
Error Code -111 reported for 63 surfaces
Error Code -114 reported for 220 surfaces

Method: spencer
Number of Valid Surfaces: 3476
Number of Invalid Surfaces: 1375
Error Codes:
Error Code -107 reported for 982 surfaces
Error Code -108 reported for 107 surfaces
Error Code -111 reported for 66 surfaces
Error Code -114 reported for 220 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

63.738	429.919
126.980	429.919
126.980	504.200
63.738	504.200

Material Boundary

0.000	387.500
50.000	387.500
67.400	387.500
92.400	387.500
124.860	387.500
134.900	387.500
151.800	387.500
212.080	387.500

Material Boundary

107.691	427.124
107.941	427.124
124.860	427.124
134.900	427.124
151.800	427.124

Material Boundary

50.000	387.500
50.000	428.000

Material Boundary

67.400	387.500
67.400	421.000

Material Boundary

92.400	387.500
92.400	421.000

Material Boundary

124.860	387.500
124.860	427.124

Material Boundary

151.800	387.500
151.800	427.124

Material Boundary

134.900	387.500
134.900	427.124

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

External Boundary

50.000	428.000
0.000	428.700
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500
212.080	427.124
151.800	427.124
134.900	434.000
124.860	434.000
107.691	427.124
106.635	426.701
92.400	421.000
67.400	421.000
53.229	426.701

Water Table

0.000	411.097
212.080	411.097

Written by: **Y. Cho**	Date: **12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date: **12/08/2010**	
Client: **Honeywell**	Project: **Onondaga Lake Sump Stability**	Project/ Proposal No.: **GJ4299**		Task No.: 05/01	

Cross Section ES-1
Global/Circular/Drained/Operation Condition

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES-1F-D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.718150
Center: 99.737, 449.527
Radius: 23.784
Left Slip Surface Endpoint: 107.471, 427.035
Right Slip Surface Endpoint: 109.674, 427.918
Resisting Horizontal Force=3.33995 lb
Driving Horizontal Force=1.94391 lb

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Method: spencer
FS: 1.718380
Center: 99.737, 449.527
Radius: 23.784
Left Slip Surface Endpoint: 107.471, 427.035
Right Slip Surface Endpoint: 109.674, 427.918
Resisting Moment=85.6105 lb-ft
Driving Moment=49.8205 lb-ft
Resisting Horizontal Force=3.34044 lb
Driving Horizontal Force=1.94395 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 3888
Number of Invalid Surfaces: 963
Error Codes:
Error Code -107 reported for 359 surfaces
Error Code -108 reported for 436 surfaces
Error Code -111 reported for 111 surfaces
Error Code -112 reported for 57 surfaces

Method: spencer
Number of Valid Surfaces: 3350
Number of Invalid Surfaces: 1501
Error Codes:
Error Code -107 reported for 359 surfaces
Error Code -108 reported for 658 surfaces
Error Code -111 reported for 424 surfaces
Error Code -112 reported for 60 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List of All Coordinates

Search Grid

58.873	429.919
126.980	429.919
126.980	527.961
58.873	527.961

Material Boundary

0.000	387.500
50.000	387.500
67.400	387.500
92.400	387.500
124.860	387.500
151.800	387.500
212.080	387.500

Material Boundary

107.941	427.124
124.860	427.124
151.800	427.124

Material Boundary

50.000	387.500
50.000	427.900

Material Boundary

67.400	387.500
67.400	420.900
67.400	421.000

Material Boundary

92.400	387.500
92.400	420.900
92.400	421.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Material Boundary

124.860	387.500
124.860	427.124
124.860	433.900

Material Boundary

151.800	387.500
151.800	427.124

Material Boundary

50.000	428.000
50.000	427.900
67.400	420.900
92.400	420.900
107.941	427.124
124.860	433.900
124.860	434.000

Material Boundary

52.492	427.000
67.400	421.000
92.400	421.000
107.383	427.000

Material Boundary

107.691	427.124
107.941	427.124

External Boundary

52.492	427.000
50.000	428.000
0.000	428.700
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500
212.080	427.124
151.800	427.124
134.900	434.000
124.860	434.000
107.691	427.124
107.383	427.000

Water Table

0.000	411.097
212.080	411.097

Cross Section ES-1
Global/Circular/Undrained/Operation Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES-1F-U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW Ave(In+75), 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 428'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=0%, 427'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified
FS: 1.748440
Center: 89.050, 485.146
Radius: 60.799
Left Slip Surface Endpoint: 110.906, 428.412
Right Slip Surface Endpoint: 112.398, 429.009
Resisting Horizontal Force=0.411651 lb
Driving Horizontal Force=0.235439 lb

Method: spencer
FS: 1.748440
Center: 89.050, 485.146
Radius: 60.799
Left Slip Surface Endpoint: 110.906, 428.412
Right Slip Surface Endpoint: 112.398, 429.009
Resisting Moment=26.9598 lb-ft
Driving Moment=15.4193 lb-ft
Resisting Horizontal Force=0.411649 lb
Driving Horizontal Force=0.235438 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 3948
Number of Invalid Surfaces: 903
Error Codes:
Error Code -107 reported for 184 surfaces
Error Code -108 reported for 448 surfaces
Error Code -111 reported for 111 surfaces
Error Code -112 reported for 4 surfaces
Error Code -114 reported for 156 surfaces

Method: spencer
Number of Valid Surfaces: 3645
Number of Invalid Surfaces: 1206
Error Codes:
Error Code -107 reported for 184 surfaces
Error Code -108 reported for 608 surfaces
Error Code -111 reported for 250 surfaces
Error Code -112 reported for 8 surfaces
Error Code -114 reported for 156 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

68.626	429.919
126.980	429.919
126.980	514.884
68.626	514.884

Material Boundary

0.000	387.500
50.000	387.500
67.400	387.500
92.400	387.500
107.691	387.500
124.860	387.500
134.900	387.500
151.800	387.500
212.080	387.500

Material Boundary

107.691	427.124

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

107.941	427.124
124.860	427.124
134.900	427.124
151.800	427.124

Material Boundary

50.000	387.500
50.000	427.900

Material Boundary

124.860	387.500
124.860	427.124

Material Boundary

151.800	387.500
151.800	427.124

Material Boundary

134.900	387.500
134.900	427.124

Material Boundary

50.000	428.000
50.000	427.900
67.400	420.900
92.400	420.900
107.691	427.024
107.691	427.124
107.691	427.124

Material Boundary

52.492	427.000
67.400	421.000
92.400	421.000
107.383	427.000

Material Boundary

107.691	387.500
107.691	427.124

External Boundary

52.492	427.000
50.000	428.000
0.000	428.700
0.000	387.500
0.000	348.000
212.080	348.000
212.080	387.500
212.080	427.124
151.800	427.124
134.900	434.000
124.860	434.000
107.691	427.124
107.691	427.124
107.500	427.047
107.383	427.000

Water Table

0.000	411.097
212.080	411.097

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section ES-2
Global/Circular/Drained/Construction Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES_2C_D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: janbu simplified

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

FS: 1.602520
Center: 1867.735, 472.220
Radius: 51.034
Left Slip Surface Endpoint: 1832.820, 435.000
Right Slip Surface Endpoint: 1867.047, 421.191
Resisting Horizontal Force=5116.9 lb
Driving Horizontal Force=3193.03 lb

Method: spencer
FS: 1.627590
Center: 1885.659, 505.214
Radius: 85.678
Left Slip Surface Endpoint: 1842.028, 431.478
Right Slip Surface Endpoint: 1864.806, 422.113
Resisting Moment=75051.7 lb-ft
Driving Moment=46112.1 lb-ft
Resisting Horizontal Force=807.567 lb
Driving Horizontal Force=496.172 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 2964
Number of Invalid Surfaces: 1876
Error Codes:
Error Code -103 reported for 61 surfaces
Error Code -106 reported for 7 surfaces
Error Code -107 reported for 1292 surfaces
Error Code -108 reported for 16 surfaces
Error Code -110 reported for 296 surfaces
Error Code -111 reported for 29 surfaces
Error Code -112 reported for 9 surfaces
Error Code -114 reported for 166 surfaces

Method: spencer
Number of Valid Surfaces: 2928
Number of Invalid Surfaces: 1912
Error Codes:
Error Code -103 reported for 61 surfaces
Error Code -106 reported for 7 surfaces
Error Code -107 reported for 1292 surfaces
Error Code -108 reported for 43 surfaces
Error Code -110 reported for 296 surfaces
Error Code -111 reported for 29 surfaces
Error Code -112 reported for 18 surfaces
Error Code -114 reported for 166 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

1807.987	428.228
1921.508	428.228
1921.508	659.187
1807.987	659.187

Material Boundary

103.116	425.094
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1805.788	426.613
1833.462	427.072
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000

Material Boundary

507.700	430.250
824.000	430.250
824.200	430.252

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
177.171	387.728
268.000	387.845
1786.163	389.802
1805.788	389.827
1833.462	389.873
1851.997	389.904
1867.512	389.947
1901.032	389.969
1918.427	390.050
1979.000	390.050

Material Boundary

180.062	426.825
182.423	427.769
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

175.665	425.068
180.062	426.825

Material Boundary

151.946	434.000
177.171	423.910

Material Boundary

180.062	426.825
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500
1689.000	426.500

Material Boundary

1786.163	426.261

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1807.462 435.000

Material Boundary
27.994 387.564
27.994 425.704

Material Boundary
49.614 387.564
49.614 417.000

Material Boundary
83.114 387.607
83.114 417.000

Material Boundary
103.116 387.633
103.116 425.094

Material Boundary
177.171 387.728
177.171 423.910

Material Boundary
1867.512 389.947
1867.512 421.000

Material Boundary
1901.032 389.969
1901.032 421.000

Material Boundary
1918.427 390.050
1918.472 428.000

Material Boundary
1400.000 431.000
1798.537 432.039

Material Boundary
1805.788 389.827
1805.788 426.613

Material Boundary
1798.537 432.039
1799.545 432.039

Material Boundary
1689.000 426.500
1790.268 428.336

Material Boundary
1790.268 428.336
1799.545 432.039
1800.123 432.269

Material Boundary
1833.462 389.873
1833.462 427.072
1833.462 435.000

External Boundary
1800.123 432.269
1461.784 431.250
1460.199 431.250
1400.000 431.250
1236.000 432.250
1161.000 433.250
1143.812 433.097
1142.148 433.082
1125.724 432.936
1095.091 432.663
825.700 430.265
824.200 430.252
507.700 430.250
506.200 430.250
188.000 430.250
175.665 425.068
153.335 434.000
151.946 434.000
125.614 434.000
103.116 425.094
83.114 417.000
49.614 417.000
27.994 425.704
0.000 426.569
0.000 387.500
0.000 347.500
1979.000 350.000
1979.000 390.050
1979.000 430.050
1918.472 428.000
1901.032 421.000
1867.512 421.000
1851.997 427.379
1833.462 435.000
1807.462 435.000

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1806.964	435.000

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section ES-2
Global/Circular/Undrained/Construction Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES_2C_U_Circular-2

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees

Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=75%, 428.3'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=Ave(In+75), 426.5'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Global Minimums

Method: janbu simplified
FS: 1.703230
Center: 1910.156, 601.447
Radius: 183.158
Left Slip Surface Endpoint: 1836.537, 433.736
Right Slip Surface Endpoint: 1844.514, 430.456
Resisting Horizontal Force=20.9528 lb
Driving Horizontal Force=12.3018 lb

Method: spencer
FS: 1.703430
Center: 1910.156, 601.447
Radius: 183.158
Left Slip Surface Endpoint: 1836.537, 433.736
Right Slip Surface Endpoint: 1844.514, 430.456
Resisting Moment=4149.54 lb-ft
Driving Moment=2435.99 lb-ft
Resisting Horizontal Force=20.9529 lb
Driving Horizontal Force=12.3004 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 11733
Number of Invalid Surfaces: 6758
Error Codes:
Error Code -103 reported for 220 surfaces
Error Code -106 reported for 26 surfaces
Error Code -107 reported for 4697 surfaces
Error Code -108 reported for 53 surfaces
Error Code -110 reported for 1147 surfaces
Error Code -111 reported for 40 surfaces
Error Code -112 reported for 123 surfaces
Error Code -114 reported for 452 surfaces

Method: spencer
Number of Valid Surfaces: 11567
Number of Invalid Surfaces: 6924
Error Codes:
Error Code -103 reported for 220 surfaces
Error Code -106 reported for 26 surfaces
Error Code -107 reported for 4697 surfaces
Error Code -108 reported for 189 surfaces
Error Code -110 reported for 1147 surfaces
Error Code -111 reported for 40 surfaces
Error Code -112 reported for 153 surfaces
Error Code -114 reported for 452 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small

(0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

1807.987	428.228
1921.508	428.228
1921.508	659.187
1807.987	659.187

Material Boundary

103.116	425.094
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1805.788	426.613
1833.462	427.072
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000

Material Boundary

507.700	430.250
824.000	430.250
824.200	430.252

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
177.171	387.728
268.000	387.845
1786.163	389.802
1805.788	389.827
1833.462	389.873
1851.997	389.904
1867.512	389.947
1901.032	389.969
1918.427	390.050
1979.000	390.050

Material Boundary

180.062	426.825
182.423	427.769
188.000	430.000

Material Boundary

267.961	422.659
268.000	387.845

Material Boundary

175.665	425.068
180.062	426.825

Material Boundary

151.946	434.000
177.171	423.910

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

180.062	426.825
347.000	423.600
600.000	423.600
640.000	424.000
728.000	424.000
1102.000	431.000
1176.000	431.000
1356.000	428.000
1474.000	427.500
1619.000	426.500
1689.000	426.500

Material Boundary

1786.163	426.261
1807.462	435.000

Material Boundary

27.994	387.564
27.994	425.704

Material Boundary

49.614	387.564
49.614	417.000

Material Boundary

83.114	387.607
83.114	417.000

Material Boundary

103.116	387.633
103.116	425.094

Material Boundary

177.171	387.728
177.171	423.910

Material Boundary

1867.512	389.947
1867.512	421.000

Material Boundary

1901.032	389.969
1901.032	421.000

Material Boundary

1918.427	390.050
1918.472	428.000

Material Boundary

1400.000	431.000
1798.537	432.039

Material Boundary

1805.788	389.827
1805.788	426.613

Material Boundary

1798.537	432.039
1799.545	432.039

Material Boundary

1689.000	426.500
1790.268	428.336

Material Boundary

1790.268	428.336
1799.545	432.039
1800.123	432.269

Material Boundary

1833.462	389.873
1833.462	427.072
1833.462	435.000

Material Boundary

1786.163	389.802
1786.163	426.261

External Boundary

1800.123	432.269
1461.784	431.250
1460.199	431.250
1400.000	431.250
1236.000	432.250
1161.000	433.250
1143.812	433.097
1142.148	433.082
1125.724	432.936
1095.091	432.663
825.700	430.265
824.200	430.252
507.700	430.250
506.200	430.250
188.000	430.250

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

175.665	425.068
153.335	434.000
151.946	434.000
125.614	434.000
103.116	425.094
83.114	417.000
49.614	417.000
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000
1901.032	421.000
1867.512	421.000
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**	Date:	**12/08/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake Sump Stability**	Project/ Proposal No.:	**GJ4299**	Task No.: 05/01	

Cross Section ES-2
Global/Circular/Drained/Operation Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES_2F_D_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (Drained)
Strength Type: Mohr-Coulomb
Unit Weight: 82 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dredge Material
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Tube Interface (Horizontal)
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tub-Tube Interface (Vertical)
Strength Type: Mohr-Coulomb
Unit Weight: 43 lb/ft3

Cohesion: 0 psf
Friction Angle: 0.1 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Gravel Interface
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geotube
Geotube
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Tangent to Slip Surface
Anchorage: Both Ends
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1600 lb/ft
Pullout Strength Adhesion: 5 lb/ft2
Pullout Strength Friction Angle: 40 degrees

Global Minimums

Method: janbu simplified
FS: 1.669400
Center: 1760.838, 553.063
Radius: 121.595
Left Slip Surface Endpoint: 1678.056, 464.000
Right Slip Surface Endpoint: 1793.014, 435.803
Resisting Horizontal Force=53230.9 lb
Driving Horizontal Force=31886.1 lb

Method: spencer
FS: 1.661020
Center: 1760.838, 553.063
Radius: 121.595
Left Slip Surface Endpoint: 1678.056, 464.000
Right Slip Surface Endpoint: 1793.014, 435.803
Resisting Moment=7.01242e+006 lb-ft
Driving Moment=4.22175e+006 lb-ft
Resisting Horizontal Force=53376 lb
Driving Horizontal Force=32134.4 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 2522
Number of Invalid Surfaces: 2318
Error Codes:
Error Code -103 reported for 338 surfaces
Error Code -106 reported for 4 surfaces
Error Code -107 reported for 346 surfaces
Error Code -108 reported for 140 surfaces
Error Code -110 reported for 1294 surfaces
Error Code -111 reported for 82 surfaces
Error Code -112 reported for 114 surfaces

Method: spencer
Number of Valid Surfaces: 2227
Number of Invalid Surfaces: 2613
Error Codes:
Error Code -103 reported for 338 surfaces
Error Code -106 reported for 4 surfaces
Error Code -107 reported for 346 surfaces
Error Code -108 reported for 158 surfaces
Error Code -110 reported for 1294 surfaces
Error Code -111 reported for 353 surfaces
Error Code -112 reported for 120 surfaces

Error Codes

The following errors were encountered during the computation:

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List of All Coordinates

Search Grid

1731.473	427.325
1917.452	427.325
1917.452	647.367
1731.473	647.367

Material Boundary

103.116	425.094
125.614	424.602
151.946	424.248
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1807.462	426.623
1833.462	427.064
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000
1778.100	431.000

Material Boundary

188.000	430.250
506.200	430.250
507.700	430.250
824.000	430.250
824.200	430.252
825.700	430.265
1142.148	433.082
1143.812	433.097

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1161.000	433.250
1236.000	432.250
1400.000	431.250
1460.199	431.250
1461.784	431.250
1778.100	431.250

Material Boundary

208.000	436.000
506.200	436.000
507.700	436.000
824.000	436.000
824.200	436.002
825.700	436.015
1142.148	438.832
1143.812	438.847
1161.000	439.000
1236.000	438.000
1400.000	437.000
1460.199	437.000
1461.784	437.000
1758.000	437.000

Material Boundary

208.000	436.250
466.200	436.250
467.700	436.250
724.201	436.250
725.697	436.250
824.000	436.250
982.197	437.658
983.718	437.672
1161.000	439.250
1236.000	438.250
1240.193	438.224
1241.724	438.215
1400.000	437.250
1498.182	437.250
1499.766	437.250
1758.000	437.250

Material Boundary

228.000	442.000
466.200	442.000
467.700	442.000
724.201	442.000
725.697	442.000
824.000	442.000
982.197	443.408
983.718	443.422
1161.000	445.000
1236.000	444.000
1240.193	443.974
1241.724	443.965
1400.000	443.000
1498.182	443.000
1499.766	443.000
1738.000	443.000

Material Boundary

228.000	442.250
530.200	442.250
531.700	442.250
824.000	442.250
832.191	442.323
833.715	442.336
1134.188	445.011
1135.719	445.025
1161.000	445.250
1236.000	444.250
1400.000	443.250
1436.205	443.250
1437.780	443.250
1738.000	443.250

Material Boundary

248.000	448.000
530.200	448.000
531.700	448.000
824.000	448.000
832.191	448.073
833.715	448.086
1134.188	450.761
1135.719	450.775
1161.000	451.000
1236.000	450.000
1400.000	449.000
1436.205	449.000
1437.780	449.000
1718.000	449.000

Material Boundary

248.000	448.250
493.200	448.250
494.700	448.250
738.195	448.250

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

739.701 448.250
824.000 448.250
983.182 449.667
984.724 449.681
1161.000 451.250
1228.192 450.354
1229.723 450.334
1236.000 450.250
1400.000 449.250
1473.204 449.250
1474.788 449.250
1718.000 449.250

Material Boundary
268.000 454.000
493.200 454.000
494.700 454.000
738.195 454.000
739.701 454.000
824.000 454.000
983.182 455.417
984.724 455.431
1161.000 457.000
1228.192 456.104
1229.723 456.084
1236.000 456.000
1400.000 455.000
1473.204 455.000
1474.788 455.000
1698.000 455.000

Material Boundary
268.000 454.250
554.200 454.250
555.700 454.250
824.000 454.250
840.193 454.394
841.706 454.408
1126.178 456.940
1127.707 456.954
1161.000 457.250
1236.000 456.250
1400.000 455.250
1412.195 455.250
1413.743 455.250
1698.000 455.250

Material Boundary

506.200 430.250
506.200 436.000

Material Boundary
507.700 430.250
507.700 436.000

Material Boundary
466.200 436.250
466.200 442.000

Material Boundary
467.700 436.250
467.700 442.000

Material Boundary
530.200 442.250
530.200 448.000

Material Boundary
531.700 442.250
531.700 448.000

Material Boundary
493.200 448.250
493.200 454.000

Material Boundary
494.700 448.250
494.700 454.000

Material Boundary
554.200 454.250
554.200 460.000

Material Boundary
555.700 454.250
555.700 460.000

Material Boundary
824.200 430.252
824.200 436.002

Material Boundary
825.700 430.265
825.700 436.015

Material Boundary

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

724.201 436.250
724.201 442.000

Material Boundary
725.697 436.250
725.697 442.000

Material Boundary
738.195 448.250
738.195 454.000

Material Boundary
739.701 448.250
739.701 454.000

Material Boundary
840.193 454.394
840.193 460.144

Material Boundary
841.706 454.408
841.706 460.158

Material Boundary
832.191 442.323
832.191 448.073

Material Boundary
833.715 442.336
833.715 448.086

Material Boundary
982.197 437.658
982.197 443.408

Material Boundary
983.182 449.667
983.182 455.417

Material Boundary
983.718 437.672
983.718 443.422

Material Boundary
984.724 449.681
984.724 455.431

Material Boundary

1134.188 445.011
1134.188 450.761

Material Boundary
1135.719 445.025
1135.719 450.775

Material Boundary
1436.205 443.250
1436.205 449.000

Material Boundary
1437.780 443.250
1437.780 449.000

Material Boundary
1126.178 456.940
1126.178 462.690

Material Boundary
1127.707 456.954
1127.707 462.704

Material Boundary
1142.148 433.082
1142.148 438.832

Material Boundary
1143.812 433.097
1143.812 438.847

Material Boundary
1228.192 450.354
1228.192 456.104

Material Boundary
1229.723 450.334
1229.723 456.084

Material Boundary
1240.193 438.224
1240.193 443.974

Material Boundary
1241.724 438.215
1241.724 443.965

Material Boundary

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1412.195 455.250
1412.195 461.000

Material Boundary
1413.743 455.250
1413.743 461.000

Material Boundary
1460.199 431.250
1460.199 437.000

Material Boundary
1461.784 431.250
1461.784 437.000

Material Boundary
1498.182 437.250
1498.182 443.000

Material Boundary
1499.766 437.250
1499.766 443.000

Material Boundary
1473.204 449.250
1473.204 455.000

Material Boundary
1474.788 449.250
1474.788 455.000

Material Boundary
0.000 387.500
27.994 387.564
49.614 387.564
83.114 387.607
103.116 387.633
125.614 387.662
151.946 387.696
177.171 387.728
268.000 387.845
1642.000 389.616
1786.163 389.802
1807.462 389.829
1833.462 389.862
1848.701 389.882
1867.512 389.969
1901.032 389.969
1918.472 389.972
1979.000 390.050

Material Boundary
268.000 462.000
268.000 460.000
554.200 460.000
555.700 460.000
824.000 460.000
840.193 460.144
841.706 460.158
1126.178 462.690
1127.707 462.704
1161.000 463.000
1236.000 462.000
1400.000 461.000
1412.195 461.000
1413.743 461.000
1698.000 461.000

Material Boundary
1698.000 463.000
1698.000 461.000
1698.000 455.250
1698.000 455.000
1718.000 455.000
1718.000 449.250
1718.000 449.000
1738.000 449.000
1738.000 443.250
1738.000 443.000
1758.000 443.000
1758.000 437.250
1758.000 437.000
1778.100 437.000
1778.100 431.250
1778.100 431.000

Material Boundary
180.062 426.825
180.500 427.000
182.423 427.769
183.000 428.000
185.500 429.000
188.000 430.000

Material Boundary
267.961 422.659

268.000 387.845

Material Boundary
161.101 430.894
175.665 425.068
180.062 426.825

Material Boundary
151.946 434.000
177.171 423.910

Material Boundary
180.062 426.825
182.423 426.779
347.000 423.600
600.000 423.600
640.000 424.000
728.000 424.000
1102.000 431.000
1176.000 431.000
1356.000 428.000
1474.000 427.500
1619.000 426.500
1689.000 426.500
1790.268 428.336

Material Boundary
188.000 430.000
188.000 430.250
188.000 436.000
208.000 436.000
208.000 436.250
208.000 442.000
228.000 442.000
228.000 442.250
228.000 448.000
248.000 448.000
248.000 448.250
248.000 454.000
268.000 454.000
268.000 454.250
268.000 460.000

Material Boundary
1786.163 426.261
1807.462 435.000

Material Boundary

27.994 387.564
27.994 425.566

Material Boundary
49.614 387.564
49.614 416.900
49.614 417.000

Material Boundary
83.114 387.607
83.114 416.900
83.114 417.000

Material Boundary
177.171 423.910
177.171 387.728

Material Boundary
27.994 425.704
27.994 425.566
49.614 416.900
83.114 416.900
103.116 424.994
103.116 424.994
103.116 425.094
103.116 425.094
83.114 417.000
49.614 417.000

Material Boundary
83.114 417.000
103.116 425.094

Material Boundary
1642.000 389.616
1642.000 424.450

Material Boundary
125.614 387.662
125.614 424.602
125.614 434.000

Material Boundary
151.946 387.696
151.946 424.248
151.946 434.000

Material Boundary

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

29.509	425.094
49.614	417.000

Material Boundary

1798.640	432.124
1800.121	432.269
1800.123	432.269

Material Boundary

1778.100	431.000
1798.640	432.124

Material Boundary

1790.268	428.336
1800.121	432.269
1800.129	432.272
1802.376	433.169

Material Boundary

1851.997	427.379
1851.997	427.279
1867.512	420.900
1901.032	420.900
1918.472	427.900
1918.472	428.000

Material Boundary

1852.919	427.000
1867.512	421.000
1901.032	421.000
1915.980	427.000

Material Boundary

1807.462	389.829
1807.462	426.623
1807.462	435.000

Material Boundary

1833.462	389.862
1833.462	427.064
1833.462	435.000

Material Boundary

1867.512	389.969
1867.512	420.900

Material Boundary

1901.032	389.969
1901.032	420.900

Material Boundary

1918.472	389.972
1918.472	427.900

External Boundary

1778.100	440.000
1758.000	446.000
1738.000	452.000
1718.000	458.000
1698.000	464.000
1400.000	464.000
1236.000	465.000
1161.000	466.000
824.000	463.000
268.000	463.000
248.000	457.000
228.000	451.000
208.000	445.000
188.000	439.000
171.455	434.000
161.101	430.894
153.335	434.000
151.946	434.000
142.619	434.000
129.614	434.000
125.614	434.000
103.116	425.094
29.509	425.094
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000
1916.925	427.379
1915.980	427.000
1852.919	427.000
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000
1802.376	433.169

Piezo Line

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Support

554.200	454.250
554.200	460.000

Support

554.200	460.000
268.000	460.000

Support

268.000	454.000
248.000	454.000

Support

248.000	454.000
248.000	448.250

Support

248.000	448.250
493.200	448.250

Support

493.200	454.000
493.200	448.250

Support

268.000	460.000
268.000	454.250

Support

268.000	454.250
554.200	454.250

Support

555.700	454.250
555.700	460.000

Support

555.700	460.000
824.000	460.000

Support

824.000	460.000
840.193	460.144

Support

840.193	460.144
840.193	454.394

Support

840.193	454.394
824.000	454.250

Support

824.000	454.250
555.700	454.250

Support

738.195	454.000
738.195	448.250

Support

739.701	454.000
739.701	448.250

Support

738.195 454.000
494.700 454.000

Support
494.700 454.000
494.700 448.250

Support
494.700 448.250
738.195 448.250

Support
724.201 442.000
724.201 436.250

Support
724.201 436.250
467.700 436.250

Support
467.700 436.250
467.700 442.000

Support
467.700 442.000
724.201 442.000

Support
228.000 448.000
228.000 442.250

Support
248.000 448.000
530.200 448.000

Support
530.200 448.000
530.200 442.250

Support
531.700 442.250
531.700 448.000

Support
530.200 442.250
228.000 442.250

Support

228.000 448.000
248.000 448.000

Support
208.000 436.250
208.000 442.000

Support
208.000 442.000
228.000 442.000

Support
228.000 442.000
466.200 442.000

Support
466.200 442.000
466.200 436.250

Support
466.200 436.250
208.000 436.250

Support
188.000 430.250
188.000 436.000

Support
188.000 436.000
208.000 436.000

Support
208.000 436.000
506.200 436.000

Support
507.700 436.000
507.700 430.250

Support
506.200 436.000
506.200 430.250

Support
506.200 430.250
188.000 430.250

Support

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

507.700 430.250
824.200 430.252

Support
824.200 430.252
824.200 436.002

Support
824.200 436.002
507.700 436.000

Support
832.191 442.323
832.191 448.073

Support
833.715 442.336
833.715 448.086

Support
832.191 448.073
824.000 448.000

Support
824.000 448.000
531.700 448.000

Support
531.700 442.250
824.000 442.250

Support
824.000 442.250
832.191 442.323

Support
841.706 460.158
841.706 454.408

Support
825.700 436.015
825.700 430.265

Support
725.697 442.000
725.697 436.250

Support

725.697 436.250
824.000 436.250

Support
824.000 436.250
982.197 437.658

Support
982.197 437.658
982.197 443.408

Support
982.197 443.408
824.000 442.000

Support
824.000 442.000
725.697 442.000

Support
739.701 448.250
824.000 448.250

Support
824.000 448.250
983.182 449.667

Support
983.182 449.667
983.182 455.417

Support
983.182 455.417
824.000 454.000

Support
824.000 454.000
739.701 454.000

Support
841.706 454.408
1126.178 456.940

Support
1126.178 456.940
1126.178 462.690

Support

1126.178 462.690
841.706 460.158

Support
833.715 448.086
1134.188 450.761

Support
1134.188 450.761
1134.188 445.011

Support
1134.188 445.011
833.715 442.336

Support
825.700 436.015
1142.148 438.832

Support
1142.148 438.832
1142.148 433.082

Support
1142.148 433.082
825.700 430.265

Support
984.724 455.431
984.724 449.681

Support
983.718 443.422
983.718 437.672

Support
983.718 437.672
1161.000 439.250

Support
1161.000 439.250
1236.000 438.250

Support
1236.000 438.250
1240.193 438.224

Support

1240.193 438.224
1240.193 443.974

Support
1240.193 443.974
1236.000 444.000

Support
1236.000 444.000
1161.000 445.000

Support
1161.000 445.000
983.718 443.422

Support
984.724 455.431
1161.000 457.000

Support
1161.000 457.000
1228.192 456.104

Support
1228.192 456.104
1228.192 450.354

Support
1228.192 450.354
1161.000 451.250

Support
1161.000 451.250
984.724 449.681

Support
268.000 454.000
493.200 454.000

Support
1127.707 462.704
1127.707 456.954

Support
1127.707 462.704
1161.000 463.000

Support

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1161.000 463.000
1236.000 462.000

Support
1236.000 462.000
1400.000 461.000

Support
1400.000 461.000
1412.195 461.000

Support
1412.195 461.000
1412.195 455.250

Support
1412.195 455.250
1400.000 455.250

Support
1400.000 455.250
1236.000 456.250

Support
1236.000 456.250
1161.000 457.250

Support
1161.000 457.250
1127.707 456.954

Support
1135.719 450.775
1135.719 445.025

Support
1135.719 450.775
1161.000 451.000

Support
1161.000 445.250
1135.719 445.025

Support
1161.000 445.250
1236.000 444.250

Support

1236.000 444.250
1400.000 443.250

Support
1400.000 443.250
1436.205 443.250

Support
1436.205 443.250
1436.205 449.000

Support
1437.780 449.000
1437.780 443.250

Support
1436.205 449.000
1400.000 449.000

Support
1400.000 449.000
1236.000 450.000

Support
1236.000 450.000
1161.000 451.000

Support
1229.723 456.084
1229.723 450.334

Support
1229.723 450.334
1236.000 450.250

Support
1236.000 456.000
1229.723 456.084

Support
1236.000 456.000
1400.000 455.000

Support
1400.000 455.000
1473.204 455.000

Support

1473.204 455.000
1473.204 449.250

Support
1474.788 449.250
1474.788 455.000

Support
1473.204 449.250
1400.000 449.250

Support
1400.000 449.250
1236.000 450.250

Support
1241.724 438.215
1241.724 443.965

Support
1143.812 438.847
1143.812 433.097

Support
1143.812 433.097
1161.000 433.250

Support
1161.000 439.000
1143.812 438.847

Support
1161.000 439.000
1236.000 438.000

Support
1236.000 438.000
1400.000 437.000

Support
1400.000 437.000
1460.199 437.000

Support
1460.199 437.000
1460.199 431.250

Support

1461.784 431.250
1461.784 437.000

Support
1460.199 431.250
1400.000 431.250

Support
1400.000 431.250
1236.000 432.250

Support
1236.000 432.250
1161.000 433.250

Support
1241.724 438.215
1400.000 437.250

Support
1400.000 437.250
1498.182 437.250

Support
1498.182 443.000
1498.182 437.250

Support
1499.766 437.250
1499.766 443.000

Support
1498.182 443.000
1400.000 443.000

Support
1400.000 443.000
1241.724 443.965

Support
1413.743 461.000
1413.743 455.250

Support
1413.743 461.000
1698.000 461.000

Support

1698.000 461.000
1698.000 455.250

Support
1698.000 455.250
1413.743 455.250

Support
1474.788 449.250
1718.000 449.250

Support
1718.000 449.250
1718.000 455.000

Support
1698.000 455.000
1474.788 455.000

Support
1461.784 431.250
1778.100 431.250

Support
1778.100 431.250
1778.100 437.000

Support
1758.000 437.000
1461.784 437.000

Support
1437.780 443.250
1738.000 443.250

Support
1738.000 443.250
1738.000 449.000

Support
1718.000 449.000
1437.780 449.000

Support
1499.766 437.250
1758.000 437.250

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Cross Section ES-2

Global/Circular/Undrained/Operation Condition

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES_2F_U_Circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Dredge Material
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Tube Interface (Horizontal)
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tub-Tube Interface (Vertical)
Strength Type: Mohr-Coulomb
Unit Weight: 43 lb/ft3
Cohesion: 0 psf
Friction Angle: 0.1 degrees

Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Gravel Interface
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=Ave(In+75), 435'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW Ave. 431.2'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 427.4'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 424.5'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 428.3'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=Ave(In+75), 426.5'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Support Properties

Support: Geotube
Geotube
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Tangent to Slip Surface
Anchorage: Both Ends
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1600 lb/ft
Pullout Strength Adhesion: 5 lb/ft2
Pullout Strength Friction Angle: 40 degrees

Global Minimums

Method: janbu simplified
FS: 1.462040
Center: 1769.018, 529.931
Radius: 132.892
Left Slip Surface Endpoint: 1653.634, 464.000
Right Slip Surface Endpoint: 1853.074, 427.000
Resisting Horizontal Force=139382 lb
Driving Horizontal Force=95333.8 lb

Method: spencer
FS: 1.540900
Center: 1769.018, 529.931
Radius: 132.892
Left Slip Surface Endpoint: 1653.634, 464.000
Right Slip Surface Endpoint: 1853.074, 427.000
Resisting Moment=2.12731e+007 lb-ft
Driving Moment=1.38057e+007 lb-ft
Resisting Horizontal Force=139105 lb
Driving Horizontal Force=90275 lb

Valid / Invalid Surfaces

Method: janbu simplified
Number of Valid Surfaces: 17016
Number of Invalid Surfaces: 11595
Error Codes:
Error Code -103 reported for 1718 surfaces
Error Code -106 reported for 27 surfaces
Error Code -107 reported for 539 surfaces
Error Code -108 reported for 399 surfaces
Error Code -110 reported for 7285 surfaces
Error Code -111 reported for 16 surfaces
Error Code -112 reported for 273 surfaces
Error Code -114 reported for 1338 surfaces

Method: spencer
Number of Valid Surfaces: 14998
Number of Invalid Surfaces: 13613
Error Codes:
Error Code -103 reported for 1718 surfaces
Error Code -106 reported for 27 surfaces
Error Code -107 reported for 539 surfaces
Error Code -108 reported for 515 surfaces
Error Code -110 reported for 7285 surfaces
Error Code -111 reported for 1871 surfaces
Error Code -112 reported for 320 surfaces
Error Code -114 reported for 1338 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-114 = Surface with Reverse Curvature.

List of All Coordinates

Search Grid

1725.878	431.250
1905.627	431.250
1905.627	666.204
1725.878	666.204

Material Boundary

103.116	425.094
125.614	424.602
151.946	424.248
177.171	423.910

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1807.462	426.623
1833.462	427.064
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000
1778.100	431.000

Material Boundary

188.000	430.250
506.200	430.250
507.700	430.250
824.000	430.250
824.200	430.252
825.700	430.265
1142.148	433.082
1143.812	433.097
1161.000	433.250
1236.000	432.250
1400.000	431.250
1460.199	431.250
1461.784	431.250
1778.100	431.250

Material Boundary

208.000	436.000
506.200	436.000
507.700	436.000
824.000	436.000
824.200	436.002
825.700	436.015
1142.148	438.832
1143.812	438.847
1161.000	439.000
1236.000	438.000
1400.000	437.000
1460.199	437.000
1461.784	437.000
1758.000	437.000

Material Boundary

208.000	436.250
466.200	436.250
467.700	436.250
724.201	436.250
725.697	436.250
824.000	436.250
982.197	437.658
983.718	437.672
1161.000	439.250
1236.000	438.250
1240.193	438.224
1241.724	438.215
1400.000	437.250
1498.182	437.250
1499.766	437.250
1758.000	437.250

Material Boundary

228.000	442.000
466.200	442.000
467.700	442.000
724.201	442.000
725.697	442.000
824.000	442.000
982.197	443.408
983.718	443.422
1161.000	445.000
1236.000	444.000
1240.193	443.974
1241.724	443.965
1400.000	443.000
1498.182	443.000
1499.766	443.000
1738.000	443.000

Material Boundary

228.000	442.250
530.200	442.250
531.700	442.250

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

824.000	442.250
832.191	442.323
833.715	442.336
1134.188	445.011
1135.719	445.025
1161.000	445.250
1236.000	444.250
1400.000	443.250
1436.205	443.250
1437.780	443.250
1738.000	443.250

Material Boundary

248.000	448.000
530.200	448.000
531.700	448.000
824.000	448.000
832.191	448.073
833.715	448.086
1134.188	450.761
1135.719	450.775
1161.000	451.000
1236.000	450.000
1400.000	449.000
1436.205	449.000
1437.780	449.000
1718.000	449.000

Material Boundary

248.000	448.250
493.200	448.250
494.700	448.250
738.195	448.250
739.701	448.250
824.000	448.250
983.182	449.667
984.724	449.681
1161.000	451.250
1228.192	450.354
1229.723	450.334
1236.000	450.250
1400.000	449.250
1473.204	449.250
1474.788	449.250
1718.000	449.250

Material Boundary

268.000	454.000
493.200	454.000
494.700	454.000
738.195	454.000
739.701	454.000
824.000	454.000
983.182	455.417
984.724	455.431
1161.000	457.000
1228.192	456.104
1229.723	456.084
1236.000	456.000
1400.000	455.000
1473.204	455.000
1474.788	455.000
1698.000	455.000

Material Boundary

268.000	454.250
554.200	454.250
555.700	454.250
824.000	454.250
840.193	454.394
841.706	454.408
1126.178	456.940
1127.707	456.954
1161.000	457.250
1236.000	456.250
1400.000	455.250
1412.195	455.250
1413.743	455.250
1698.000	455.250

Material Boundary

506.200	430.250
506.200	436.000

Material Boundary

507.700	430.250
507.700	436.000

Material Boundary

466.200	436.250
466.200	442.000

Material Boundary

467.700	436.250
467.700	442.000

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary
530.200 442.250
530.200 448.000

Material Boundary
531.700 442.250
531.700 448.000

Material Boundary
493.200 448.250
493.200 454.000

Material Boundary
494.700 448.250
494.700 454.000

Material Boundary
554.200 454.250
554.200 460.000

Material Boundary
555.700 454.250
555.700 460.000

Material Boundary
824.200 430.252
824.200 436.002

Material Boundary
825.700 430.265
825.700 436.015

Material Boundary
724.201 436.250
724.201 442.000

Material Boundary
725.697 436.250
725.697 442.000

Material Boundary
738.195 448.250
738.195 454.000

Material Boundary
739.701 448.250
739.701 454.000

Material Boundary
840.193 454.394
840.193 460.144

Material Boundary
841.706 454.408
841.706 460.158

Material Boundary
832.191 442.323
832.191 448.073

Material Boundary
833.715 442.336
833.715 448.086

Material Boundary
982.197 437.658
982.197 443.408

Material Boundary
983.182 449.667
983.182 455.417

Material Boundary
983.718 437.672
983.718 443.422

Material Boundary
984.724 449.681
984.724 455.431

Material Boundary
1134.188 445.011
1134.188 450.761

Material Boundary
1135.719 445.025
1135.719 450.775

Material Boundary
1436.205 443.250
1436.205 449.000

Material Boundary
1437.780 443.250
1437.780 449.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

1126.178	456.940
1126.178	462.690

Material Boundary

1127.707	456.954
1127.707	462.704

Material Boundary

1142.148	433.082
1142.148	438.832

Material Boundary

1143.812	433.097
1143.812	438.847

Material Boundary

1228.192	450.354
1228.192	456.104

Material Boundary

1229.723	450.334
1229.723	456.084

Material Boundary

1240.193	438.224
1240.193	443.974

Material Boundary

1241.724	438.215
1241.724	443.965

Material Boundary

1412.195	455.250
1412.195	461.000

Material Boundary

1413.743	455.250
1413.743	461.000

Material Boundary

1460.199	431.250
1460.199	437.000

Material Boundary

1461.784	431.250
1461.784	437.000

Material Boundary

1498.182	437.250
1498.182	443.000

Material Boundary

1499.766	437.250
1499.766	443.000

Material Boundary

1473.204	449.250
1473.204	455.000

Material Boundary

1474.788	449.250
1474.788	455.000

Material Boundary

0.000	387.500
27.994	387.564
49.614	387.564
83.114	387.607
103.116	387.633
125.614	387.662
151.946	387.696
177.171	387.728
268.000	387.845
1642.000	389.616
1786.163	389.802
1807.462	389.829
1833.462	389.862
1848.701	389.882
1851.997	389.897
1867.512	389.969
1901.032	389.969
1918.472	389.972
1979.000	390.050

Material Boundary

268.000	462.000
268.000	460.000
554.200	460.000
555.700	460.000
824.000	460.000
840.193	460.144
841.706	460.158
1126.178	462.690
1127.707	462.704
1161.000	463.000

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1236.000 462.000
1400.000 461.000
1412.195 461.000
1413.743 461.000
1698.000 461.000

Material Boundary
1698.000 463.000
1698.000 461.000
1698.000 455.250
1698.000 455.000
1718.000 455.000
1718.000 449.250
1718.000 449.000
1738.000 449.000
1738.000 443.250
1738.000 443.000
1758.000 443.000
1758.000 437.250
1758.000 437.000
1778.100 437.000
1778.100 431.250
1778.100 431.000

Material Boundary
180.062 426.825
180.500 427.000
182.423 427.769
183.000 428.000
185.500 429.000
188.000 430.000

Material Boundary
267.961 422.659
268.000 387.845

Material Boundary
161.101 430.894
175.665 425.068
180.062 426.825

Material Boundary
151.946 434.000
177.171 423.910

Material Boundary
180.062 426.825
182.423 426.779

347.000 423.600
600.000 423.600
640.000 424.000
728.000 424.000
1102.000 431.000
1176.000 431.000
1356.000 428.000
1474.000 427.500
1619.000 426.500
1689.000 426.500
1790.268 428.336

Material Boundary
188.000 430.000
188.000 430.250
188.000 436.000
208.000 436.000
208.000 436.250
208.000 442.000
228.000 442.000
228.000 442.250
228.000 448.000
248.000 448.000
248.000 448.250
248.000 454.000
268.000 454.000
268.000 454.250
268.000 460.000

Material Boundary
1786.163 426.261
1807.462 435.000

Material Boundary
27.994 387.564
27.994 425.566

Material Boundary
49.614 387.564
49.614 416.900
49.614 417.000

Material Boundary
83.114 387.607
83.114 416.900
83.114 417.000

Material Boundary

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

177.171 423.910
177.171 387.728

Material Boundary
27.994 425.704
27.994 425.566
49.614 416.900
83.114 416.900
103.116 424.994
103.116 424.994
103.116 425.094
103.116 425.094
83.114 417.000
49.614 417.000

Material Boundary
83.114 417.000
103.116 425.094

Material Boundary
1642.000 389.616
1642.000 424.450

Material Boundary
125.614 387.662
125.614 424.602
125.614 434.000

Material Boundary
151.946 387.696
151.946 424.248
151.946 434.000

Material Boundary
29.509 425.094
49.614 417.000

Material Boundary
1798.640 432.124
1800.121 432.269
1800.123 432.269

Material Boundary
1778.100 431.000
1798.640 432.124

Material Boundary
1790.268 428.336
1800.121 432.269
1800.129 432.272
1802.376 433.169

Material Boundary
1851.997 427.379
1851.997 427.279
1867.512 420.900
1901.032 420.900
1918.472 427.900
1918.472 428.000

Material Boundary
1852.920 427.000
1867.512 421.000
1901.032 421.000
1915.979 427.000

Material Boundary
1833.462 389.862
1833.462 427.064
1833.462 435.000

Material Boundary
1918.472 389.972
1918.472 427.900

Material Boundary
1786.163 426.261
1786.163 389.802

Material Boundary
1851.997 389.897
1851.997 427.279

Material Boundary
1807.462 389.829
1807.462 426.623

External Boundary
1778.100 440.000
1758.000 446.000
1738.000 452.000
1718.000 458.000
1698.000 464.000
1400.000 464.000
1236.000 465.000
1161.000 466.000

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

824.000	463.000
268.000	463.000
248.000	457.000
228.000	451.000
208.000	445.000
188.000	439.000
171.455	434.000
161.101	430.894
153.335	434.000
151.946	434.000
142.619	434.000
129.614	434.000
125.614	434.000
103.116	425.094
29.509	425.094
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000
1916.925	427.379
1915.979	427.000
1852.920	427.000
1851.997	427.379
1833.462	435.000
1807.462	435.000
1806.964	435.000
1802.376	433.169

Piezo Line

182.423	427.779
347.000	424.600
600.000	424.600
640.000	425.000
728.000	425.000
1102.000	432.000
1176.000	432.000
1356.000	429.000
1474.000	428.500
1619.000	427.500
1689.000	427.500
1790.000	429.000
1792.668	429.000

Water Table

0.000	412.500
204.000	408.550
405.000	405.750
472.000	407.050
557.156	407.108
768.000	407.250
805.000	408.150
925.000	408.250
1165.000	413.350
1347.000	410.150
1436.000	411.150
1642.000	409.450
1768.160	411.260
1841.123	411.953
1979.000	415.050

Support

554.200	454.250
554.200	460.000

Support

554.200	460.000
268.000	460.000

Support

268.000	454.000
248.000	454.000

Support

248.000	454.000
248.000	448.250

Support

248.000	448.250
493.200	448.250

Support

493.200	454.000
493.200	448.250

Support

268.000	460.000
268.000	454.250

Support

268.000	454.250
554.200	454.250

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Support
555.700 454.250
555.700 460.000

Support
555.700 460.000
824.000 460.000

Support
824.000 460.000
840.193 460.144

Support
840.193 460.144
840.193 454.394

Support
840.193 454.394
824.000 454.250

Support
824.000 454.250
555.700 454.250

Support
738.195 454.000
738.195 448.250

Support
739.701 454.000
739.701 448.250

Support
738.195 454.000
494.700 454.000

Support
494.700 454.000
494.700 448.250

Support
494.700 448.250
738.195 448.250

Support
724.201 442.000
724.201 436.250

Support
724.201 436.250
467.700 436.250

Support
467.700 436.250
467.700 442.000

Support
467.700 442.000
724.201 442.000

Support
228.000 448.000
228.000 442.250

Support
248.000 448.000
530.200 448.000

Support
530.200 448.000
530.200 442.250

Support
531.700 442.250
531.700 448.000

Support
530.200 442.250
228.000 442.250

Support
228.000 448.000
248.000 448.000

Support
208.000 436.250
208.000 442.000

Support
208.000 442.000
228.000 442.000

Support
228.000 442.000
466.200 442.000

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Support
466.200 442.000
466.200 436.250

Support
466.200 436.250
208.000 436.250

Support
188.000 430.250
188.000 436.000

Support
188.000 436.000
208.000 436.000

Support
208.000 436.000
506.200 436.000

Support
507.700 436.000
507.700 430.250

Support
506.200 436.000
506.200 430.250

Support
506.200 430.250
188.000 430.250

Support
507.700 430.250
824.200 430.252

Support
824.200 430.252
824.200 436.002

Support
824.200 436.002
507.700 436.000

Support
832.191 442.323
832.191 448.073

Support
833.715 442.336
833.715 448.086

Support
832.191 448.073
824.000 448.000

Support
824.000 448.000
531.700 448.000

Support
531.700 442.250
824.000 442.250

Support
824.000 442.250
832.191 442.323

Support
841.706 460.158
841.706 454.408

Support
825.700 436.015
825.700 430.265

Support
725.697 442.000
725.697 436.250

Support
725.697 436.250
824.000 436.250

Support
824.000 436.250
982.197 437.658

Support
982.197 437.658
982.197 443.408

Support
982.197 443.408
824.000 442.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Support
824.000 442.000
725.697 442.000

Support
739.701 448.250
824.000 448.250

Support
824.000 448.250
983.182 449.667

Support
983.182 449.667
983.182 455.417

Support
983.182 455.417
824.000 454.000

Support
824.000 454.000
739.701 454.000

Support
841.706 454.408
1126.178 456.940

Support
1126.178 456.940
1126.178 462.690

Support
1126.178 462.690
841.706 460.158

Support
833.715 448.086
1134.188 450.761

Support
1134.188 450.761
1134.188 445.011

Support
1134.188 445.011
833.715 442.336

Support
825.700 436.015
1142.148 438.832

Support
1142.148 438.832
1142.148 433.082

Support
1142.148 433.082
825.700 430.265

Support
984.724 455.431
984.724 449.681

Support
983.718 443.422
983.718 437.672

Support
983.718 437.672
1161.000 439.250

Support
1161.000 439.250
1236.000 438.250

Support
1236.000 438.250
1240.193 438.224

Support
1240.193 438.224
1240.193 443.974

Support
1240.193 443.974
1236.000 444.000

Support
1236.000 444.000
1161.000 445.000

Support
1161.000 445.000
983.718 443.422

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Support
984.724 455.431
1161.000 457.000

Support
1161.000 457.000
1228.192 456.104

Support
1228.192 456.104
1228.192 450.354

Support
1228.192 450.354
1161.000 451.250

Support
1161.000 451.250
984.724 449.681

Support
268.000 454.000
493.200 454.000

Support
1127.707 462.704
1127.707 456.954

Support
1127.707 462.704
1161.000 463.000

Support
1161.000 463.000
1236.000 462.000

Support
1236.000 462.000
1400.000 461.000

Support
1400.000 461.000
1412.195 461.000

Support
1412.195 461.000
1412.195 455.250

Support
1412.195 455.250
1400.000 455.250

Support
1400.000 455.250
1236.000 456.250

Support
1236.000 456.250
1161.000 457.250

Support
1161.000 457.250
1127.707 456.954

Support
1135.719 450.775
1135.719 445.025

Support
1135.719 450.775
1161.000 451.000

Support
1161.000 445.250
1135.719 445.025

Support
1161.000 445.250
1236.000 444.250

Support
1236.000 444.250
1400.000 443.250

Support
1400.000 443.250
1436.205 443.250

Support
1436.205 443.250
1436.205 449.000

Support
1437.780 449.000
1437.780 443.250

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

Support
1436.205 449.000
1400.000 449.000

Support
1400.000 449.000
1236.000 450.000

Support
1236.000 450.000
1161.000 451.000

Support
1229.723 456.084
1229.723 450.334

Support
1229.723 450.334
1236.000 450.250

Support
1236.000 456.000
1229.723 456.084

Support
1236.000 456.000
1400.000 455.000

Support
1400.000 455.000
1473.204 455.000

Support
1473.204 455.000
1473.204 449.250

Support
1474.788 449.250
1474.788 455.000

Support
1473.204 449.250
1400.000 449.250

Support
1400.000 449.250
1236.000 450.250

Support
1241.724 438.215
1241.724 443.965

Support
1143.812 438.847
1143.812 433.097

Support
1143.812 433.097
1161.000 433.250

Support
1161.000 439.000
1143.812 438.847

Support
1161.000 439.000
1236.000 438.000

Support
1236.000 438.000
1400.000 437.000

Support
1400.000 437.000
1460.199 437.000

Support
1460.199 437.000
1460.199 431.250

Support
1461.784 431.250
1461.784 437.000

Support
1460.199 431.250
1400.000 431.250

Support
1400.000 431.250
1236.000 432.250

Support
1236.000 432.250
1161.000 433.250

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Support

1241.724	438.215
1400.000	437.250

Support

1400.000	437.250
1498.182	437.250

Support

1498.182	443.000
1498.182	437.250

Support

1499.766	437.250
1499.766	443.000

Support

1498.182	443.000
1400.000	443.000

Support

1400.000	443.000
1241.724	443.965

Support

1413.743	461.000
1413.743	455.250

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.:	05/01

Cross Section ES-2
Liner Waste Block/Operation Condition

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01

Slide Analysis Information

Document Name

File Name: ES_2F_U_LWB

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Janbu simplified
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 175
Right Projection Angle (Start Angle): 5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Final Cover Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Dike Soil
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Piezometric Line 1
Custom Hu value: 1

Material: SOLW (undrained)
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Dredge Material
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Tube Interface (Horizontal)
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tub-Tube Interface (Vertical)
Strength Type: Mohr-Coulomb

Unit Weight: 43 lb/ft3
Cohesion: 0 psf
Friction Angle: 0.1 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Tube-Gravel Interface
Strength Type: Mohr-Coulomb
Unit Weight: 86 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW U=Ave(In+75), 435'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: SOLW Ave. 431.2'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 427.4'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 424.5'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=75%, 428.3'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Material: SOLW U=Ave(In+75), 426.5'
Strength Type: Discrete function
Unit Weight: 82 lb/ft3
Water Surface: None

Support Properties

Support: Geotube
Geotube
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Tangent to Slip Surface
Anchorage: Both Ends
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1600 lb/ft
Pullout Strength Adhesion: 5 lb/ft2
Pullout Strength Friction Angle: 40 degrees

Global Minimums

Method: janbu simplified
FS: 2.075860
Axis Location: 1766.378, 589.660
Left Slip Surface Endpoint: 1667.298, 464.000
Right Slip Surface Endpoint: 1807.457, 435.000
Resisting Horizontal Force=81704.8 lb
Driving Horizontal Force=39359.5 lb

Method: spencer
FS: 2.087100
Axis Location: 1766.378, 589.660
Left Slip Surface Endpoint: 1667.298, 464.000
Right Slip Surface Endpoint: 1807.457, 435.000
Resisting Moment=1.3733e+007 lb-ft
Driving Moment=6.57997e+006 lb-ft
Resisting Horizontal Force=81650.4 lb
Driving Horizontal Force=39121.5 lb

Valid / Invalid Surfaces

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Method: janbu simplified
Number of Valid Surfaces: 2085
Number of Invalid Surfaces: 2915
Error Codes:
Error Code -105 reported for 1634 surfaces
Error Code -108 reported for 527 surfaces
Error Code -110 reported for 253 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 486 surfaces
Error Code -1000 reported for 14 surfaces

Method: spencer
Number of Valid Surfaces: 407
Number of Invalid Surfaces: 4593
Error Codes:
Error Code -105 reported for 1634 surfaces
Error Code -108 reported for 651 surfaces
Error Code -110 reported for 253 surfaces
Error Code -111 reported for 1419 surfaces
Error Code -112 reported for 622 surfaces
Error Code -1000 reported for 14 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

List of All Coordinates

Block Search Polyline

1786.163	426.261
1794.559	426.404
1851.997	427.379
1867.512	420.900

Material Boundary

103.116	425.094
125.614	424.602
151.946	424.248
177.171	423.910
204.000	423.550
267.961	422.659
405.000	420.750
472.000	422.050
768.000	422.250
805.000	423.150
925.000	423.250
1165.000	428.350
1347.000	425.150
1436.000	426.150
1642.000	424.450
1786.163	426.261
1807.462	426.623
1833.462	427.064
1851.997	427.379

Material Boundary

188.000	430.000
824.000	430.000
1161.000	433.000
1236.000	432.000
1400.000	431.000
1778.100	431.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

188.000	430.250
506.200	430.250
507.700	430.250
824.000	430.250
824.200	430.252
825.700	430.265
1142.148	433.082
1143.812	433.097
1161.000	433.250
1236.000	432.250
1400.000	431.250
1460.199	431.250
1461.784	431.250
1778.100	431.250

Material Boundary

208.000	436.000
506.200	436.000
507.700	436.000
824.000	436.000
824.200	436.002
825.700	436.015
1142.148	438.832
1143.812	438.847
1161.000	439.000
1236.000	438.000
1400.000	437.000
1460.199	437.000
1461.784	437.000
1758.000	437.000

Material Boundary

208.000	436.250
466.200	436.250
467.700	436.250
724.201	436.250
725.697	436.250
824.000	436.250
982.197	437.658
983.718	437.672
1161.000	439.250
1236.000	438.250
1240.193	438.224
1241.724	438.215
1400.000	437.250
1498.182	437.250
1499.766	437.250
1758.000	437.250

Material Boundary

228.000	442.000
466.200	442.000
467.700	442.000
724.201	442.000
725.697	442.000
824.000	442.000
982.197	443.408
983.718	443.422
1161.000	445.000
1236.000	444.000
1240.193	443.974
1241.724	443.965
1400.000	443.000
1498.182	443.000
1499.766	443.000
1738.000	443.000

Material Boundary

228.000	442.250
530.200	442.250
531.700	442.250
824.000	442.250
832.191	442.323
833.715	442.336
1134.188	445.011
1135.719	445.025
1161.000	445.250
1236.000	444.250
1400.000	443.250
1436.205	443.250
1437.780	443.250
1738.000	443.250

Material Boundary

248.000	448.000
530.200	448.000
531.700	448.000
824.000	448.000
832.191	448.073
833.715	448.086
1134.188	450.761
1135.719	450.775
1161.000	451.000
1236.000	450.000

1400.000	449.000
1436.205	449.000
1437.780	449.000
1718.000	449.000

Material Boundary

248.000	448.250
493.200	448.250
494.700	448.250
738.195	448.250
739.701	448.250
824.000	448.250
983.182	449.667
984.724	449.681
1161.000	451.250
1228.192	450.354
1229.723	450.334
1236.000	450.250
1400.000	449.250
1473.204	449.250
1474.788	449.250
1718.000	449.250

Material Boundary

268.000	454.000
493.200	454.000
494.700	454.000
738.195	454.000
739.701	454.000
824.000	454.000
983.182	455.417
984.724	455.431
1161.000	457.000
1228.192	456.104
1229.723	456.084
1236.000	456.000
1400.000	455.000
1473.204	455.000
1474.788	455.000
1698.000	455.000

Material Boundary

268.000	454.250
554.200	454.250
555.700	454.250
824.000	454.250
840.193	454.394
841.706	454.408
1126.178	456.940
1127.707	456.954
1161.000	457.250
1236.000	456.250
1400.000	455.250
1412.195	455.250
1413.743	455.250
1698.000	455.250

Material Boundary

506.200	430.250
506.200	436.000

Material Boundary

507.700	430.250
507.700	436.000

Material Boundary

466.200	436.250
466.200	442.000

Material Boundary

467.700	436.250
467.700	442.000

Material Boundary

530.200	442.250
530.200	448.000

Material Boundary

531.700	442.250
531.700	448.000

Material Boundary

493.200	448.250
493.200	454.000

Material Boundary

494.700	448.250
494.700	454.000

Material Boundary

554.200	454.250
554.200	460.000

Material Boundary

555.700	454.250
555.700	460.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010
Client:	Honeywell	Project:	Onondaga Lake Sump Stability	Project/ Proposal No.:	GJ4299	Task No.: 05/01	

Material Boundary
824.200 430.252
824.200 436.002

Material Boundary
825.700 430.265
825.700 436.015

Material Boundary
724.201 436.250
724.201 442.000

Material Boundary
725.697 436.250
725.697 442.000

Material Boundary
738.195 448.250
738.195 454.000

Material Boundary
739.701 448.250
739.701 454.000

Material Boundary
840.193 454.394
840.193 460.144

Material Boundary
841.706 454.408
841.706 460.158

Material Boundary
832.191 442.323
832.191 448.073

Material Boundary
833.715 442.336
833.715 448.086

Material Boundary
982.197 437.658
982.197 443.408

Material Boundary
983.182 449.667
983.182 455.417

Material Boundary
983.718 437.672
983.718 443.422

Material Boundary
984.724 449.681
984.724 455.431

Material Boundary
1134.188 445.011
1134.188 450.761

Material Boundary
1135.719 445.025
1135.719 450.775

Material Boundary
1436.205 443.250
1436.205 449.000

Material Boundary
1437.780 443.250
1437.780 449.000

Material Boundary
1126.178 456.940
1126.178 462.690

Material Boundary
1127.707 456.954
1127.707 462.704

Material Boundary
1142.148 433.082
1142.148 438.832

Material Boundary
1143.812 433.097
1143.812 438.847

Material Boundary
1228.192 450.354
1228.192 456.104

Material Boundary
1229.723 450.334
1229.723 456.084

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary
1240.193 438.224
1240.193 443.974

Material Boundary
1241.724 438.215
1241.724 443.965

Material Boundary
1412.195 455.250
1412.195 461.000

Material Boundary
1413.743 455.250
1413.743 461.000

Material Boundary
1460.199 431.250
1460.199 437.000

Material Boundary
1461.784 431.250
1461.784 437.000

Material Boundary
1498.182 437.250
1498.182 443.000

Material Boundary
1499.766 437.250
1499.766 443.000

Material Boundary
1473.204 449.250
1473.204 455.000

Material Boundary
1474.788 449.250
1474.788 455.000

Material Boundary
0.000 387.500
27.994 387.564
49.614 387.564
83.114 387.607
103.116 387.633
125.614 387.662
151.946 387.696
177.171 387.728
268.000 387.845
1642.000 389.616
1786.163 389.802
1807.462 389.829
1833.462 389.862
1848.701 389.882
1851.997 389.897
1867.512 389.969
1901.032 389.969
1918.472 389.972
1979.000 390.050

Material Boundary
268.000 462.000
268.000 460.000
554.200 460.000
555.700 460.000
824.000 460.000
840.193 460.144
841.706 460.158
1126.178 462.690
1127.707 462.704
1161.000 463.000
1236.000 462.000
1400.000 461.000
1412.195 461.000
1413.743 461.000
1698.000 461.000

Material Boundary
1698.000 463.000
1698.000 461.000
1698.000 455.250
1698.000 455.000
1718.000 455.000
1718.000 449.250
1718.000 449.000
1738.000 449.000
1738.000 443.250
1738.000 443.000
1758.000 443.000
1758.000 437.250
1758.000 437.000
1778.100 437.000
1778.100 431.250
1778.100 431.000

Written by:	**Y. Cho**	Date:	**12/07/2010**	Reviewed by:	**N. Yafrate/R. Kulasingam**
Date:	**12/08/2010**				

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

180.062 426.825
180.500 427.000
182.423 427.769
183.000 428.000
185.500 429.000
188.000 430.000

Material Boundary

267.961 422.659
268.000 387.845

Material Boundary

161.101 430.894
175.665 425.068
180.062 426.825

Material Boundary

151.946 434.000
177.171 423.910

Material Boundary

180.062 426.825
182.423 426.779
347.000 423.600
600.000 423.600
640.000 424.000
728.000 424.000
1102.000 431.000
1176.000 431.000
1356.000 428.000
1474.000 427.500
1619.000 426.500
1689.000 426.500
1790.268 428.336

Material Boundary

188.000 430.000
188.000 430.250
188.000 436.000
208.000 436.000
208.000 436.250
208.000 442.000
228.000 442.000
228.000 442.250
228.000 448.000
248.000 448.000
248.000 448.250
248.000 454.000
268.000 454.000
268.000 454.250
268.000 460.000

Material Boundary

1786.163 426.261
1807.462 435.000

Material Boundary

27.994 387.564
27.994 425.566

Material Boundary

49.614 387.564
49.614 416.900
49.614 417.000

Material Boundary

83.114 387.607
83.114 416.900
83.114 417.000

Material Boundary

177.171 423.910
177.171 387.728

Material Boundary

27.994 425.704
27.994 425.566
49.614 416.900
83.114 416.900
103.116 424.994
103.116 424.994
103.116 425.094
103.116 425.094
83.114 417.000
49.614 417.000

Material Boundary

83.114 417.000
103.116 425.094

Material Boundary

1642.000 389.616
1642.000 424.450

Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

Material Boundary

125.614	387.662
125.614	424.602
125.614	434.000

Material Boundary

151.946	387.696
151.946	424.248
151.946	434.000

Material Boundary

29.509	425.094
49.614	417.000

Material Boundary

1798.640	432.124
1800.121	432.269
1800.123	432.269

Material Boundary

1778.100	431.000
1798.640	432.124

Material Boundary

1790.268	428.336
1800.121	432.269
1800.129	432.272
1802.376	433.169

Material Boundary

1851.997	427.379
1851.997	427.279
1867.512	420.900
1901.032	420.900
1918.472	427.900
1918.472	428.000

Material Boundary

1851.997	427.379
1867.512	421.000
1901.032	421.000
1916.925	427.379

Material Boundary

1833.462	389.862
1833.462	427.064
1833.462	435.000

Material Boundary

1918.472	389.972
1918.472	427.900

Material Boundary

1786.163	426.261
1786.163	389.802

Material Boundary

1851.997	389.897
1851.997	427.279

Material Boundary

1807.462	389.829
1807.462	426.623

External Boundary

1778.100	440.000
1758.000	446.000
1738.000	452.000
1718.000	458.000
1698.000	464.000
1400.000	464.000
1236.000	465.000
1161.000	466.000
824.000	463.000
268.000	463.000
248.000	457.000
228.000	451.000
208.000	445.000
188.000	439.000
171.455	434.000
161.101	430.894
153.335	434.000
151.946	434.000
142.619	434.000
129.614	434.000
125.614	434.000
103.116	425.094
29.509	425.094
27.994	425.704
0.000	426.569
0.000	387.500
0.000	347.500
1979.000	350.000
1979.000	390.050
1979.000	430.050
1918.472	428.000

Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

1916.925	427.379
1851.997	427.379
1833.462	435.000
1807.462	435.000
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Piezo Line

182.423	427.779
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1347.000	410.150
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Written by: **Y. Cho** Date: **12/07/2010** Reviewed by: **N. Yafrate/R. Kulasingam** Date: **12/08/2010**

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

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Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

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Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

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Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

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Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

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Written by:	Y. Cho	Date:	12/07/2010	Reviewed by:	N. Yafrate/R. Kulasingam	Date:	12/08/2010

Client: **Honeywell** Project: **Onondaga Lake Sump Stability** Project/ Proposal No.: **GJ4299** Task No.: 05/01

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GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: Honeywell **Project:** Onondaga Lake SCA Final Design **Project/Proposal #:** GJ4299 **Task #:** 05

TITLE OF COMPUTATIONS **SETTLEMENT ANALYSES FOR SCA BASIN**

COMPUTATIONS BY:

Signature [signature] for

Printed Name and Title: Fan Zhu, Senior Staff Engineer

DATE: 9/19/2011

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)

Signature R. Kulasingam [signature]

Printed Name and Title: R. Kulasingam, Senior Engineer

DATE: 9/19/2011

COMPUTATIONS CHECKED BY:

Signature [signature]

Printed Name and Title: Joseph Sura, Senior Staff Engineer

DATE: 9/19/2011

COMPUTATIONS BACKCHECKED BY: (Originator)

Signature [signature] for

Printed Name and Title: Fan Zhu, Senior Staff Engineer

DATE: 9/19/2011

APPROVED BY: (PM or Designate)

Signature [signature]

Printed Name and Title: Jay Beech, Principal

DATE: 19 Sept 2011

[Seal: State of New York, John ... Beech, Professional Engineer, 066337]

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by:	**Fan Zhu**	Date:	**12/10/2010**	Reviewed by:	**R. Kulasingam/Jay Beech**	Date:	**12/13/2010**
Client:	**Honeywell**	Project:	**Onondaga Lake SCA Final Design**	Project/ Proposal No.:	**GJ4299**	Task No.:	**05**

SETTLEMENT ANALYSES FOR SCA BASIN

INTRODUCTION

This package was prepared in support of the design of the Sediment Consolidation Area (SCA) for the Onondaga Lake Bottom Site, which will be constructed on Wastebed 13. This package presents settlement calculation results for the proposed stormwater basins of the SCA. Two basins will be constructed on the western and eastern sides of the SCA. Water from the SCA will gravity flow through conveyance pipes (i.e., culverts) into the basin sumps, where it will be pumped out for treatment. The locations of the proposed basins, conveyance pipes, and sumps are shown in Figure 1. A plan view of the sump areas is provided in Figure 2. As shown in the figure, the sumps will be filled with 6 ft of gravel material.

Specifically, the purpose of this package is:

(i) to calculate foundation settlement of the existing Solvay waste (SOLW) in the basin area and the drainage slope of the conveyance;

(ii) to estimate the post-settlement grades in the east and west basins to confirm that positive drainage towards the sumps will be maintained during operations; and

(iii) to estimate the post-settlement tensile strains for the liner system in the basins. The performance of the liner system is then evaluated to verify that maximum tensile strains in the liner geosynthetic components do not exceed the maximum allowable tensile strains.

Prior to the construction of the conveyance pipes and sumps, 5 ft of preload soil will be applied to the sump area and the outlet of the conveyance pipes that penetrate the berm. The preload is expected to compress the foundation soil and lower the existing ground surface, which allows a steeper initial installation slope for the conveyance pipes. The proposed preload is 5-ft high with a 2.5H:1V side slope. The preliminary dimension of the preload is shown in Figure 3.

The methodology used for settlement analyses was presented in the calculation package titled "*Settlement Analyses for SCA*" (referred to as the SCA Settlement Package) as part of the SCA Final Design and is not repeated here. The Cross-section Settlement Model (CSM) was used for analyses presented in this package. Six cross sections were selected for analyses, as shown in Figure 1.

Information regarding the subsurface stratigraphy and material properties was presented in a calculation package titled "*Subsurface Stratigraphy Model of Wastebed 13 for the Design of Sediment Consolidation Area*" (referred to as the Data Package) and the SCA Settlement Package as part of the SCA Final Design. For the analyses presented herein, the unit weight of the SCA/basin berm and preload material was assumed to be 120 pcf.

ANALYZED CASES

Three cases were analyzed for each of the six selected cross sections. These three cases were based on the following construction and loading sequence expected for the basins and adjacent areas:

- SCA berms near the basins will be constructed first as part of the overall SCA berm construction.
- A 5 ft preload using soil will be applied to the sump area and the outlet of the future locations of the conveyance pipes that penetrate the berm.
- Preload will be removed after about 3 months when primary consolidation is expected to be over based on the previous test fill performance.
- The SCA berm near the basin sump area will be removed to facilitate the installation of the conveyance pipes.
- The ground elevations will be resurveyed and the design grades of the basin sumps and tie-in to basin base area away from the pre-load boundary will be updated.
- Conveyance pipes will be installed and SCA perimeter berm rebuilt in the areas where it was removed previously. 7 ft deep basin sumps will be excavated.
- Liner system will be constructed for the basins and SCA. Basin sumps will be filled with gravel.
- Geo-tubes will be placed in SCA. Liquid will gravity drain to basin sumps.
- During a storm event, basins may fill up with storm water to the design high-water level.

CASE 1: Settlement during Basin Construction Period (after preloading)

This case calculates settlement due to preloading and construction of the SCA berm and basins. In this case, both the preloading and berm were considered as the load. Only primary settlement was calculated. The secondary settlement was not considered for this case.

CASE 2: Settlement at End of Operational Period

This case calculates settlement at the end of the operational period, which is considered the worst case during operations. The load in this case includes the liner system and geo-tubes in the SCA, the 6-ft gravel material in the basin sump, and 0.5 ft of water on top of gravel in the sump.

The liner system and geo-tubes in the SCA were modeled as an instantaneous load. This assumption was expected to be conservative because it results in relatively larger calculated settlement at the inlet of the conveyance pipes. By applying the entire liner system and geo-tube loading as an instantaneous load, the time required for placement is not taken into consideration and the amount of time available for secondary compression is increased. Therefore, this assumption results in a higher calculated total settlement, which is conservative from the perspective of maintaining positive drainage between the SCA and the basins. The initial inlet location (i.e., starting point for this calculation) for the conveyance pipes that penetrate the berm was assumed to be the lowest point on top of the SCA liner system, and the outlet location was assumed to be the toe of berm in the basin (above the sump). The location of conveyance pipes is illustrated in the analysis results presented below.

For these calculations, the OCR values of the foundation soil in the preloading area and under the berm were adjusted to count for the overconsolidation effect caused by preloading and removal of the berm for conveyance pipe installation. The rebound of foundation soil due to removing the preload was expected to be relatively small (i.e., calculated to be on the order of 0.1 ft) compared to the calculated settlement, and was therefore neglected.

It was assumed that the liner system and geo-tubes in the SCA will be built to the originally designed grade, although the foundation soil near the SCA berm has settled as a result of the preloading.

Settlement was calculated for a 5-year period, which was considered to be the period of time between basin construction and completion of SCA operations. Both primary settlement and secondary settlement of the foundation SOLW were calculated. The time for completion of primary settlement of the foundation SOLW was assumed to be 0.5 years. Therefore, the time ratio for secondary settlement calculation was considered to be 5/0.5=10.

The calculated post-settlement grade from this case was used to estimate the slope of the conveyance pipes, to calculate the tensile strain of the basin liner, and to confirm that positive drainage towards the basin sump can be maintained during operations.

CASE 3: Settlement at End of Operational Period with Full Water in Basins

This case is similar to Case 2 except that the basin was assumed to be full of water for the entire 4-year operational period. The calculated post-settlement grade from this case was used to estimate the slope of the conveyance pipes, to calculate the tensile strain of the basin liner, and to confirm that positive drainage towards the sump can be maintained during operations.

RESULTS

West Basin

The pre- vs. post- settlement profiles for the three analyzed cases along Cross Sections 1 through 3 are shown in Figures 4 through 12.

At Cross Section 1, according to Figure 4, as a result of the berm construction and preloading, the existing ground in the sump area and under the berm is expected to settle up to 3 ft. Figures 5 and 6 show the initial location of the conveyance pipe and its location at the end of operational period, for Case 2 and Case 3, respectively. The initial slope of the conveyance pipe is estimated to be 4.6%. The estimated slope of the conveyance pipe at the end of operations is 2.3% and 2.6%, for Case 2 and Case 3, respectively. Figures 5 and 6 also show that positive drainage towards the sump will be maintained during operations. The maximum tensile strain of the liner system in the basin is 0.3% and 0.8% for Case 2 and Case 3, respectively. The location of the maximum tensile strain is near the toe of the basin berm for both cases. The spreadsheet output for the settlement analysis for 10 representative calculation points (i.e., 11 through 20, Case 1) is presented in Attachment 1.

At Cross Section 2, according to Figure 7, as a result of berm construction and preloading, the existing ground in sump area and under the berm is expected to settle up to 2 ft. Figures 8 and 9 show that positive drainage towards the sump will be maintained during operations. The maximum tensile strain of the liner system in the basin is 0.2% and 0.5% for Case 2 and Case 3, respectively. The location of the maximum tensile strain is in the sump for Case 2, and near the toe of the basin berm for Case 3.

At Cross Section 3, according to Figure 10, as a result of berm construction and preloading, the existing ground in the sump area and under the berm is expected to settle up to 3 ft. Figures 11 and 12 show that positive drainage towards the sump will be maintained during operations. The maximum tensile strain of the liner system in the basin is 0.3% and 0.9% for Case 2 and Case 3, respectively. The location of the maximum tensile strain is on the slope of the SCA berm for Case 2, and near the toe of the basin berm for Case 3.

East Basin

The pre- vs. post- settlement profiles for the three analyzed cases along Cross Sections 4 through 6 are shown in Figures 13 through 21.

At Cross Section 4, according to Figure 13, as a result of berm construction and preloading, the existing ground in the sump area and under the berm is expected to settle up to 2 ft. Figures 14 and 15 show the initial location of the conveyance pipe and its post-settlement location at the end of the operational period, for Case 2 and Case 3, respectively. The initial slope of the conveyance pipe is estimated to be 4.4%. The estimated slope of the conveyance pipe at the end of the operational period is 2.5% for both Case 2 and Case 3. Figures 14 and 15 also show that positive drainage towards the sump will be maintained in the western part of the basin during operations. However, water in the eastern side of the basin is expected to drain toward the basin berm. This water will need to be handled by a contingency sump and/or mobile pumps to be located at the southeastern corner of the East Basin. The maximum tensile strain of the liner system in the basin is 0.1% and 0.6% for Case 2 and Case 3, respectively. The location of the maximum tensile strain is near the toe of the basin berm for both cases. The spreadsheet output for the settlement analysis for 10 representative calculation points (i.e., 11 through 20, Case 1) is presented in Attachment 2.

At Cross Section 5, according to Figure 16, as a result of berm construction and preloading, the existing ground in the sump area and under the berm is expected to settle up to 1.5 ft. Figures 17 and 18 show the initial location of the drainage pipe and its post-settlement location at the end of the operational period, for Case 2 and Case 3, respectively. The initial slope of the pipe is estimated to be 1.5%. The estimated slope of the drainage pipe at end of operational period is 1.5% and 1.3%, for Case 2 and Case 3, respectively. It is noted that the actual location of the conveyance pipe is not on the selected Cross Section 5. However, Cross Section 5 was considered to be a proper approximation of the conveyance pipe for the purpose of settlement estimation. Figures 17 and 18 also show that positive drainage towards the sump will be maintained during operations. The maximum tensile strain of the liner system in the basin is 0.3% and 0.9% for Case 2 and Case 3, respectively. The location of the maximum tensile strain is near the toe of the basin berm for both cases.

At Cross Section 6, according to Figure 19, as a result of berm construction and preloading, the existing ground in the sump area and under the berm is expected to settle up to 2 ft. Figure 20 shows that positive drainage towards the sump will be maintained at the end of the operational period for Case 2. However, Figure 21 shows water in the eastern side of the basin is expected to drain toward the basin berm. This water will need to be handled by a contingency sump and/or mobile pumps to be located at the southeastern corner of the East Basin. The maximum tensile strain of the liner system in the basin is 0.2% and 0.3% for Case 2 and Case 3, respectively. The location of the maximum tensile strain is in the sump for Case 2, and near the toe of the basin berm for Case 3.

CONCLUSIONS AND RECOMMENDATIONS

The analyses provided herein indicate that:

(i) By applying the 5-ft preload soil, it was anticipated that a minimum 1.0% slope could be maintained during the operational period for the conveyance pipes. It is recommended that the conveyance pipes be installed at a minimum slope of 3.8% and 3.4% for the West Basin and East Basin, respectively. Based on the calculations, these slopes are expected to result in post-settlement slopes of 1.5%. For the conveyance pipe in the East Basin that connects to the sump, the minimum installation slope is recommended to be 1.25%. Based on the calculations, this slope is expected to result in a post-settlement slope of 1.0%.

(ii) Positive drainage towards the sump will be maintained during the operational period for the West Basin. For the East Basin, a portion of the water is expected to drain toward the southeastern corner of the basin. This water will need to be handled by a contingency sump and/or mobile pumps.

(iii) The maximum tensile strain of the liner system is estimated to be less than 1.0% during the operational period for both the west and east basins. This is less than the allowable tensile strain of 5% for liner geomembrane, as discussed in the SCA Settlement Package.

Written by:	Fan Zhu	Date:	12/10/2010	Reviewed by:	R. Kulasingam/Jay Beech	Date:	12/13/2010
Client:	Honeywell	Project:	Onondaga Lake SCA Final Design	Project/ Proposal No.:	GJ4299	Task No.:	05

Figures

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

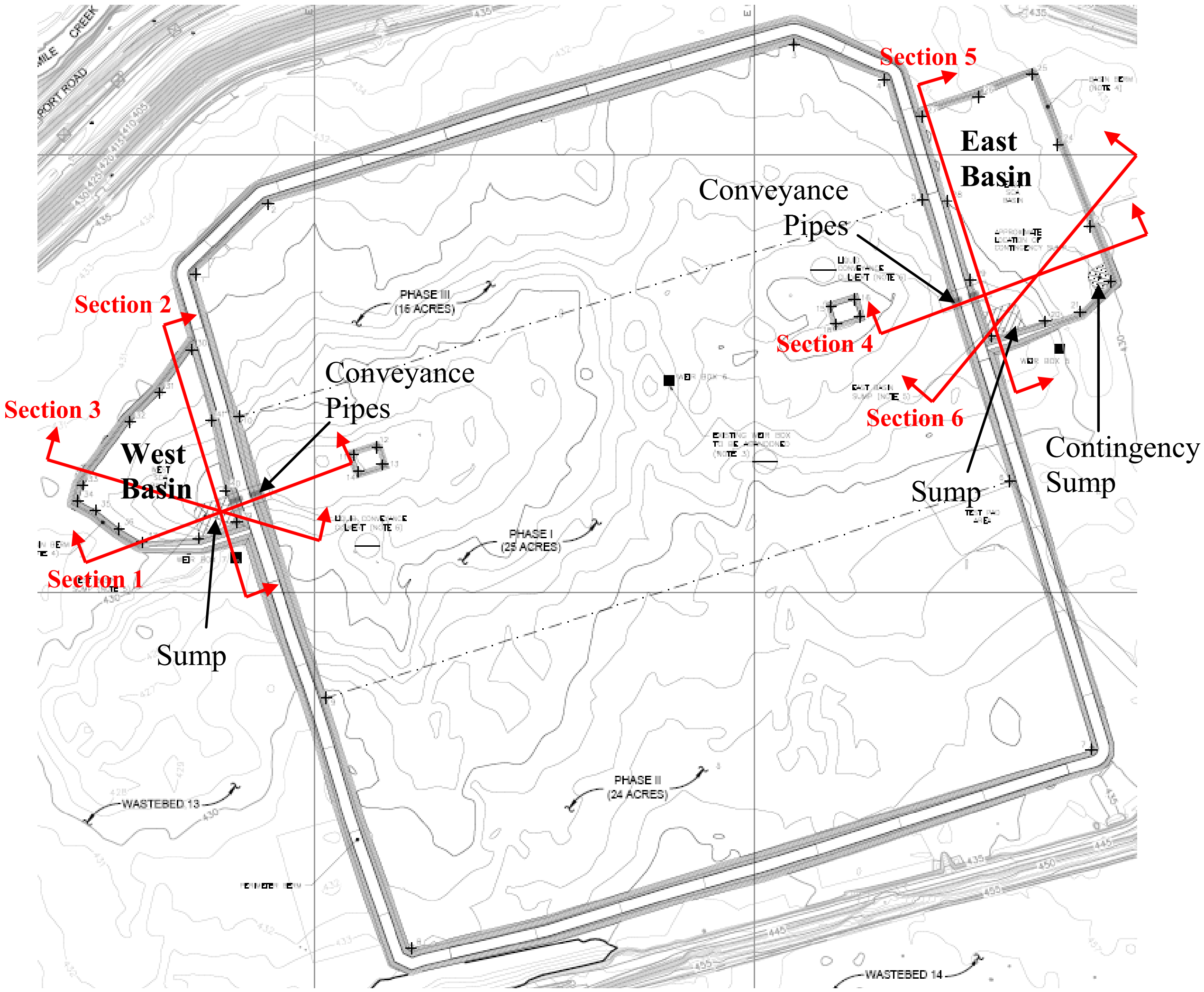

Figure 1. Location of Proposed Stormwater Basins and Selected Cross Sections

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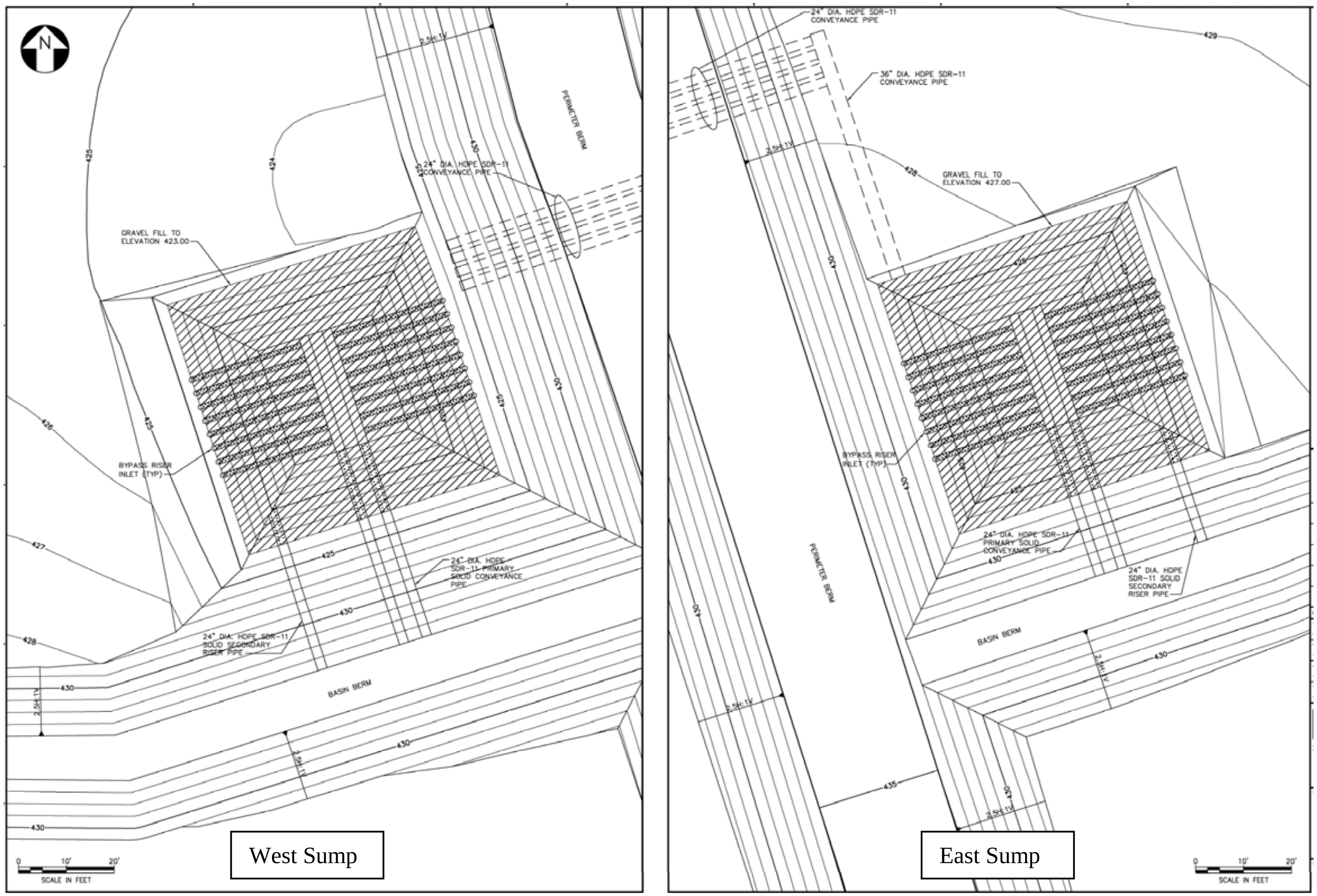

Figure 2. Plan View of Sump Areas

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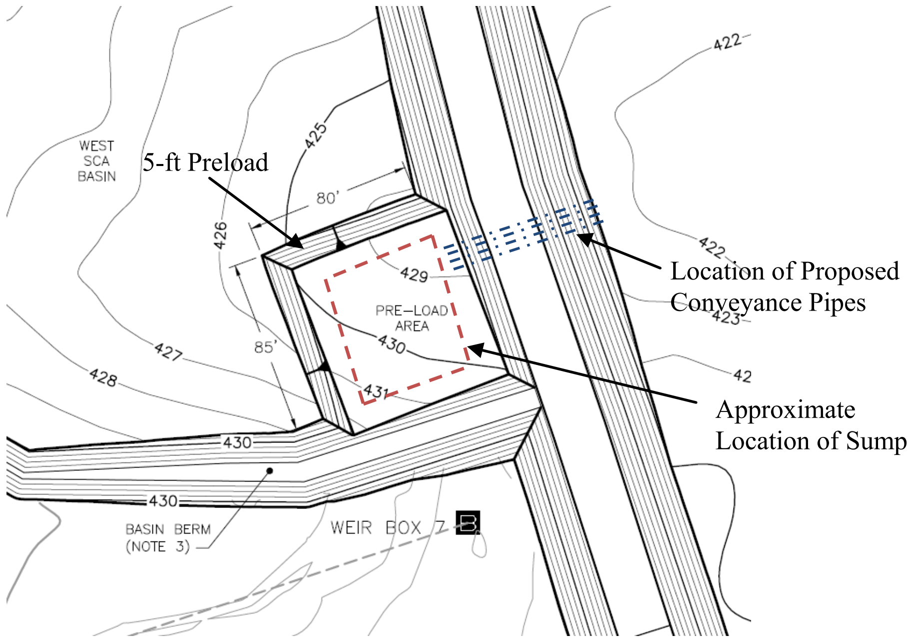
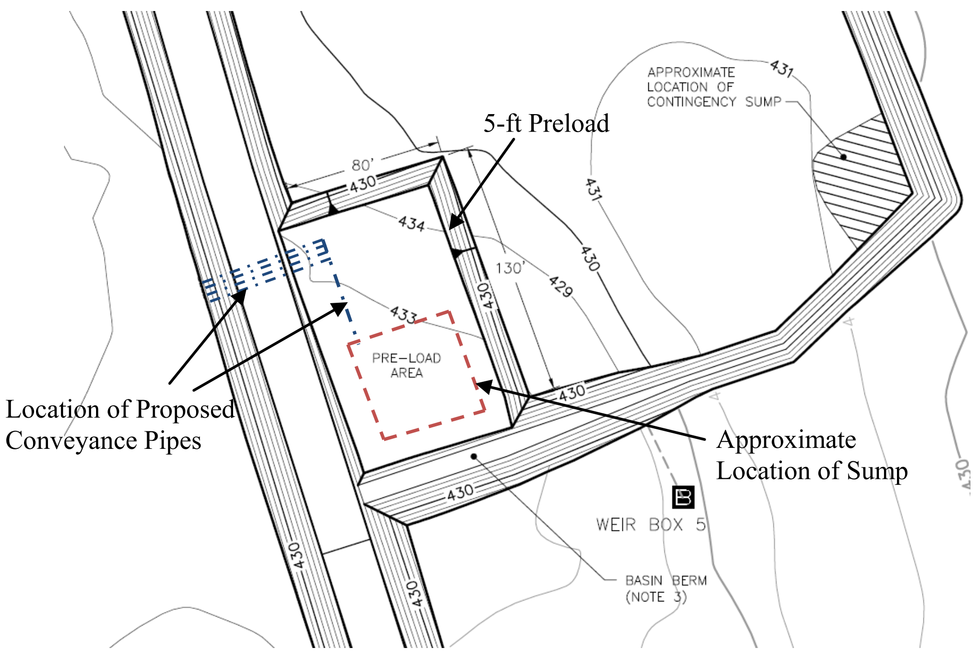


(a) West Basin



(b) East Basin

Figure 3. Configuration of Proposed Preload

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

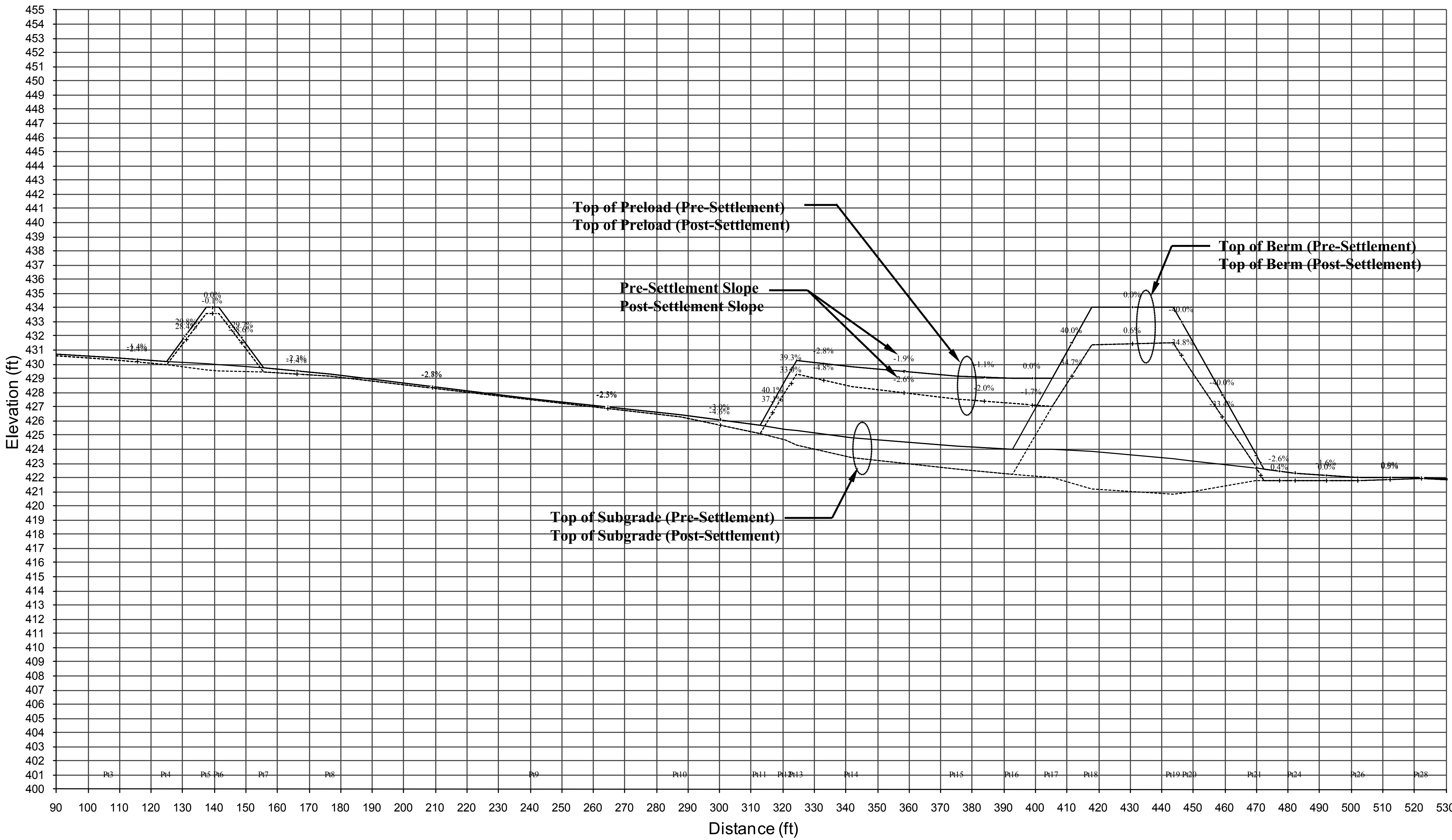


Figure 4. Pre- vs. Post- Settlement Profile of Section 1 – Case 1

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

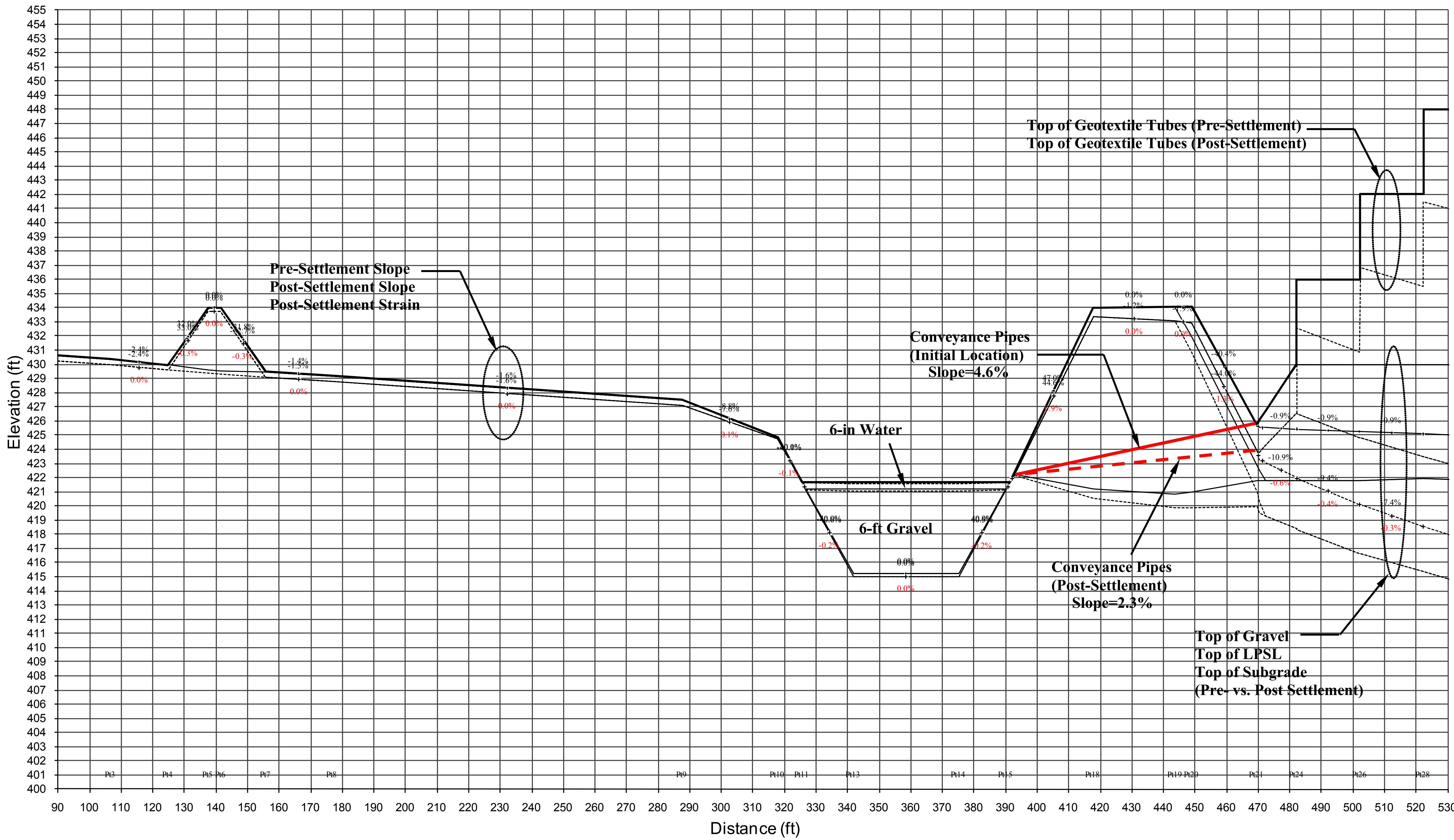


Figure 5. Pre- vs. Post- Settlement Profile of Section 1 – Case 2

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

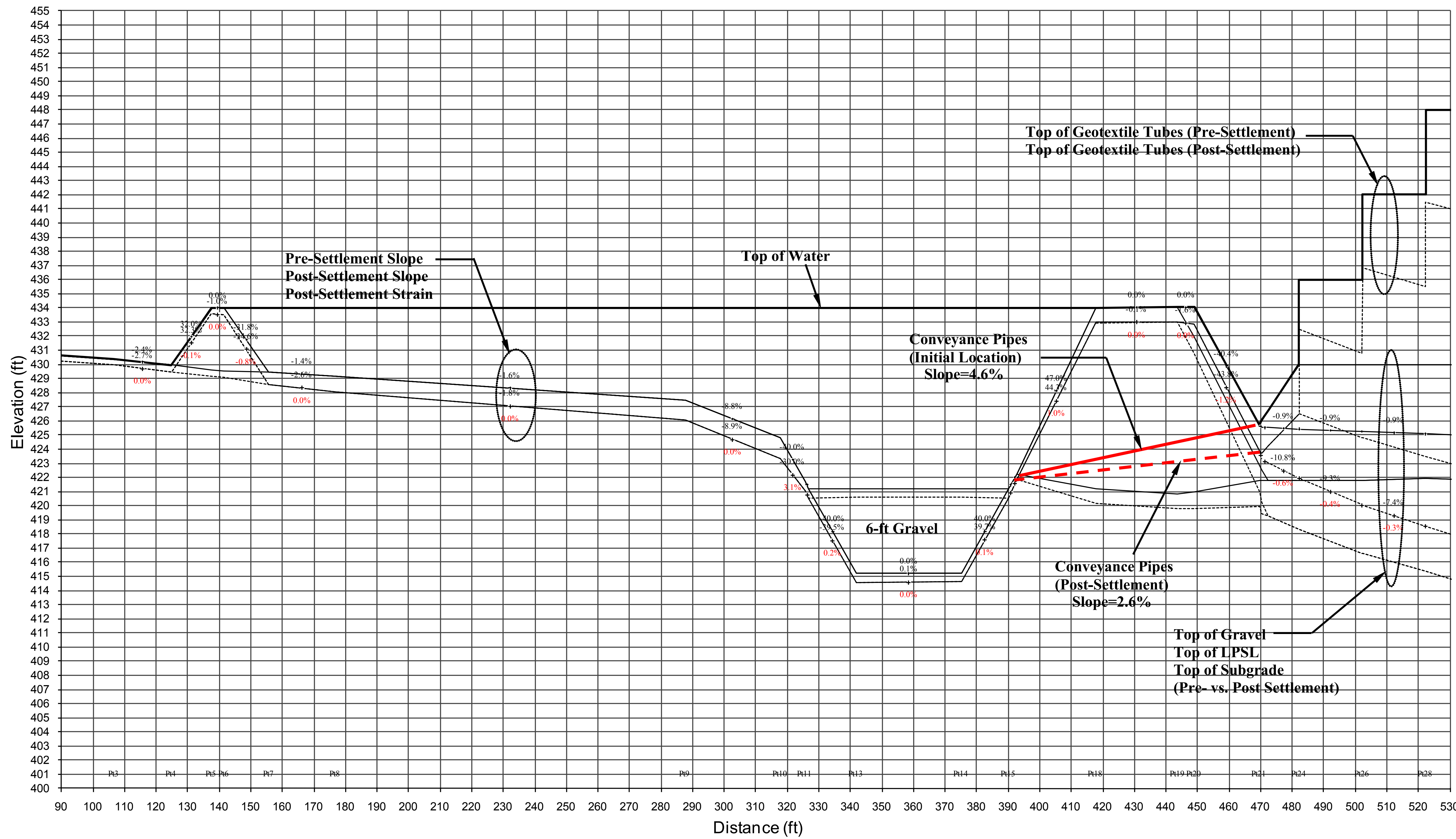


Figure 6. Pre- vs. Post- Settlement Profile of Section 1 – Case 3

Written by: Fan Zhu Date: 12/10/2010 Reviewed by: R. Kulasingam/Jay Beech Date: 12/13/2010

Client: Honeywell Project: Onondaga Lake SCA Final Design Project/ Proposal No.: GJ4299 Task No.: 05

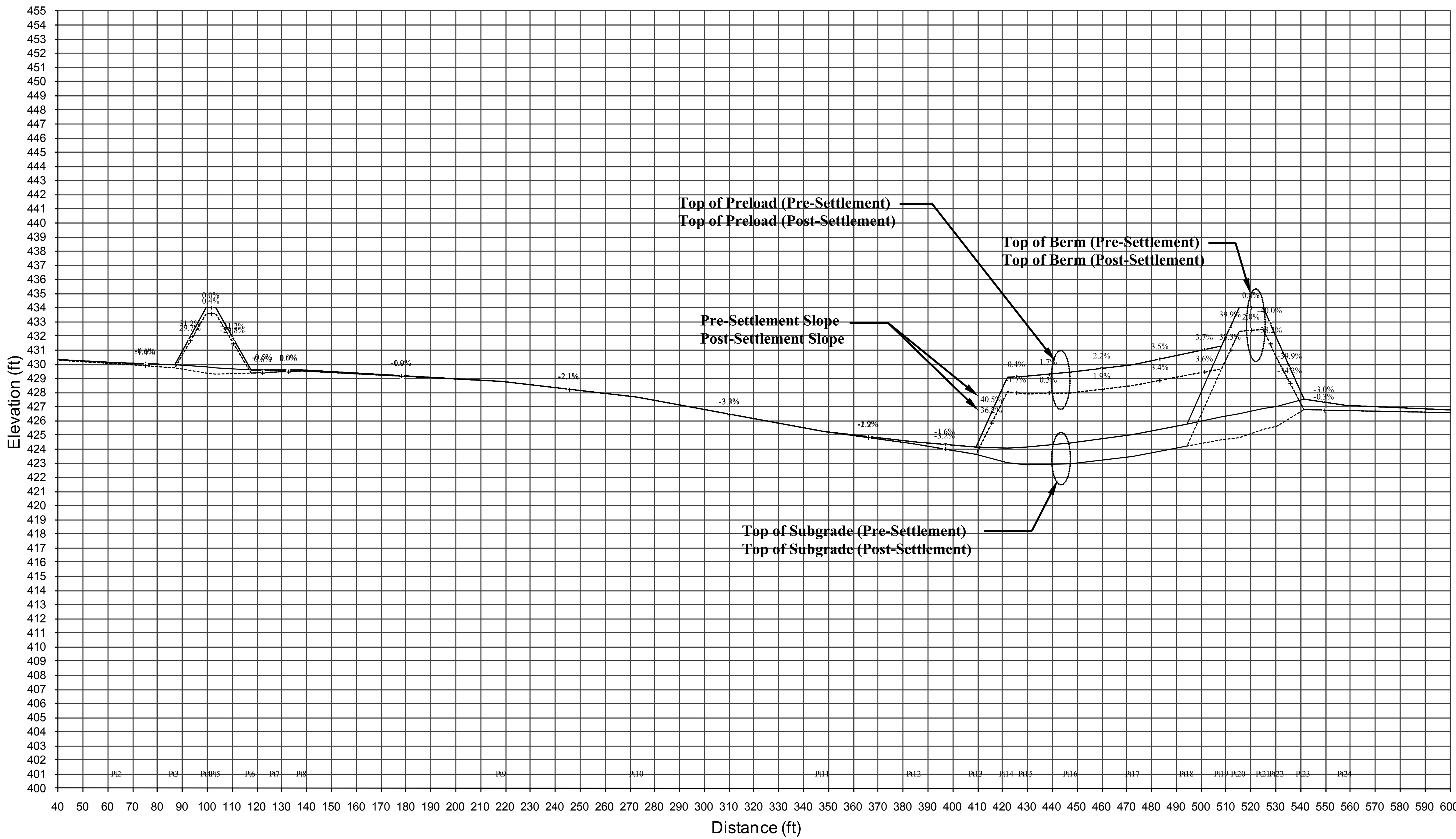


Figure 7. Pre- vs. Post- Settlement Profile of Section 2 – Case 1

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

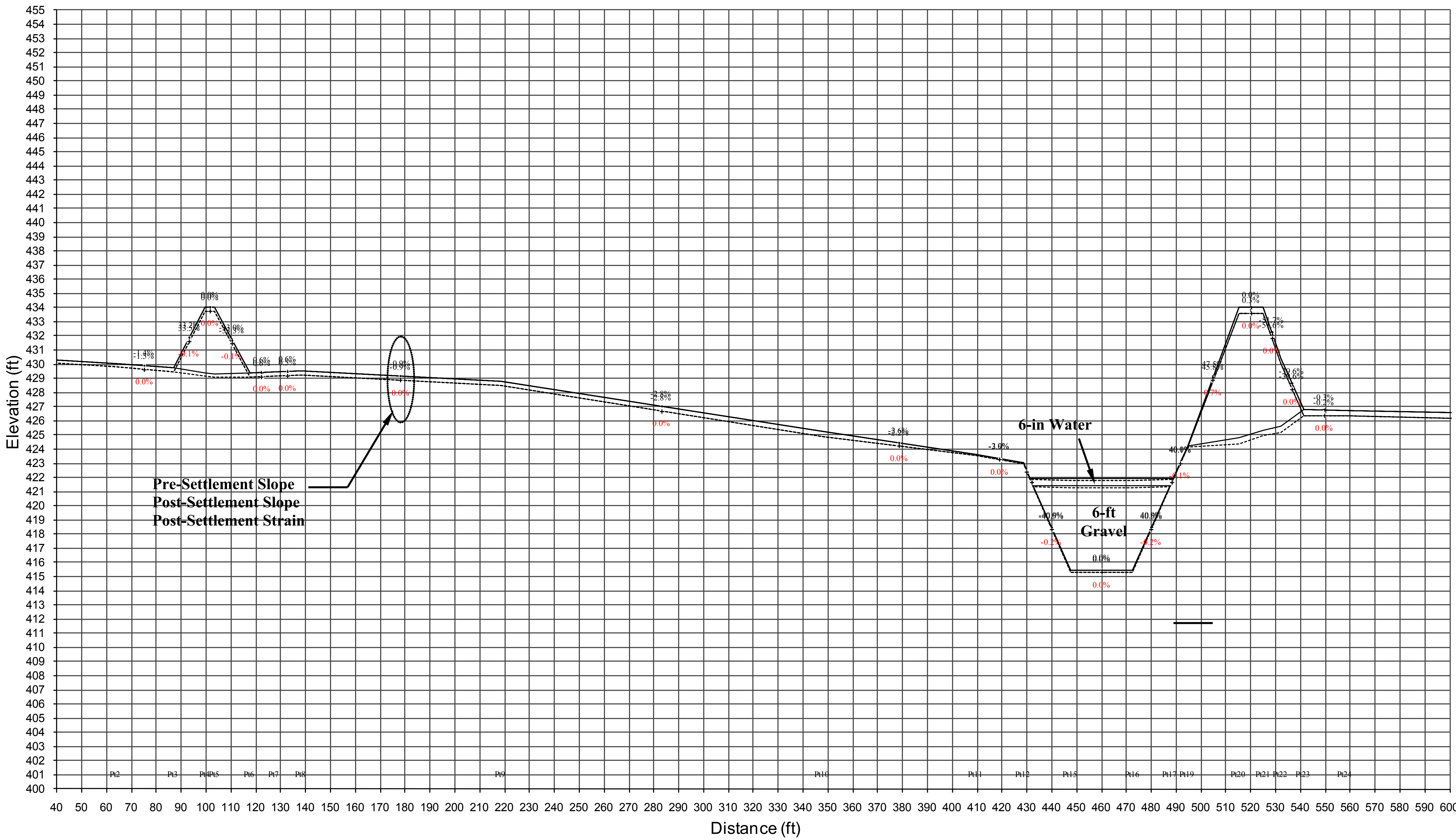


Figure 8. Pre- vs. Post- Settlement Profile of Section 2 – Case 2

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

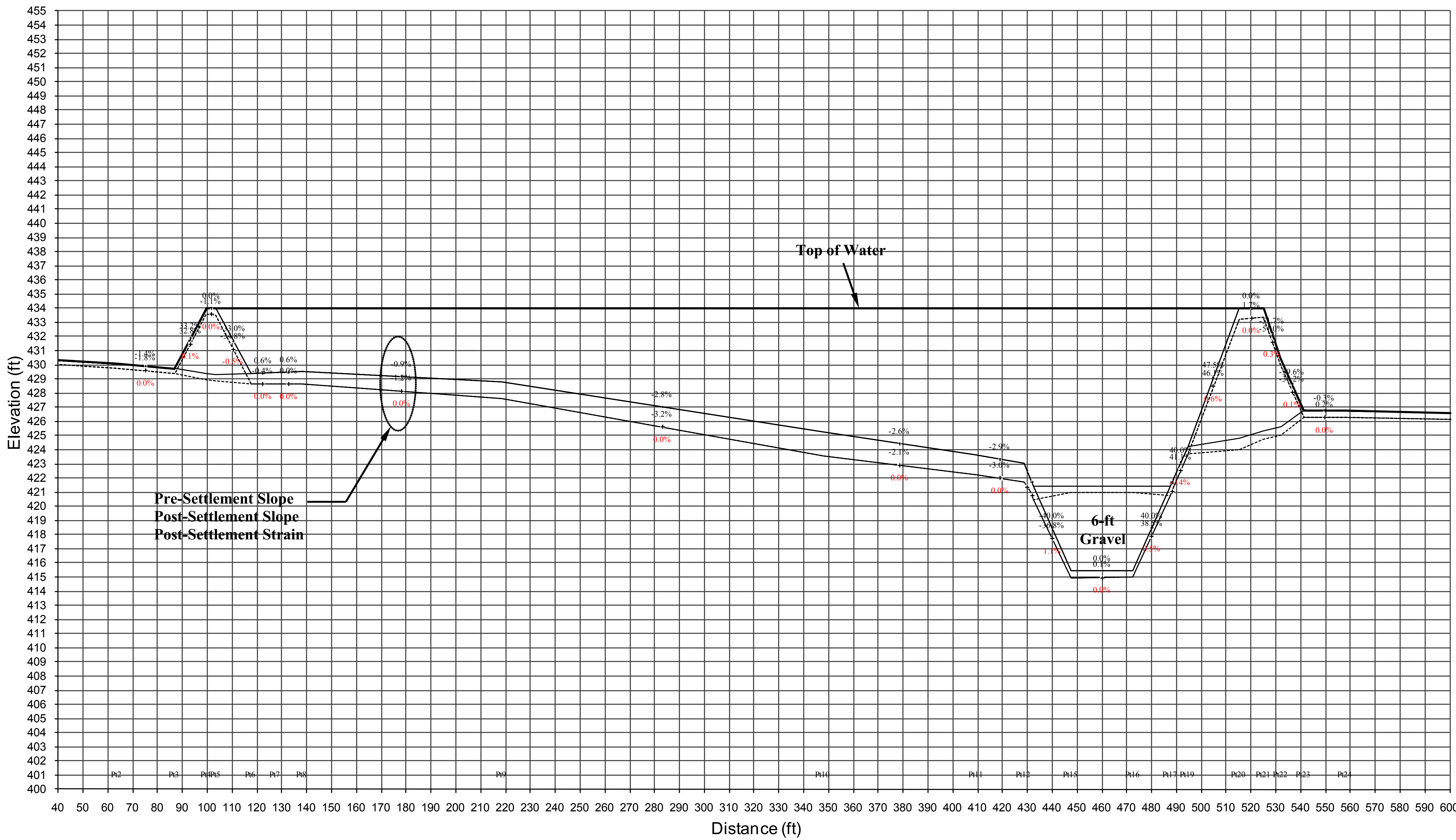


Figure 9. Pre- vs. Post- Settlement Profile of Section 2 – Case 3

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

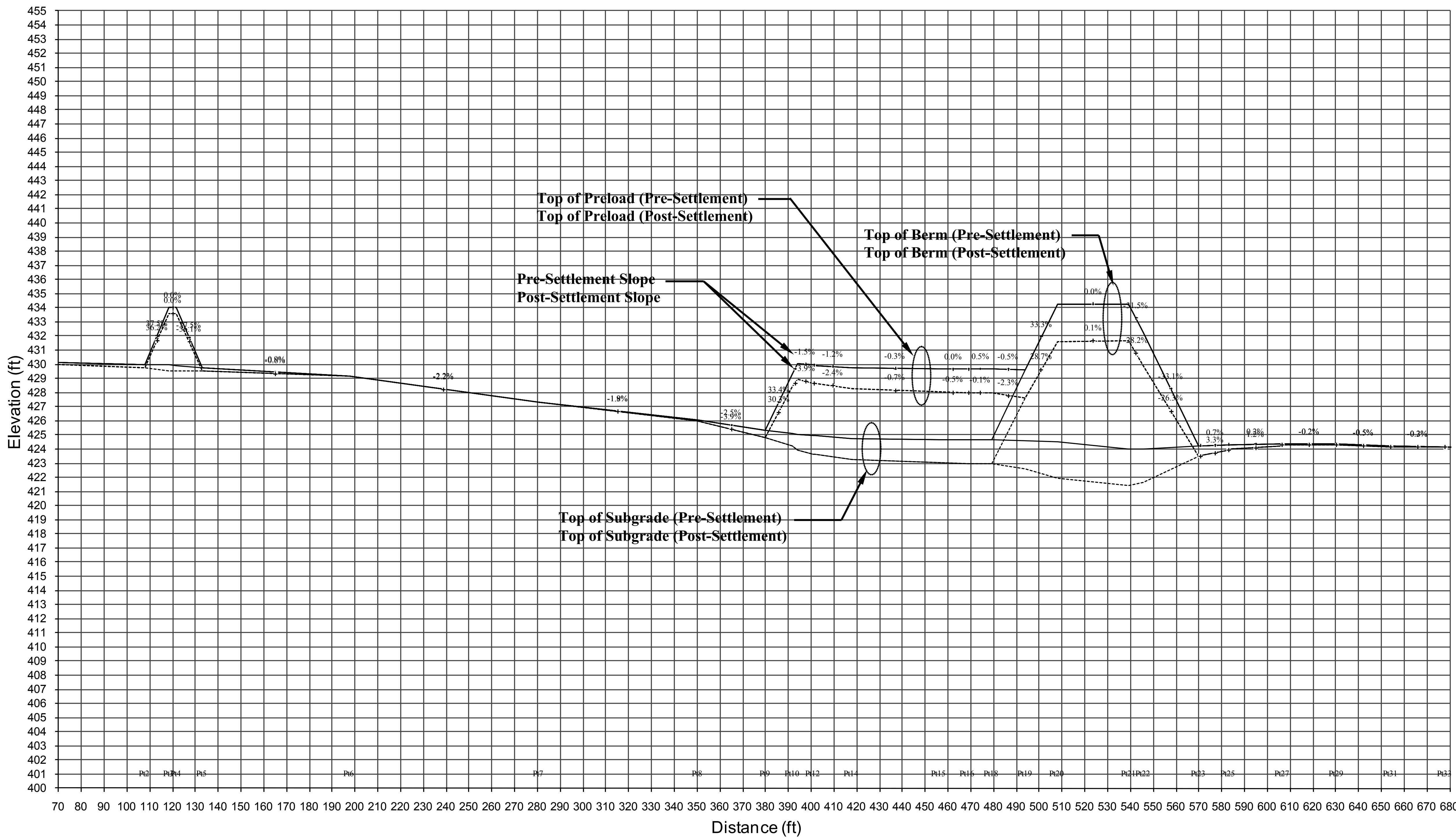


Figure 10. Pre- vs. Post- Settlement Profile of Section 3 – Case 1

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

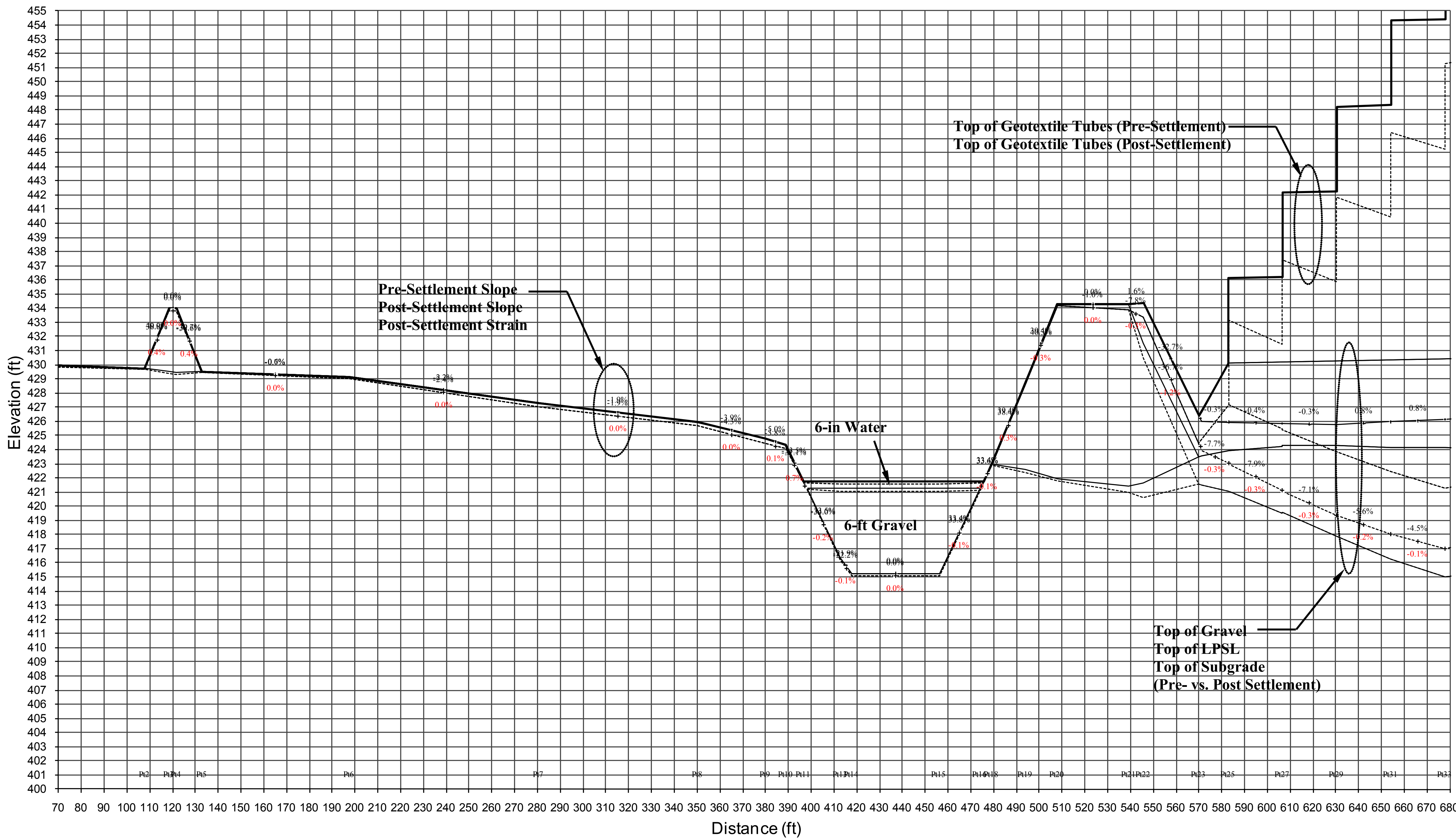


Figure 11. Pre- vs. Post- Settlement Profile of Section 3 – Case 2

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

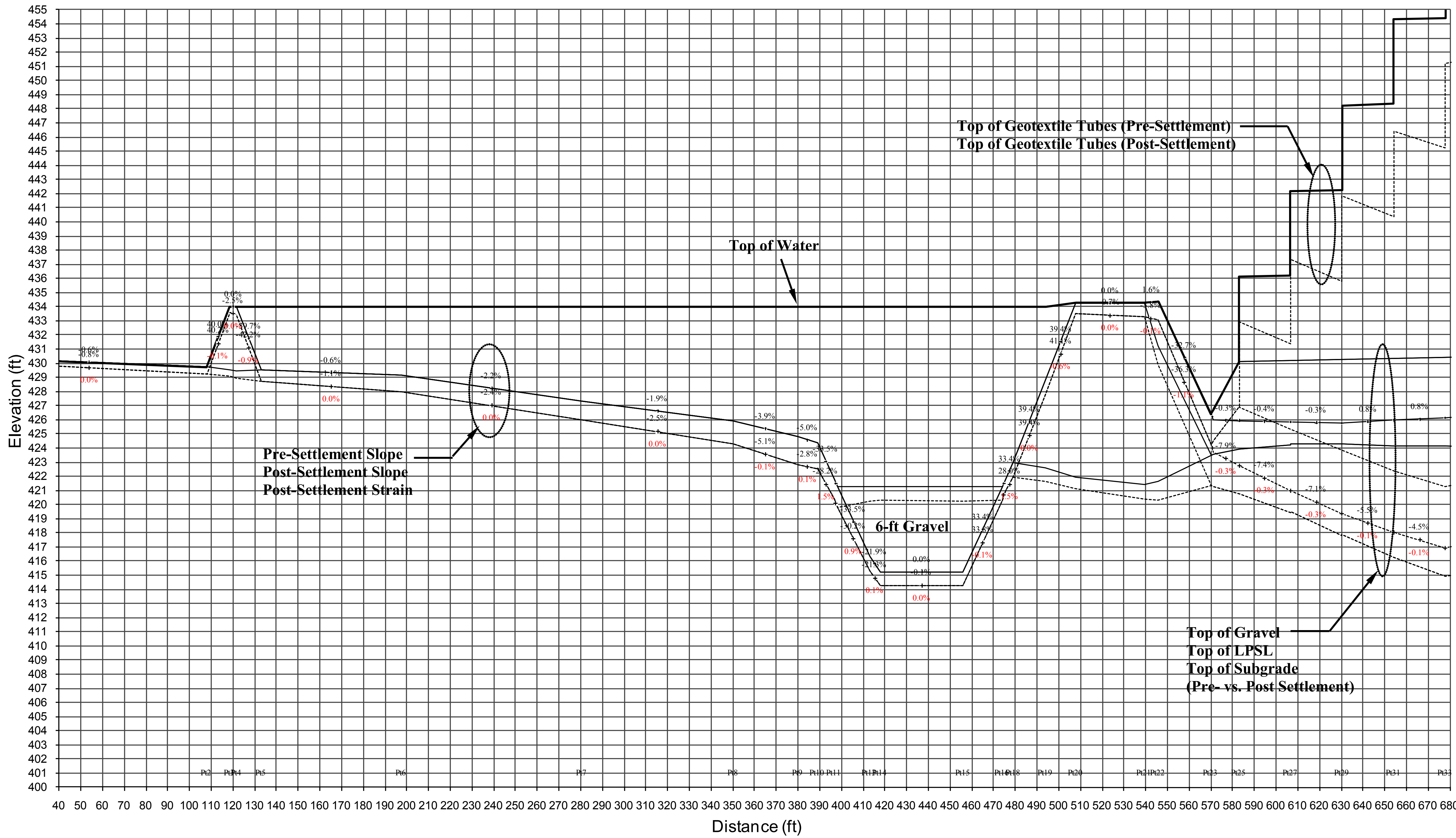


Figure 12. Pre- vs. Post- Settlement Profile of Section 3 – Case 3

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

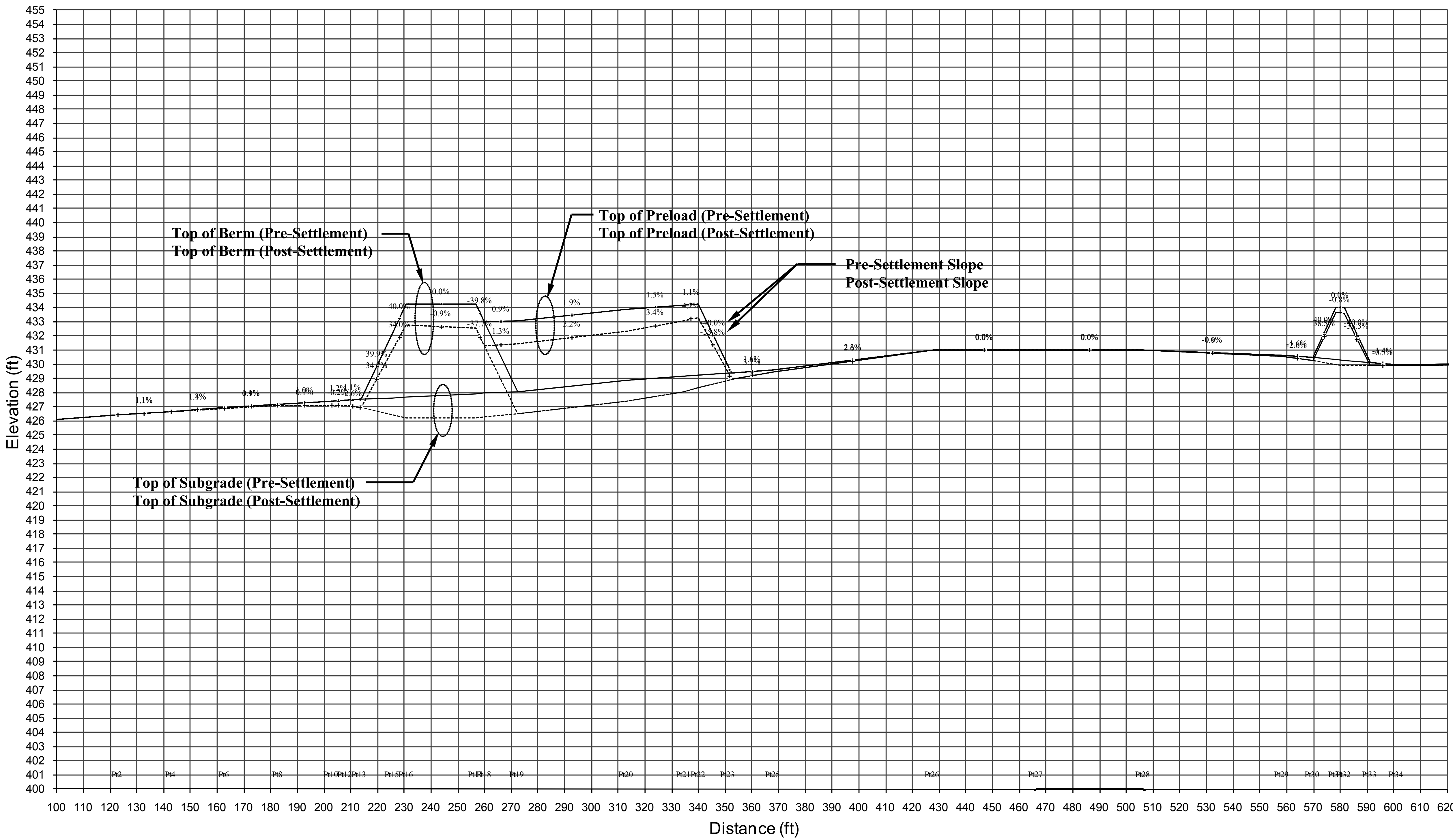


Figure 13. Pre- vs. Post- Settlement Profile of Section 4 – Case 1

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

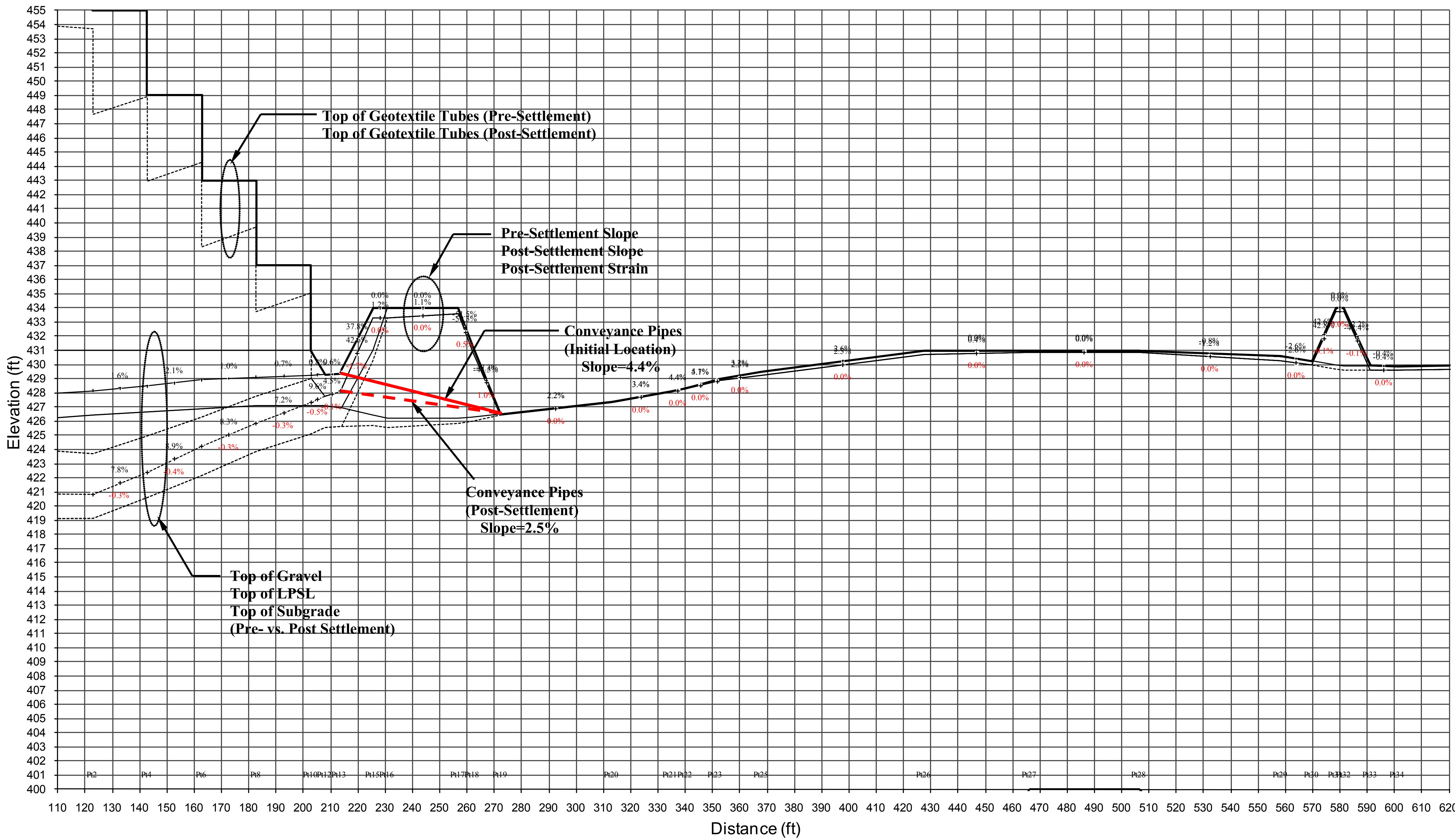


Figure 14. Pre- vs. Post- Settlement Profile of Section 4 – Case 2

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

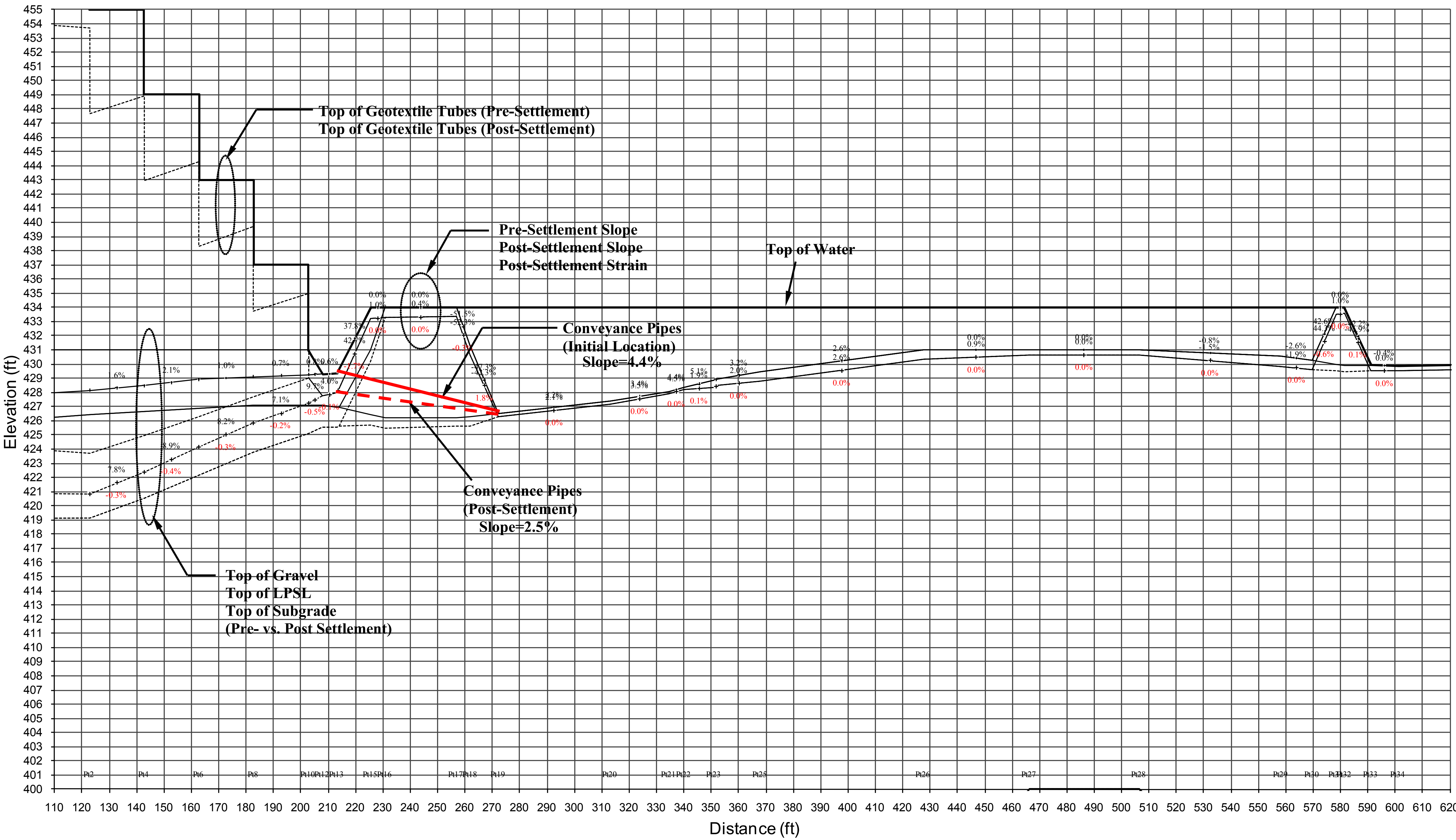


Figure 15. Pre- vs. Post- Settlement Profile of Section 4 – Case 3

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

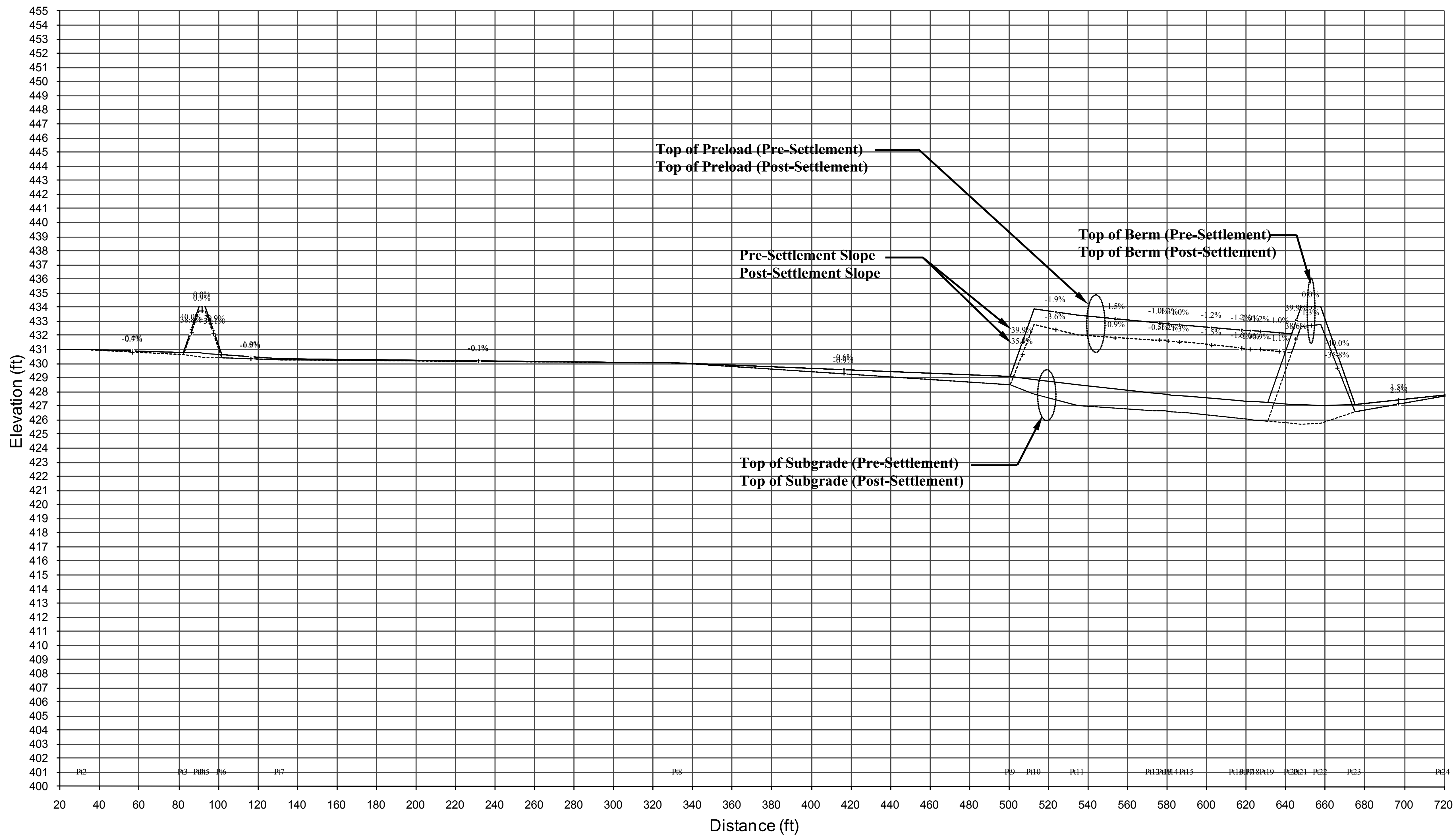


Figure 16. Pre- vs. Post- Settlement Profile of Section 5 – Case 1

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

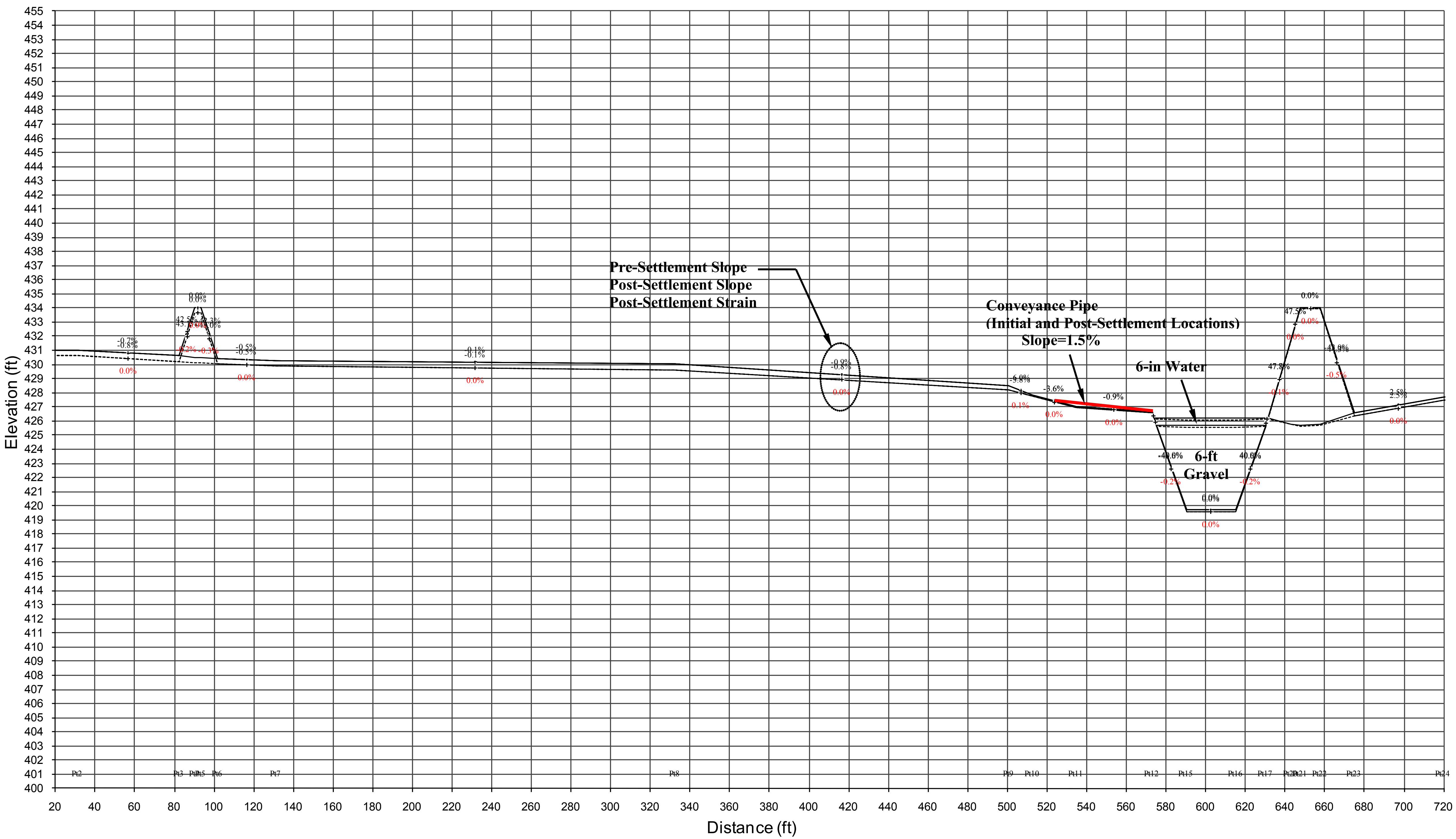


Figure 17. Pre- vs. Post- Settlement Profile of Section 5 – Case 2

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

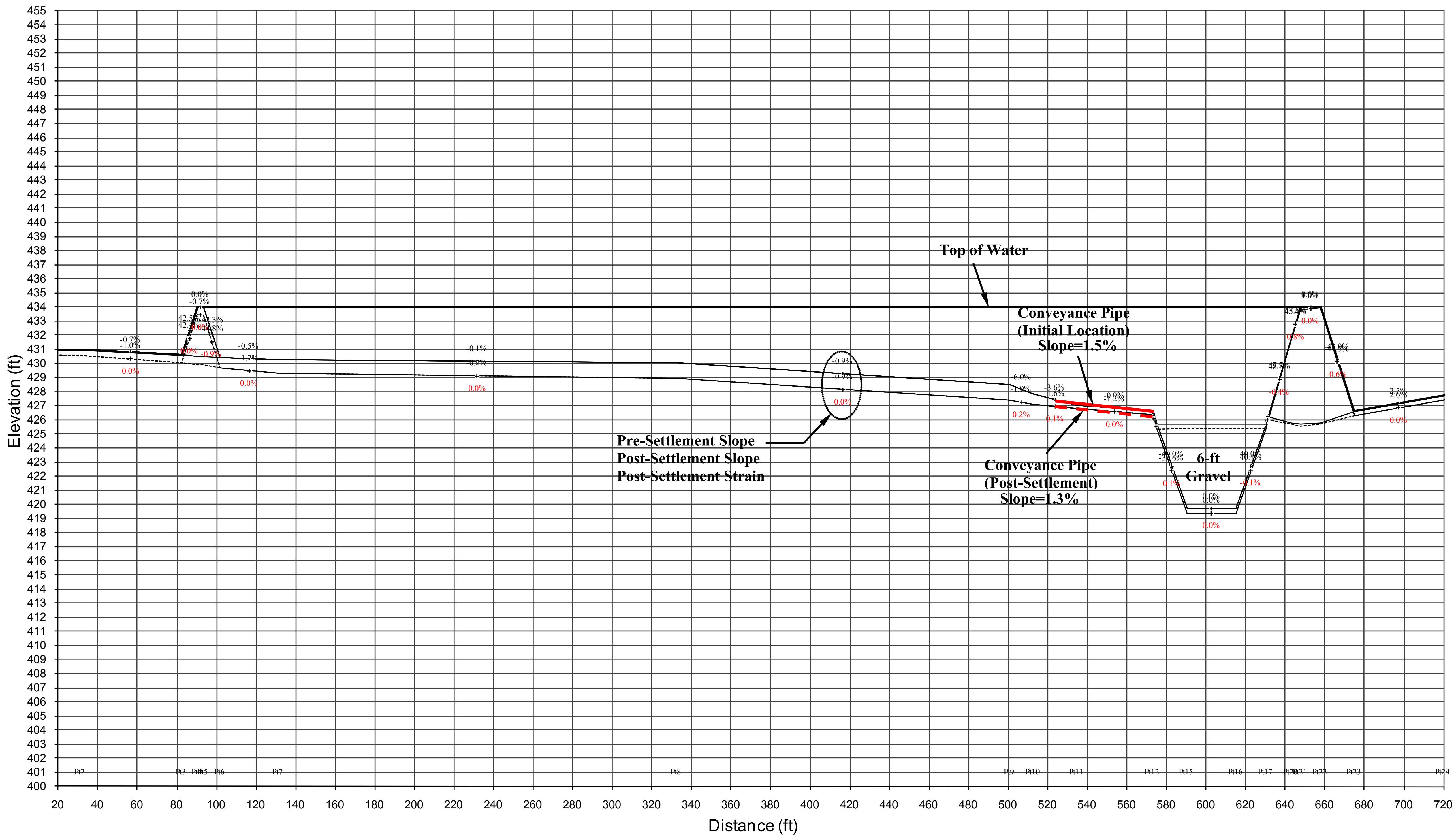


Figure 18. Pre- vs. Post- Settlement Profile of Section 5 – Case 3

Written by: Fan Zhu Date: 12/10/2010 Reviewed by: R. Kulasingam/Jay Beech Date: 12/13/2010

Client: Honeywell Project: Onondaga Lake SCA Final Design Project/ Proposal No.: GJ4299 Task No.: 05

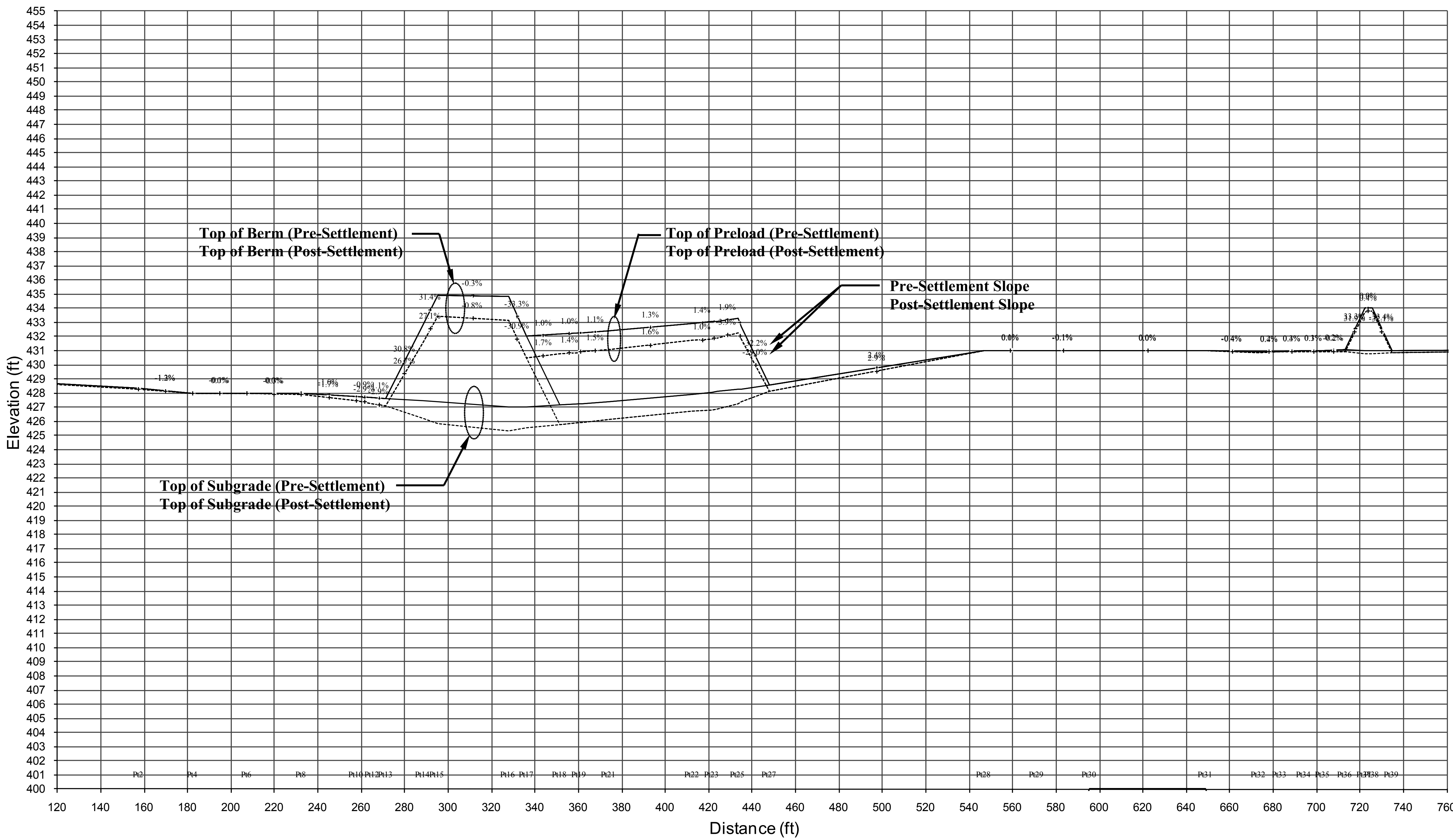


Figure 19. Pre- vs. Post- Settlement Profile of Section 6 – Case 1

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

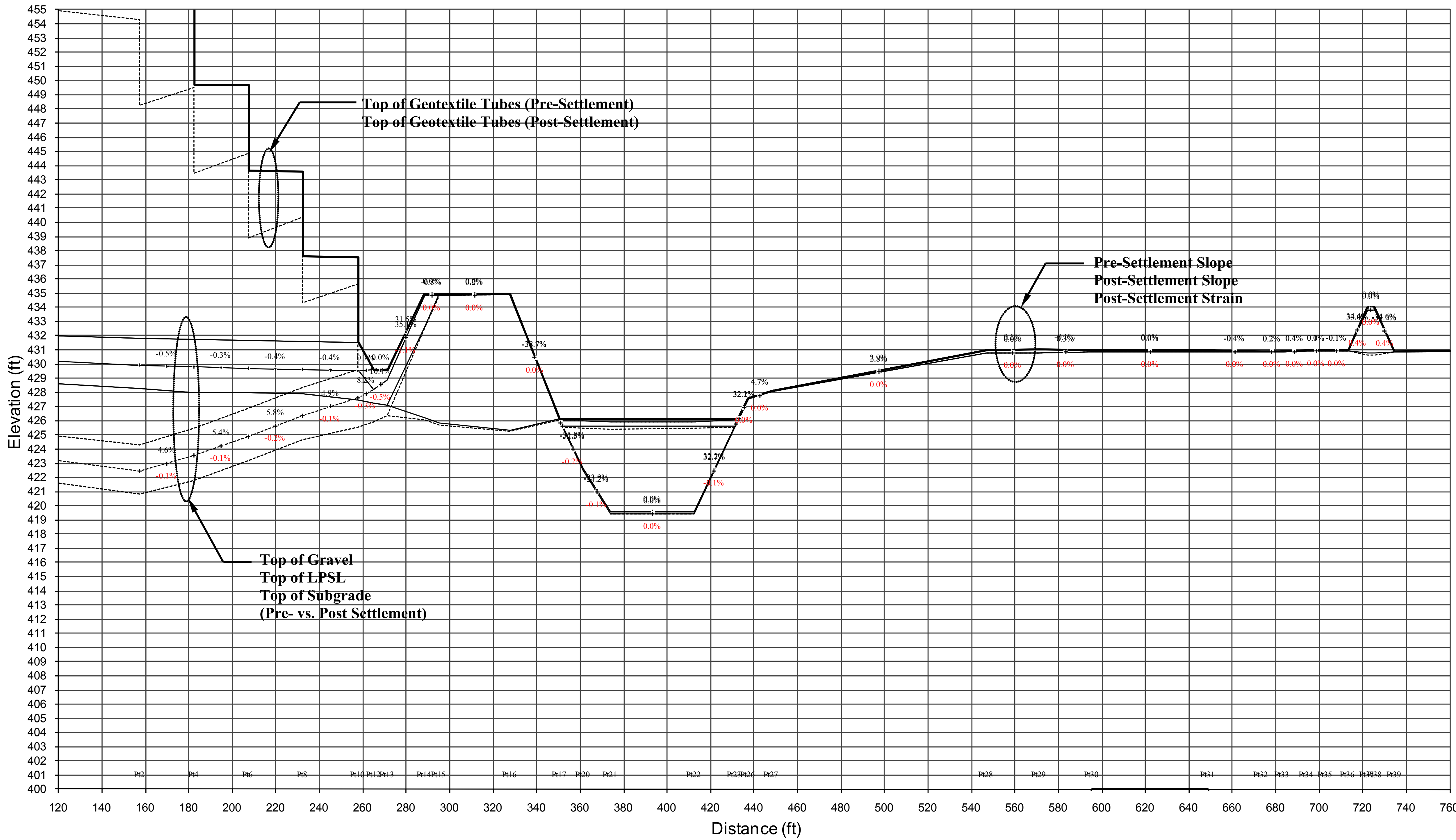


Figure 20. Pre- vs. Post- Settlement Profile of Section 6 – Case 2

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

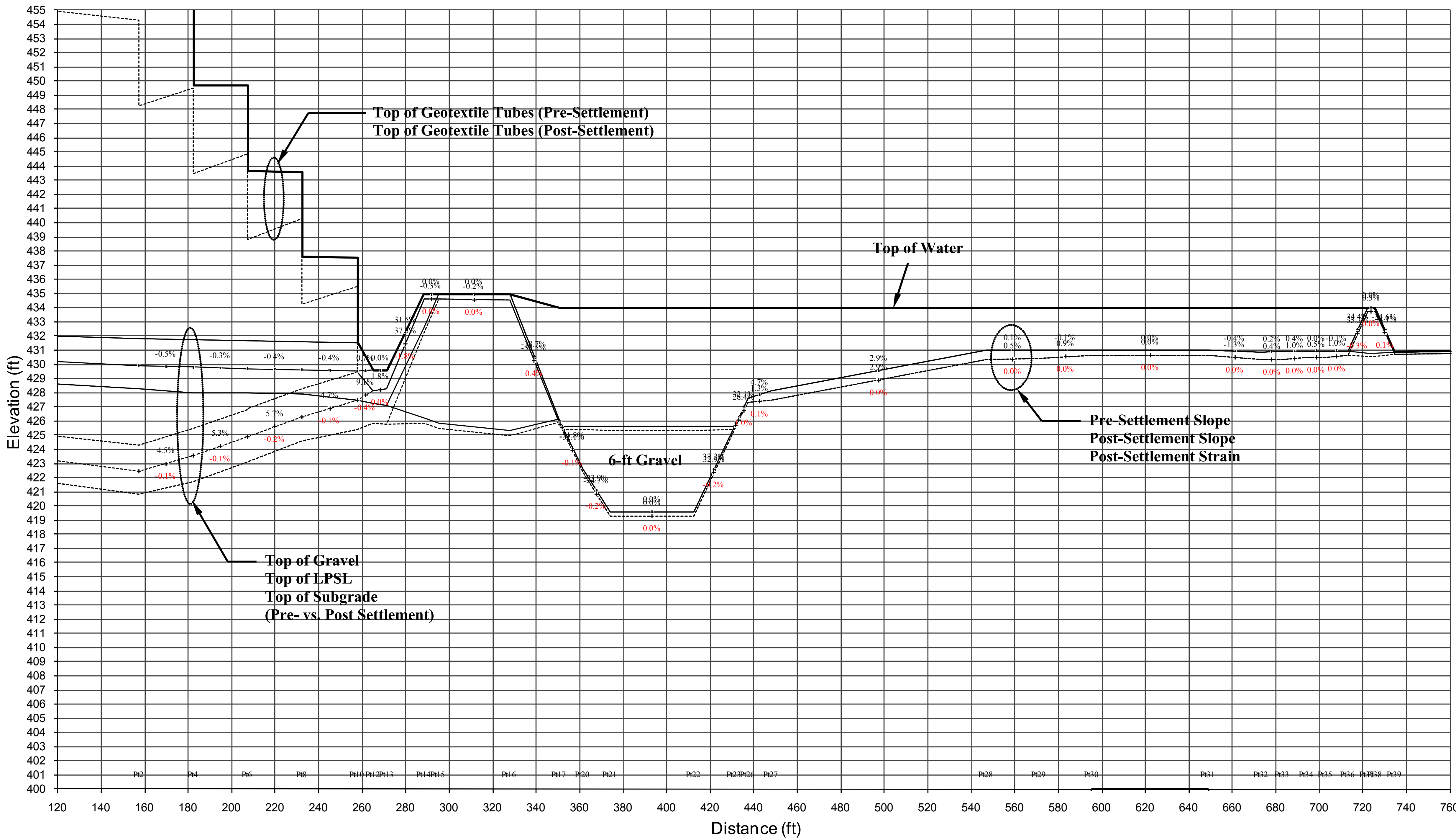


Figure 21. Pre- vs. Post- Settlement Profile of Section 6 – Case 3

Written by:	Fan Zhu	Date:	12/10/2010	Reviewed by:	R. Kulasingam/Jay Beech	Date:	12/13/2010
Client:	Honeywell	Project:	Onondaga Lake SCA Final Design	Project/ Proposal No.:	GJ4299	Task No.:	05

Attachment 1

Settlement Analysis for Cross Section 1 - CASE 1
(Points 11 to 20)

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Settlement Prediction Model

Programmer: **Yiwen Cao, GeoSyntec Consultants**

Version Control V 1.002 11.14.2007

Project: **Onondaga Lake SCA Final**

Notes:

Unit: **ft / psf**

Average Compaction Effort = **1440.00** kPa or psf

Consider Compaction Effort = **N** yes or no

S

E

ELEVATION (M/FT)

Point #			11	12	13	14	15	16	17	18	19	20
Distance (meter or ft)			312.84	320.78	324.40	341.85	375.22	392.67	405.16	417.72	443.73	448.95
Line	1		425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
Line	2		425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
Line	3		425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
Line	4	Top of Preload	425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
Line	5	Top of Dike	425.70	425.43	425.30	424.81	424.19	424.00	429.00	434.02	434.03	431.94
Line	6	Top of Subgrade	425.70	425.43	425.30	424.81	424.19	424.00	424.00	423.84	423.35	423.20
Line	7		422.72	422.46	422.34	421.88	421.30	421.12	421.12	420.97	420.51	420.36
Line	8		419.74	419.50	419.38	418.95	418.40	418.24	418.24	418.09	417.66	417.53
Line	9		416.75	416.53	416.42	416.02	415.51	415.35	415.35	415.22	414.82	414.69
Line	10		413.77	413.56	413.46	413.09	412.62	412.47	412.47	412.35	411.97	411.86
Line	11		410.79	410.60	410.51	410.16	409.72	409.59	409.59	409.48	409.13	409.02
Line	12		407.81	407.63	407.55	407.23	406.83	406.71	406.71	406.60	406.29	406.19
Line	13		404.82	404.66	404.59	404.30	403.94	403.82	403.82	403.73	403.44	403.35
Line	14		401.84	401.70	401.63	401.37	401.04	400.94	400.94	400.86	400.60	400.52
Line	15		398.86	398.73	398.67	398.44	398.15	398.06	398.06	397.98	397.75	397.68
Line	16		395.88	395.77	395.71	395.51	395.25	395.18	395.18	395.11	394.91	394.85
Line	17		392.89	392.80	392.75	392.58	392.36	392.29	392.29	392.24	392.06	392.01
Line	18		389.91	389.83	389.79	389.65	389.47	389.41	389.41	389.36	389.22	389.18
Line	19		386.93	386.87	386.84	386.72	386.57	386.53	386.53	386.49	386.38	386.34
Line	20		383.95	383.90	383.88	383.79	383.68	383.65	383.65	383.62	383.53	383.51
Line	21		380.96	380.93	380.92	380.86	380.79	380.76	380.76	380.75	380.69	380.67
Line	22		377.98	377.97	377.96	377.93	377.89	377.88	377.88	377.87	377.84	377.84
Line	23	Bottom of Zone2 Above GW	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00
Line	24		375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00
Line	25	Bottom of Zone 3 Above GW	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00
Line	26		372.14	372.10	372.09	371.99	371.85	371.76	371.70	371.63	371.48	371.45
Line	27	Bottom of Zone 2 Below GW	369.27	369.20	369.17	368.97	368.70	368.52	368.39	368.25	367.96	367.89
Line	28	Top of Incompressible Layer	369.27	369.20	369.17	368.97	368.70	368.52	368.39	368.25	367.96	367.89
Line	29	GND for sigma_p	425.70	425.43	425.30	424.81	424.19	424.00	424.00	423.84	423.35	423.20
Line	30	GW	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00
Line	31	ROCK	369.27	369.20	369.17	368.97	368.70	368.52	368.39	368.25	367.96	367.89

LAYER THICKNESS (M/FT)

Layer No.	From	To	Material	11	12	13	14	15	16	17	18	19	20
1	1	2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2	3		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	3	4		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	4	5	Preload	0.00	3.45	5.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00
5	5	6	Dike	0.00	0.00	0.00	0.00	0.00	0.00	5.00	10.18	10.68	8.74
6	6	7	Zone2-Above-GW-1	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
7	7	8	Zone2-Above-GW-2	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
8	8	9	Zone2-Above-GW-3	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
9	9	10	Zone2-Above-GW-4	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
10	10	11	Zone2-Above-GW-5	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
11	11	12	Zone2-Above-GW-6	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
12	12	13	Zone2-Above-GW-7	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
13	13	14	Zone2-Above-GW-8	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
14	14	15	Zone2-Above-GW-9	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
15	15	16	Zone2-Above-GW-10	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
16	16	17	Zone2-Above-GW-11	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
17	17	18	Zone2-Above-GW-12	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
18	18	19	Zone2-Above-GW-13	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
19	19	20	Zone2-Above-GW-14	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
20	20	21	Zone2-Above-GW-15	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
21	21	22	Zone2-Above-GW-16	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
22	22	23	Zone2-Above-GW-17	2.98	2.97	2.96	2.93	2.89	2.88	2.88	2.87	2.84	2.84
23	23	24	Zone3-Above-GW-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	24	25	Zone3-Above-GW-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	25	26	Zone2-Below-GW-18	2.87	2.90	2.91	3.01	3.15	3.24	3.31	3.38	3.52	3.56
26	26	27	Zone2-Below-GW-19	2.87	2.90	2.92	3.01	3.15	3.24	3.31	3.38	3.52	3.56
27	27	28	Zone3-Below-GW-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28													
29	29	30	Soil Above GW	50.70	50.43	50.30	49.81	49.19	49.00	49.00	48.84	48.35	48.20
30	30	31	Soil Below GW	5.73	5.80	5.83	6.03	6.30	6.48	6.61	6.75	7.04	7.11
Thickness Check													
	From Line	To Line	SUM	56.43	59.68	61.13	60.84	60.49	60.48	60.61	65.77	66.07	64.05
	1	28	Thickness =	56.43	59.68	61.13	60.84	60.49	60.48	60.61	65.77	66.07	64.05
			Thickness Check	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

	Layer No.	Material										
UNIT WEIGHT	1		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
	2		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
	3		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
	4	*Preload*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*
	5	*Dike*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*	*120.0*
	6	*Zone2-Above-GW-1*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	7	*Zone2-Above-GW-2*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	8	*Zone2-Above-GW-3*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	9	*Zone2-Above-GW-4*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	10	*Zone2-Above-GW-5*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	11	*Zone2-Above-GW-6*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	12	*Zone2-Above-GW-7*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	13	*Zone2-Above-GW-8*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	14	*Zone2-Above-GW-9*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	15	*Zone2-Above-GW-10*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	16	*Zone2-Above-GW-11*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	17	*Zone2-Above-GW-12*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	18	*Zone2-Above-GW-13*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	19	*Zone2-Above-GW-14*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	20	*Zone2-Above-GW-15*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	21	*Zone2-Above-GW-16*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	22	*Zone2-Above-GW-17*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	23	*Zone3-Above-GW-1*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	24	*Zone3-Above-GW-2*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	25	*Zone2-Below-GW-18*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*
	26	*Zone2-Below-GW-19*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*
	27	*Zone3-Below-GW-3*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*
	28											
	29	*Soil Above GW*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*	*82.0*
	30	*Soil below GW*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*	*19.6*
	Layer No. *1* 0											
		Initial Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
		Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
	Midpoint Elevation, (m / ft)		425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
	Initial Effective Stress, σ'_i (kPa /psf)		Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
	Final Effective Stress, σ'_f (kPa/psf)		Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method												
Modulus, E (kPa/psf)=		Strain										
		Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)												
Consolidation Properties												
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)												
OCR Manual Input Value												
OCR Computation Input												
Preconsolidation pressure, σ'_p (kPa / psf)												
Modified Primary Compression Index, $C_{c\varepsilon}$												
Modified Recompression Index, $C_{r\varepsilon}$												
Modified Secondary Compression Index, C_α												
ratio of t2 / t1												
Settlements												
Primary Settlement, (m / ft)												
Secondary Settlement (m / ft)												
Total Settlement (m / ft)												
		Elastic or Plastic (E/P)										
		Settlement of Layer 1 (m / ft)										

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Layer No. 2 **0**										
Initial Stress Reference Layer (top of layer)	2	2	2	2	2	2	2	2	2	2
Final Stress Reference Layer (top of layer)	2	2	2	2	2	2	2	2	2	2
Midpoint Elevation, (m / ft)	425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= ___ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m / ft)										
Secondary Settlement (m / ft)										
Total Settlement (m / ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 2 (m / ft)										

Layer No. 3 **0**										
Initial Stress Reference Layer (top of layer)	3	3	3	3	3	3	3	3	3	3
Final Stress Reference Layer (top of layer)	3	3	3	3	3	3	3	3	3	3
Midpoint Elevation, (m / ft)	425.70	428.88	430.30	429.81	429.19	429.00	429.00	434.02	434.03	431.94
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= ___ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m / ft)										
Secondary Settlement (m / ft)										
Total Settlement (m / ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 3 (m / ft)										

Layer No. 4 **Preload**										
Initial Stress Reference Layer (top of layer)	4	4	4	4	4	4	4	4	4	4
Final Stress Reference Layer (top of layer)	4	4	4	4	4	4	4	4	4	4
Midpoint Elevation, (m / ft)	425.70	427.16	427.80	427.31	426.69	426.50	429.00	434.02	434.03	431.94
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= ___ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m / ft)										
Secondary Settlement (m / ft)										
Total Settlement (m / ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 4 (m / ft)										

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Layer No. 5 **Dike**										
Initial Stress Reference Layer (top of layer)	5	5	5	5	5	5	5	5	5	5
Final Stress Reference Layer (top of layer)	5	5	5	5	5	5	5	5	5	5
Midpoint Elevation, (m / ft)	425.70	425.43	425.30	424.81	424.19	424.00	426.50	428.93	428.69	427.57
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= ____ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m / ft)										
Secondary Settlement (m / ft)										
Total Settlement (m / ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 5 (m / ft)										
Layer No. 6 **Zone2-Above-GW-1**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	424.21	423.95	423.82	423.35	422.74	422.56	422.56	422.40	421.93	421.78
Initial Effective Stress, σ'_i (kPa /psf)	122	122	121	120	119	118	118	118	117	116
Final Effective Stress, σ'_f (kPa/psf)	146	508	673	722	720	720	753	1,319	1,363	1,153
Elastic Method										
Modulus, E (kPa/psf)= ____ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	550	547	546	541	534	532	532	530	525	523
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.003	0.026	0.151	0.196	0.199	0.201	0.226	0.549	0.569	0.473
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.003	0.026	0.151	0.196	0.199	0.201	0.226	0.549	0.569	0.473
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 6 (m / ft)	0.003	0.026	0.151	0.196	0.199	0.201	0.226	0.549	0.569	0.473
Layer No. 7 **Zone2-Above-GW-2**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	421.23	420.98	420.86	420.42	419.85	419.68	419.68	419.53	419.08	418.95
Initial Effective Stress, σ'_i (kPa /psf)	367	365	364	360	356	355	355	353	350	349
Final Effective Stress, σ'_f (kPa/psf)	420	742	889	961	957	958	1,013	1,529	1,573	1,380
Elastic Method										
Modulus, E (kPa/psf)= ____ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	1,651	1,642	1,638	1,622	1,602	1,595	1,595	1,590	1,574	1,569
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.002	0.013	0.016	0.017	0.017	0.017	0.018	0.026	0.026	0.024
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.002	0.013	0.016	0.017	0.017	0.017	0.018	0.026	0.026	0.024
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 7 (m / ft)	0.002	0.013	0.016	0.017	0.017	0.017	0.018	0.026	0.026	0.024

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Layer No. 8 **Zone2-Above-GW-3**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	418.24	418.01	417.90	417.49	416.96	416.79	416.79	416.66	416.24	416.11
Initial Effective Stress, σ'_i (kPa /psf)	611	608	607	601	593	591	591	589	583	581
Final Effective Stress, σ'_f(kPa/psf)	714	966	1,082	1,196	1,195	1,202	1,295	1,717	1,754	1,585
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,751	2,737	2,730	2,703	2,669	2,659	2,659	2,650	2,624	2,616
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.003	0.008	0.010	0.012	0.012	0.012	0.014	0.019	0.019	0.017
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.003	0.008	0.010	0.012	0.012	0.012	0.014	0.019	0.019	0.017
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 8 (m / ft)	0.003	0.008	0.010	0.012	0.012	0.012	0.014	0.019	0.019	0.017
Layer No. 9 **Zone2-Above-GW-4**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	415.26	415.05	414.94	414.56	414.06	413.91	413.91	413.78	413.40	413.28
Initial Effective Stress, σ'_i (kPa /psf)	856	851	849	841	830	827	827	825	816	814
Final Effective Stress, σ'_f(kPa/psf)	979	1,201	1,305	1,432	1,433	1,445	1,551	1,931	1,961	1,800
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.5	4.5
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	1,712	1,703	1,698	1,682	1,661	1,654	1,654	1,649	3,673	3,662
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.91%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.002	0.006	0.008	0.009	0.010	0.010	0.011	0.103	0.015	0.014
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.002	0.006	0.008	0.009	0.010	0.010	0.011	0.103	0.015	0.014
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 9 (m / ft)	0.002	0.006	0.008	0.009	0.010	0.010	0.011	0.103	0.015	0.014
Layer No. 10 **Zone2-Above-GW-5**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	412.28	412.08	411.99	411.63	411.17	411.03	411.03	410.91	410.55	410.44
Initial Effective Stress, σ'_i (kPa /psf)	1,100	1,095	1,092	1,081	1,068	1,064	1,064	1,060	1,049	1,046
Final Effective Stress, σ'_f(kPa/psf)	1,256	1,433	1,517	1,661	1,672	1,697	1,818	2,128	2,141	1,994
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,201	2,189	2,184	2,162	2,135	2,127	2,127	2,120	2,099	2,092
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.91%	0.91%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.002	0.005	0.006	0.008	0.008	0.008	0.009	0.014	0.023	0.011
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.002	0.005	0.006	0.008	0.008	0.008	0.009	0.014	0.023	0.011
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 10 (m / ft)	0.002	0.005	0.006	0.008	0.008	0.008	0.009	0.014	0.023	0.011

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Layer No. *11* **Zone2-Above-GW-6**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	409.30	409.11	409.03	408.70	408.28	408.15	408.15	408.04	407.71	407.61
Initial Effective Stress, σ'_i (kPa /psf)	1,345	1,338	1,334	1,321	1,305	1,300	1,300	1,296	1,283	1,279
Final Effective Stress, σ'_f (kPa/psf)	1,524	1,672	1,748	1,894	1,911	1,943	2,066	2,346	2,348	2,207
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,690	2,676	2,669	2,643	2,610	2,600	2,600	2,591	2,565	2,557
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m/ ft)	0.002	0.004	0.005	0.006	0.007	0.007	0.008	0.010	0.010	0.009
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.002	0.004	0.005	0.006	0.007	0.007	0.008	0.010	0.010	0.009
Elastic or Plastic (E/P)										
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 11 (m/ ft)	0.002	0.004	0.005	0.006	0.007	0.007	0.008	0.010	0.010	0.009
Layer No. *12* **Zone2-Above-GW-7**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	406.31	406.15	406.07	405.77	405.38	405.26	405.26	405.17	404.86	404.77
Initial Effective Stress, σ'_i (kPa /psf)	1,590	1,581	1,577	1,562	1,542	1,536	1,536	1,531	1,516	1,511
Final Effective Stress, σ'_f (kPa/psf)	1,778	1,909	1,973	2,119	2,149	2,196	2,318	2,549	2,530	2,401
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,179	3,162	3,154	3,123	3,085	3,073	3,073	3,063	3,032	3,022
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m/ ft)	0.002	0.003	0.004	0.005	0.006	0.006	0.007	0.009	0.009	0.008
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.002	0.003	0.004	0.005	0.006	0.006	0.007	0.009	0.009	0.008
Elastic or Plastic (E/P)										
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 12 (m/ ft)	0.002	0.003	0.004	0.005	0.006	0.006	0.007	0.009	0.009	0.008
Layer No. *13* **Zone2-Above-GW-8**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	403.33	403.18	403.11	402.84	402.49	402.38	402.38	402.29	402.02	401.94
Initial Effective Stress, σ'_i (kPa /psf)	1,834	1,824	1,820	1,802	1,780	1,773	1,773	1,767	1,749	1,744
Final Effective Stress, σ'_f (kPa/psf)	2,038	2,148	2,202	2,351	2,391	2,440	2,560	2,769	2,739	2,615
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	1,834	1,824	1,820	1,802	1,780	1,773	1,773	1,767	1,749	1,744
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m/ ft)	0.063	0.097	0.113	0.156	0.171	0.184	0.212	0.258	0.255	0.230
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.063	0.097	0.113	0.156	0.171	0.184	0.212	0.258	0.255	0.230
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 13 (m/ ft)	0.063	0.097	0.113	0.156	0.171	0.184	0.212	0.258	0.255	0.230

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Layer No. 14 **Zone2-Above-GW-9**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	400.35	400.22	400.15	399.91	399.60	399.50	399.50	399.42	399.18	399.10
Initial Effective Stress, σ'_i (kPa /psf)	2,079	2,068	2,062	2,042	2,017	2,009	2,009	2,002	1,982	1,976
Final Effective Stress, σ'_f (kPa/psf)	2,289	2,390	2,439	2,576	2,628	2,690	2,803	2,975	2,926	2,812
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,079	2,068	2,062	2,042	2,017	2,009	2,009	2,002	1,982	1,976
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.057	0.086	0.099	0.136	0.153	0.168	0.192	0.227	0.221	0.200
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.057	0.086	0.099	0.136	0.153	0.168	0.192	0.227	0.221	0.200
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 14 (m/ ft)	0.057	0.086	0.099	0.136	0.153	0.168	0.192	0.227	0.221	0.200

Layer No. 15 **Zone2-Above-GW-10**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	397.37	397.25	397.19	396.98	396.70	396.62	396.62	396.55	396.33	396.26
Initial Effective Stress, σ'_i (kPa /psf)	2,323	2,311	2,305	2,282	2,254	2,245	2,245	2,238	2,216	2,209
Final Effective Stress, σ'_f (kPa/psf)	2,545	2,630	2,673	2,809	2,870	2,932	3,040	3,196	3,137	3,028
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,323	2,311	2,305	2,282	2,254	2,245	2,245	2,238	2,216	2,209
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.054	0.077	0.088	0.122	0.140	0.154	0.175	0.205	0.198	0.179
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.054	0.077	0.088	0.122	0.140	0.154	0.175	0.205	0.198	0.179
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 15 (m/ ft)	0.054	0.077	0.088	0.122	0.140	0.154	0.175	0.205	0.198	0.179

Layer No. 16 **Zone2-Above-GW-11**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	394.39	394.28	394.23	394.05	393.81	393.74	393.74	393.67	393.49	393.43
Initial Effective Stress, σ'_i (kPa /psf)	2,568	2,554	2,548	2,523	2,491	2,482	2,482	2,474	2,449	2,441
Final Effective Stress, σ'_f (kPa/psf)	2,794	2,873	2,912	3,036	3,105	3,176	3,276	3,403	3,329	3,245
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,568	2,554	2,548	2,523	2,491	2,482	2,482	2,474	2,449	2,441
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.050	0.070	0.079	0.108	0.127	0.142	0.160	0.183	0.175	0.161
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.050	0.070	0.079	0.108	0.127	0.142	0.160	0.183	0.175	0.161
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 16 (m/ ft)	0.050	0.070	0.079	0.108	0.127	0.142	0.160	0.183	0.175	0.161

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Layer No. *17*	**Zone2-Above-GW-12**										
Initial Stress Reference Layer (top of layer)		6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)		1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)		391.40	391.32	391.27	391.12	390.91	390.85	390.85	390.80	390.64	390.59
Initial Effective Stress, σ'_i (kPa /psf)		2,812	2,797	2,790	2,763	2,729	2,718	2,718	2,709	2,682	2,674
Final Effective Stress, σ'_f (kPa/psf)		3,046	3,115	3,149	3,264	3,348	3,415	3,510	3,625	3,543	3,447
Elastic Method											
Modulus, E (kPa/psf)=	Strain										
	Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)											
Consolidation Properties											
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)		MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input											
Preconsolidation pressure, σ'_p (kPa / psf)		2,812	2,797	2,790	2,763	2,729	2,718	2,718	2,709	2,682	2,674
Modified Primary Compression Index, $C_{c\varepsilon}$		0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$		0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$		0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements											
Primary Settlement, (m / ft)		0.048	0.064	0.071	0.097	0.118	0.131	0.147	0.167	0.158	0.144
Secondary Settlement (m / ft)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)		0.048	0.064	0.071	0.097	0.118	0.131	0.147	0.167	0.158	0.144
Elastic or Plastic (E/P)		p	p	p	p	p	p	p	p	p	p
		1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 17 (m / ft)		0.048	0.064	0.071	0.097	0.118	0.131	0.147	0.167	0.158	0.144
Layer No. *18*	**Zone2-Above-GW-13**										
Initial Stress Reference Layer (top of layer)		6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)		1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)		388.42	388.35	388.31	388.19	388.02	387.97	387.97	387.93	387.80	387.76
Initial Effective Stress, σ'_i (kPa /psf)		3,057	3,041	3,033	3,003	2,966	2,954	2,954	2,945	2,915	2,906
Final Effective Stress, σ'_f (kPa/psf)		3,295	3,358	3,389	3,498	3,580	3,655	3,740	3,833	3,758	3,665
Elastic Method											
Modulus, E (kPa/psf)=	Strain										
	Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)											
Consolidation Properties											
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)		MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input											
Preconsolidation pressure, σ'_p (kPa / psf)		3,057	3,041	3,033	3,003	2,966	2,954	2,954	2,945	2,915	2,906
Modified Primary Compression Index, $C_{c\varepsilon}$		0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$		0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$		0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements											
Primary Settlement, (m / ft)		0.045	0.059	0.066	0.089	0.109	0.123	0.136	0.151	0.144	0.131
Secondary Settlement (m / ft)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)		0.045	0.059	0.066	0.089	0.109	0.123	0.136	0.151	0.144	0.131
Elastic or Plastic (E/P)		p	p	p	p	p	p	p	p	p	p
		1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 18 (m / ft)		0.045	0.059	0.066	0.089	0.109	0.123	0.136	0.151	0.144	0.131
Layer No. *19*	**Zone2-Above-GW-14**										
Initial Stress Reference Layer (top of layer)		6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)		1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)		385.44	385.38	385.36	385.26	385.13	385.09	385.09	385.06	384.95	384.92
Initial Effective Stress, σ'_i (kPa /psf)		3,301	3,284	3,275	3,244	3,203	3,191	3,191	3,180	3,148	3,139
Final Effective Stress, σ'_f (kPa/psf)		3,545	3,600	3,628	3,728	3,824	3,892	3,973	4,055	3,956	3,871
Elastic Method											
Modulus, E (kPa/psf)=	Strain										
	Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)											
Consolidation Properties											
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)		MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input											
Preconsolidation pressure, σ'_p (kPa / psf)		3,301	3,284	3,275	3,244	3,203	3,191	3,191	3,180	3,148	3,139
Modified Primary Compression Index, $C_{c\varepsilon}$		0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$		0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$		0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements											
Primary Settlement, (m / ft)		0.042	0.054	0.060	0.082	0.102	0.114	0.126	0.139	0.130	0.119
Secondary Settlement (m / ft)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)		0.042	0.054	0.060	0.082	0.102	0.114	0.126	0.139	0.130	0.119
Elastic or Plastic (E/P)		p	p	p	p	p	p	p	p	p	p
		1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 19 (m / ft)		0.042	0.054	0.060	0.082	0.102	0.114	0.126	0.139	0.130	0.119

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Layer No. 20 Zone2-Above-GW-15										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	382.46	382.42	382.40	382.33	382.23	382.21	382.21	382.18	382.11	382.09
Initial Effective Stress, σ'_i (kPa /psf)	3,546	3,527	3,518	3,484	3,440	3,427	3,427	3,416	3,382	3,371
Final Effective Stress, σ'_f (kPa/psf)	3,793	3,843	3,869	3,964	4,053	4,127	4,199	4,264	4,173	4,091
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,546	3,527	3,518	3,484	3,440	3,427	3,427	3,416	3,382	3,371
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.040	0.051	0.056	0.076	0.095	0.107	0.117	0.127	0.120	0.110
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.040	0.051	0.056	0.076	0.095	0.107	0.117	0.127	0.120	0.110
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 20 (m / ft)	0.040	0.051	0.056	0.076	0.095	0.107	0.117	0.127	0.120	0.110
Layer No. 21 Zone2-Above-GW-16										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	379.47	379.45	379.44	379.40	379.34	379.32	379.32	379.31	379.27	379.25
Initial Effective Stress, σ'_i (kPa /psf)	3,791	3,770	3,761	3,724	3,678	3,663	3,663	3,652	3,615	3,604
Final Effective Stress, σ'_f (kPa/psf)	4,042	4,086	4,108	4,195	4,297	4,362	4,430	4,487	4,376	4,300
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,791	3,770	3,761	3,724	3,678	3,663	3,663	3,652	3,615	3,604
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.038	0.048	0.052	0.070	0.090	0.100	0.109	0.118	0.109	0.100
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.038	0.048	0.052	0.070	0.090	0.100	0.109	0.118	0.109	0.100
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 21 (m / ft)	0.038	0.048	0.052	0.070	0.090	0.100	0.109	0.118	0.109	0.100
Layer No. 22 Zone2-Above-GW-17										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	376.49	376.48	376.48	376.47	376.45	376.44	376.44	376.44	376.42	376.42
Initial Effective Stress, σ'_i (kPa /psf)	4,035	4,014	4,003	3,964	3,915	3,900	3,900	3,887	3,848	3,836
Final Effective Stress, σ'_f (kPa/psf)	4,291	4,329	4,350	4,432	4,524	4,593	4,654	4,698	4,595	4,521
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,035	4,014	4,003	3,964	3,915	3,900	3,900	3,887	3,848	3,836
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.037	0.045	0.049	0.065	0.084	0.094	0.102	0.109	0.101	0.093
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.037	0.045	0.049	0.065	0.084	0.094	0.102	0.109	0.101	0.093
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 22 (m / ft)	0.037	0.045	0.049	0.065	0.084	0.094	0.102	0.109	0.101	0.093

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Layer No. 23 **Zone3-Above-GW-1**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00
Initial Effective Stress, σ'_i (kPa /psf)	4,157	4,135	4,125	4,084	4,034	4,018	4,018	4,005	3,965	3,952
Final Effective Stress, σ'_f (kPa/psf)	4,414	4,451	4,470	4,548	4,641	4,712	4,773	4,815	4,698	4,627
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,157	4,135	4,125	4,084	4,034	4,018	4,018	4,005	3,965	3,952
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 23 (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Layer No. 24 **Zone3-Above-GW-2**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00	375.00
Initial Effective Stress, σ'_i (kPa /psf)	4,157	4,135	4,125	4,084	4,034	4,018	4,018	4,005	3,965	3,952
Final Effective Stress, σ'_f (kPa/psf)	4,414	4,451	4,470	4,548	4,641	4,712	4,773	4,815	4,698	4,627
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,157	4,135	4,125	4,084	4,034	4,018	4,018	4,005	3,965	3,952
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 24 (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Layer No. 25 **Zone2-Below-GW-18**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	373.57	373.55	373.54	373.49	373.43	373.38	373.35	373.31	373.24	373.22
Initial Effective Stress, σ'_i (kPa /psf)	4,185	4,164	4,153	4,114	4,064	4,050	4,050	4,038	3,999	3,987
Final Effective Stress, σ'_f (kPa/psf)	4,444	4,480	4,498	4,574	4,679	4,740	4,799	4,836	4,720	4,651
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,185	4,164	4,153	4,114	4,064	4,050	4,050	4,038	3,999	3,987
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.034	0.042	0.046	0.064	0.089	0.102	0.112	0.122	0.116	0.109
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.034	0.042	0.046	0.064	0.089	0.102	0.112	0.122	0.116	0.109
Elastic or Plastic (E/P)										
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 25 (m/ ft)	0.034	0.042	0.046	0.064	0.089	0.102	0.112	0.122	0.116	0.109

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Layer No. 26 **Zone2-Below-GW-19**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	370.70	370.65	370.63	370.48	370.28	370.14	370.04	369.94	369.72	369.67
Initial Effective Stress, σ'_i (kPa /psf)	4,242	4,221	4,210	4,173	4,126	4,113	4,115	4,104	4,068	4,057
Final Effective Stress, σ'_f (kPa/psf)	4,504	4,537	4,554	4,630	4,736	4,797	4,850	4,879	4,764	4,701
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,242	4,221	4,210	4,173	4,126	4,113	4,115	4,104	4,068	4,057
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.034	0.042	0.046	0.063	0.087	0.100	0.108	0.117	0.111	0.105
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.034	0.042	0.046	0.063	0.087	0.100	0.108	0.117	0.111	0.105
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 26 (m / ft)	0.034	0.042	0.046	0.063	0.087	0.100	0.108	0.117	0.111	0.105
Layer No. 27 **Zone3-Below-GW-3**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	369.27	369.20	369.17	368.97	368.70	368.52	368.39	368.25	367.96	367.89
Initial Effective Stress, σ'_i (kPa /psf)	4,270	4,249	4,239	4,203	4,157	4,145	4,148	4,137	4,103	4,092
Final Effective Stress, σ'_f (kPa/psf)	4,532	4,565	4,582	4,656	4,757	4,824	4,875	4,901	4,787	4,726
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,270	4,249	4,239	4,203	4,157	4,145	4,148	4,137	4,103	4,092
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 27 (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

LAYER SETTLEMENT

Layer No.	Material										
1											
2											
3											
4	*Preload*										
5	*Dike*										
6	*Zone2-Above-GW-1*	0.003	0.026	0.151	0.196	0.199	0.201	0.226	0.549	0.569	0.473
7	*Zone2-Above-GW-2*	0.002	0.013	0.016	0.017	0.017	0.017	0.018	0.026	0.026	0.024
8	*Zone2-Above-GW-3*	0.003	0.008	0.010	0.012	0.012	0.012	0.014	0.019	0.019	0.017
9	*Zone2-Above-GW-4*	0.002	0.006	0.008	0.009	0.010	0.010	0.011	0.103	0.015	0.014
10	*Zone2-Above-GW-5*	0.002	0.005	0.006	0.008	0.008	0.008	0.009	0.014	0.023	0.011
11	*Zone2-Above-GW-6*	0.002	0.004	0.005	0.006	0.007	0.007	0.008	0.010	0.010	0.009
12	*Zone2-Above-GW-7*	0.002	0.003	0.004	0.005	0.006	0.006	0.007	0.009	0.009	0.008
13	*Zone2-Above-GW-8*	0.063	0.097	0.113	0.156	0.171	0.184	0.212	0.258	0.255	0.230
14	*Zone2-Above-GW-9*	0.057	0.086	0.099	0.136	0.153	0.168	0.192	0.227	0.221	0.200
15	*Zone2-Above-GW-10*	0.054	0.077	0.088	0.122	0.140	0.154	0.175	0.205	0.198	0.179
16	*Zone2-Above-GW-11*	0.050	0.070	0.079	0.108	0.127	0.142	0.160	0.183	0.175	0.161
17	*Zone2-Above-GW-12*	0.048	0.064	0.071	0.097	0.118	0.131	0.147	0.167	0.158	0.144
18	*Zone2-Above-GW-13*	0.045	0.059	0.066	0.089	0.109	0.123	0.136	0.151	0.144	0.131
19	*Zone2-Above-GW-14*	0.042	0.054	0.060	0.082	0.102	0.114	0.126	0.139	0.130	0.119
20	*Zone2-Above-GW-15*	0.040	0.051	0.056	0.076	0.095	0.107	0.117	0.127	0.120	0.110
21	*Zone2-Above-GW-16*	0.038	0.048	0.052	0.070	0.090	0.100	0.109	0.118	0.109	0.100
22	*Zone2-Above-GW-17*	0.037	0.045	0.049	0.065	0.084	0.094	0.102	0.109	0.101	0.093
23	*Zone3-Above-GW-1*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	*Zone3-Above-GW-2*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	*Zone2-Below-GW-18*	0.034	0.042	0.046	0.064	0.089	0.102	0.112	0.122	0.116	0.109
26	*Zone2-Below-GW-19*	0.034	0.042	0.046	0.063	0.087	0.100	0.108	0.117	0.111	0.105
27	*Zone3-Below-GW-3*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28											
29	*Soil Above GW*										
30	*Soil Below GW*										
	TOTAL SETTLEMENT	**0.56**	**0.80**	**1.03**	**1.38**	**1.62**	**1.78**	**1.99**	**2.65**	**2.51**	**2.24**

POST-SETTLEMENT ELEVATION (M/FT)

Line	1		425.14	428.08	429.27	428.43	427.57	427.22	427.01	431.37	431.52	429.70
Line	2		425.14	428.08	429.27	428.43	427.57	427.22	427.01	431.37	431.52	429.70
Line	3		425.14	428.08	429.27	428.43	427.57	427.22	427.01	431.37	431.52	429.70
Line	4	Top of Preload	425.14	428.08	429.27	428.43	427.57	427.22	427.01	431.37	431.52	429.70
Line	5	Top of Dike	425.14	424.63	424.27	423.43	422.57	422.22	427.01	431.37	431.52	429.70
Line	6	Top of Subgrade	425.14	424.63	424.27	423.43	422.57	422.22	422.01	421.19	420.84	420.96
Line	7		422.16	421.69	421.47	420.69	419.87	419.54	419.35	418.86	418.57	418.60
Line	8		419.18	418.74	418.52	417.78	417.00	416.67	416.49	416.02	415.75	415.79
Line	9		416.20	415.78	415.58	414.86	414.12	413.80	413.62	413.16	412.92	412.97
Line	10		413.22	412.82	412.62	411.94	411.23	410.93	410.75	410.39	410.09	410.15
Line	11		410.24	409.86	409.67	409.02	408.35	408.06	407.88	407.53	407.27	407.33
Line	12		407.26	406.89	406.72	406.10	405.46	405.18	405.00	404.67	404.44	404.50
Line	13		404.28	403.93	403.76	403.17	402.57	402.30	402.13	401.81	401.60	401.67
Line	14		401.36	401.06	400.92	400.40	399.85	399.61	399.46	399.19	399.02	399.07
Line	15		398.44	398.18	398.06	397.60	397.11	396.89	396.77	396.55	396.39	396.43
Line	16		395.51	395.29	395.19	394.80	394.35	394.16	394.06	393.88	393.75	393.77
Line	17		392.58	392.39	392.31	391.97	391.59	391.42	391.34	391.19	391.08	391.10
Line	18		389.64	389.49	389.42	389.14	388.81	388.67	388.60	388.48	388.39	388.41
Line	19		386.70	386.58	386.53	386.30	386.03	385.91	385.85	385.76	385.69	385.71
Line	20		383.76	383.67	383.63	383.45	383.24	383.14	383.10	383.03	382.98	382.99
Line	21		380.82	380.76	380.72	380.60	380.44	380.37	380.33	380.28	380.25	380.26
Line	22		377.88	377.84	377.82	377.74	377.63	377.59	377.56	377.53	377.52	377.53
Line	23	Bottom of Zone2 Above GW	374.93	374.92	374.91	374.87	374.82	374.80	374.78	374.76	374.77	374.79
Line	24		374.93	374.92	374.91	374.87	374.82	374.80	374.78	374.76	374.77	374.79
Line	25	Bottom of Zone 3 Above GW	374.93	374.92	374.91	374.87	374.82	374.80	374.78	374.76	374.77	374.79
Line	26		372.10	372.06	372.04	371.92	371.76	371.66	371.59	371.51	371.37	371.34
Line	27	Bottom of Zone 2 Below GW	369.27	369.20	369.17	368.97	368.70	368.52	368.39	368.25	367.96	367.89
Line	28	Top of Incompressible Layer	369.27	369.20	369.17	368.97	368.70	368.52	368.39	368.25	367.96	367.89
Line	29	GND										
Line	30	GW										
Line	31	ROCK										

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Client:	Honeywell	Project:	Onondaga Lake SCA Final Design	Project/ Proposal No.:	GJ4299	Task No.:	05

Attachment 2

Settlement Analysis for Cross Section 4 - CASE 1
(Points 11 to 20)

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Settlement Prediction Model

Programmer: **Yiwen Cao, GeoSyntec Consultants**

Version Control V 1.002 11.14.2007

Project: **Onondaga Lake SCA Final**

S

E

Notes:

Unit: **ft / psf**

Average Compaction Effort = kPa or psf

Consider Compaction Effort = N yes or no

Point #			11	12	13	14	15	16	17	18	19	20
Distance (meter or ft)			202.77	207.91	213.25	213.94	225.58	230.80	256.80	260.01	272.24	313.08
ELEVATION (M/FT)	Line 1		427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
	Line 2		427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
	Line 3		427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
	Line 4	Top of Preload	427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
	Line 5	Top of Dike	427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	428.08	428.86
	Line 6	Top of Subgrade	427.38	427.44	427.50	427.51	427.63	427.68	427.94	427.97	428.08	428.86
	Line 7		425.03	425.09	425.15	425.16	425.28	425.33	425.59	425.62	425.73	426.51
	Line 8		422.68	422.74	422.79	422.80	422.92	422.97	423.23	423.26	423.37	424.15
	Line 9		420.32	420.38	420.44	420.45	420.57	420.62	420.88	420.91	421.02	421.80
	Line 10		417.97	418.03	418.09	418.10	418.22	418.27	418.53	418.56	418.67	419.45
	Line 11		415.62	415.68	415.74	415.74	415.86	415.91	416.17	416.20	416.32	417.10
	Line 12		413.27	413.33	413.38	413.39	413.51	413.56	413.82	413.85	413.96	414.74
	Line 13		410.91	410.97	411.03	411.04	411.16	411.21	411.47	411.50	411.61	412.39
	Line 14		408.56	408.62	408.68	408.68	408.80	408.85	409.11	409.14	409.26	410.04
	Line 15		406.21	406.27	406.32	406.33	406.45	406.50	406.76	406.79	406.90	407.68
	Line 16		403.86	403.92	403.97	403.97	404.09	404.14	404.40	404.43	404.55	405.33
	Line 17		401.50	401.56	401.62	401.62	401.74	401.79	402.05	402.08	402.20	402.98
	Line 18		399.15	399.21	399.26	399.27	399.39	399.44	399.70	399.73	399.84	400.62
	Line 19		396.80	396.86	396.91	396.91	397.03	397.08	397.34	397.37	397.49	398.27
	Line 20		394.45	394.51	394.56	394.56	394.68	394.73	394.99	395.02	395.14	395.92
	Line 21		392.09	392.15	392.21	392.21	392.33	392.38	392.64	392.67	392.79	393.57
	Line 22		389.74	389.80	389.85	389.85	389.97	390.02	390.28	390.31	390.43	391.21
	Line 23	Bottom of Zone2 Above GW	387.39	387.45	387.50	387.50	387.62	387.67	387.93	387.96	388.08	388.86
	Line 24		382.22	382.32	382.32	382.31	382.17	382.10	381.78	381.75	381.62	381.93
	Line 25	Bottom of Zone 3 Above GW	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
	Line 26		377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
	Line 27	Bottom of Zone 2 Below GW	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
	Line 28	Top of Incompressible Layer	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
	Line 29	GND for sigma_p	427.38	427.44	427.50	427.51	427.63	427.68	427.94	427.97	428.08	428.86
	Line 30	GW	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
	Line 31	ROCK	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00

LAYER THICKNESS (M/FT) Layer No.	From	To	Material	11	12	13	14	15	16	17	18	19	20
1	1	2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2	3		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	3	4		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	4	5	Preload	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
5	5	6	Dike	0.00	0.00	0.00	0.00	4.53	6.57	6.31	5.00	0.00	0.00
6	6	7	Zone2-Above-GW-1	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
7	7	8	Zone2-Above-GW-2	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
8	8	9	Zone2-Above-GW-3	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
9	9	10	Zone2-Above-GW-4	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
10	10	11	Zone2-Above-GW-5	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
11	11	12	Zone2-Above-GW-6	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
12	12	13	Zone2-Above-GW-7	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
13	13	14	Zone2-Above-GW-8	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
14	14	15	Zone2-Above-GW-9	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
15	15	16	Zone2-Above-GW-10	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
16	16	17	Zone2-Above-GW-11	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
17	17	18	Zone2-Above-GW-12	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
18	18	19	Zone2-Above-GW-13	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
19	19	20	Zone2-Above-GW-14	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
20	20	21	Zone2-Above-GW-15	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
21	21	22	Zone2-Above-GW-16	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
22	22	23	Zone2-Above-GW-17	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
23	23	24	Zone3-Above-GW-1	5.17	5.13	5.19	5.19	5.46	5.57	6.15	6.21	6.46	6.93
24	24	25	Zone3-Above-GW-2	5.18	5.13	5.19	5.19	5.45	5.57	6.15	6.22	6.47	6.93
25	25	26	Zone2-Below-GW-18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	26	27	Zone2-Below-GW-19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	27	28	Zone3-Below-GW-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28													
29	29	30	Soil Above GW	50.34	50.25	50.37	50.40	50.92	51.15	52.31	52.44	52.93	53.86
30	30	31	Soil Below GW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thickness Check													
	From Line	To Line	SUM	50.34	50.25	50.37	50.40	55.45	57.72	58.62	57.44	57.93	58.86
	1	28	Thickness =	50.34	50.25	50.37	50.40	55.45	57.72	58.62	57.44	57.93	58.86
			Thickness Check	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

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UNIT WEIGHT											
Layer No.	Material										
1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	*Preload*	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
5	*Dike*	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
6	*Zone2-Above-GW-1*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
7	*Zone2-Above-GW-2*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
8	*Zone2-Above-GW-3*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
9	*Zone2-Above-GW-4*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
10	*Zone2-Above-GW-5*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
11	*Zone2-Above-GW-6*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
12	*Zone2-Above-GW-7*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
13	*Zone2-Above-GW-8*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
14	*Zone2-Above-GW-9*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
15	*Zone2-Above-GW-10*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
16	*Zone2-Above-GW-11*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
17	*Zone2-Above-GW-12*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
18	*Zone2-Above-GW-13*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
19	*Zone2-Above-GW-14*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
20	*Zone2-Above-GW-15*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
21	*Zone2-Above-GW-16*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
22	*Zone2-Above-GW-17*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
23	*Zone3-Above-GW-1*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
24	*Zone3-Above-GW-2*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
25	*Zone2-Below-GW-18*	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
26	*Zone2-Below-GW-19*	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
27	*Zone3-Below-GW-3*	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
28											
29	*Soil Above GW*	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
30	*Soil below GW*	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
Layer No. *1* 0											
Initial Stress Reference Layer (top of layer)		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Final Stress Reference Layer (top of layer)		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m / ft)		427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
Initial Effective Stress, σ'_i (kPa /psf)		Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)		Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method											
Modulus, E (kPa/psf)=	Strain										
	Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)											
Consolidation Properties											
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)											
OCR Manual Input Value											
OCR Computation Input											
Preconsolidation pressure, σ'_p (kPa / psf)											
Modified Primary Compression Index, $C_{c\varepsilon}$											
Modified Recompression Index, $C_{r\varepsilon}$											
Modified Secondary Compression Index, C_{α}											
ratio of t2 / t1											
Settlements											
Primary Settlement, (m / ft)											
Secondary Settlement (m / ft)											
Total Settlement (m / ft)											
Elastic or Plastic (E/P)											
Settlement of Layer 1 (m / ft)											

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Layer No. 2 **0**										
Initial Stress Reference Layer (top of layer)	2	2	2	2	2	2	2	2	2	2
Final Stress Reference Layer (top of layer)	2	2	2	2	2	2	2	2	2	2
Midpoint Elevation, (m/ ft)	427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m/ ft)										
Secondary Settlement (m/ ft)										
Total Settlement (m/ ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 2 (m/ ft)										

Layer No. 3 **0**										
Initial Stress Reference Layer (top of layer)	3	3	3	3	3	3	3	3	3	3
Final Stress Reference Layer (top of layer)	3	3	3	3	3	3	3	3	3	3
Midpoint Elevation, (m/ ft)	427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	433.08	433.86
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m/ ft)										
Secondary Settlement (m/ ft)										
Total Settlement (m/ ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 3 (m/ ft)										

Layer No. 4 **Preload**										
Initial Stress Reference Layer (top of layer)	4	4	4	4	4	4	4	4	4	4
Final Stress Reference Layer (top of layer)	4	4	4	4	4	4	4	4	4	4
Midpoint Elevation, (m/ ft)	427.38	427.44	427.50	427.51	432.16	434.25	434.25	432.97	430.58	431.36
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m/ ft)										
Secondary Settlement (m/ ft)										
Total Settlement (m/ ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 4 (m/ ft)										

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Layer No. 5 **Dike**										
Initial Stress Reference Layer (top of layer)	5	5	5	5	5	5	5	5	5	5
Final Stress Reference Layer (top of layer)	5	5	5	5	5	5	5	5	5	5
Midpoint Elevation, (m/ ft)	427.38	427.44	427.50	427.51	429.90	430.97	431.10	430.47	428.08	428.86
Initial Effective Stress, σ'_i (kPa /psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Final Effective Stress, σ'_f (kPa/psf)	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)										
OCR Manual Input Value										
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)										
Modified Primary Compression Index, $C_{c\varepsilon}$										
Modified Recompression Index, $C_{r\varepsilon}$										
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$										
ratio of t2 / t1										
Settlements										
Primary Settlement, (m/ ft)										
Secondary Settlement (m/ ft)										
Total Settlement (m/ ft)										
Elastic or Plastic (E/P)										
Settlement of Layer 5 (m/ ft)										
Layer No. 6 **Zone2-Above-GW-1**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	426.20	426.26	426.32	426.33	426.45	426.50	426.76	426.79	426.90	427.68
Initial Effective Stress, σ'_i (kPa /psf)	96	96	96	96	96	96	96	96	96	96
Final Effective Stress, σ'_f (kPa/psf)	97	98	119	119	642	865	836	734	698	696
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	434	434	434	434	434	434	434	434	434	434
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.000	0.000	0.003	0.003	0.205	0.345	0.330	0.269	0.245	0.243
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.000	0.000	0.003	0.003	0.205	0.345	0.330	0.269	0.245	0.243
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 6 (m/ ft)	0.000	0.000	0.003	0.003	0.205	0.345	0.330	0.269	0.245	0.243
Layer No. 7 **Zone2-Above-GW-2**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	423.85	423.91	423.97	423.98	424.10	424.15	424.41	424.44	424.55	425.33
Initial Effective Stress, σ'_i (kPa /psf)	289	289	289	289	289	289	289	289	289	289
Final Effective Stress, σ'_f (kPa/psf)	292	296	341	341	829	1,032	1,015	939	892	888
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	1,302	1,302	1,302	1,303	1,303	1,303	1,303	1,303	1,302	1,302
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.000	0.000	0.002	0.002	0.015	0.018	0.018	0.017	0.016	0.016
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.000	0.000	0.002	0.002	0.015	0.018	0.018	0.017	0.016	0.016
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 7 (m/ ft)	0.000	0.000	0.002	0.002	0.015	0.018	0.018	0.017	0.016	0.016

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Layer No. *8* **Zone2-Above-GW-3**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m / ft)	421.50	421.56	421.62	421.63	421.75	421.80	422.06	422.09	422.20	422.98
Initial Effective Stress, σ'_i (kPa /psf)	482	482	482	482	482	482	482	482	482	482
Final Effective Stress, σ'_f (kPa/psf)	490	499	561	561	1,012	1,199	1,198	1,140	1,086	1,081
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,170	2,170	2,171	2,171	2,171	2,171	2,171	2,171	2,171	2,171
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.000	0.000	0.002	0.002	0.011	0.013	0.013	0.012	0.012	0.012
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.000	0.000	0.002	0.002	0.011	0.013	0.013	0.012	0.012	0.012
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 8 (m / ft)	0.000	0.000	0.002	0.002	0.011	0.013	0.013	0.012	0.012	0.012
Layer No. *9* **Zone2-Above-GW-4**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m / ft)	419.15	419.21	419.26	419.27	419.39	419.44	419.70	419.73	419.84	420.62
Initial Effective Stress, σ'_i (kPa /psf)	675	675	675	675	675	675	675	675	675	675
Final Effective Stress, σ'_f (kPa/psf)	690	706	780	780	1,193	1,366	1,383	1,337	1,281	1,272
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*	*4.5*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,038	3,038	3,039	3,040	3,040	3,040	3,040	3,040	3,039	3,039
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.000	0.001	0.002	0.002	0.008	0.010	0.010	0.010	0.009	0.009
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.000	0.001	0.002	0.002	0.008	0.010	0.010	0.010	0.009	0.009
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 9 (m / ft)	0.000	0.001	0.002	0.002	0.008	0.010	0.010	0.010	0.009	0.009
Layer No. *10* **Zone2-Above-GW-5**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m / ft)	416.79	416.85	416.91	416.92	417.04	417.09	417.35	417.38	417.49	418.27
Initial Effective Stress, σ'_i (kPa /psf)	868	868	868	868	868	868	868	868	868	868
Final Effective Stress, σ'_f (kPa/psf)	893	915	996	996	1,374	1,534	1,570	1,532	1,477	1,464
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	1,736	1,736	1,736	1,737	1,737	1,737	1,737	1,737	1,736	1,736
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.000	0.001	0.002	0.002	0.007	0.008	0.008	0.008	0.008	0.007
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.000	0.001	0.002	0.002	0.007	0.008	0.008	0.008	0.008	0.007
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 10 (m / ft)	0.000	0.001	0.002	0.002	0.007	0.008	0.008	0.008	0.008	0.007

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Layer No. 11 **Zone2-Above-GW-6**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	414.44	414.50	414.56	414.57	414.69	414.74	415.00	415.03	415.14	415.92
Initial Effective Stress, σ'_i (kPa /psf)	1,061	1,061	1,061	1,061	1,061	1,061	1,061	1,061	1,061	1,061
Final Effective Stress, σ'_f (kPa/psf)	1,098	1,124	1,210	1,210	1,555	1,704	1,758	1,726	1,672	1,654
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,122	2,122	2,122	2,123	2,123	2,123	2,123	2,123	2,122	2,122
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.000	0.001	0.002	0.002	0.005	0.007	0.007	0.007	0.007	0.006
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.000	0.001	0.002	0.002	0.005	0.007	0.007	0.007	0.007	0.006
Elastic or Plastic (E/P)										
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 11 (m/ ft)	0.000	0.001	0.002	0.002	0.005	0.007	0.007	0.007	0.007	0.006
Layer No. 12 **Zone2-Above-GW-7**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	412.09	412.15	412.21	412.21	412.33	412.38	412.64	412.67	412.79	413.57
Initial Effective Stress, σ'_i (kPa /psf)	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254
Final Effective Stress, σ'_f (kPa/psf)	1,316	1,350	1,437	1,437	1,728	1,857	1,939	1,917	1,869	1,841
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,508	2,508	2,508	2,509	2,509	2,509	2,509	2,509	2,508	2,508
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.001	0.001	0.002	0.002	0.005	0.006	0.006	0.006	0.006	0.005
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.001	0.001	0.002	0.002	0.005	0.006	0.006	0.006	0.006	0.005
Elastic or Plastic (E/P)										
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 12 (m/ ft)	0.001	0.001	0.002	0.002	0.005	0.006	0.006	0.006	0.006	0.005
Layer No. 13 **Zone2-Above-GW-8**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m/ ft)	409.74	409.80	409.85	409.86	409.98	410.03	410.29	410.32	410.43	411.21
Initial Effective Stress, σ'_i (kPa /psf)	1,447	1,447	1,447	1,447	1,447	1,447	1,447	1,447	1,447	1,447
Final Effective Stress, σ'_f (kPa/psf)	1,522	1,558	1,644	1,645	1,913	2,033	2,125	2,107	2,063	2,029
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,893	2,893	2,894	2,895	2,895	2,895	2,895	2,895	2,894	2,894
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m/ ft)	0.001	0.001	0.002	0.002	0.004	0.005	0.005	0.005	0.005	0.005
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.001	0.001	0.002	0.002	0.004	0.005	0.005	0.005	0.005	0.005
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 13 (m/ ft)	0.001	0.001	0.002	0.002	0.004	0.005	0.005	0.005	0.005	0.005

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Layer No. 14 **Zone2-Above-GW-9**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	407.39	407.45	407.50	407.51	407.63	407.68	407.94	407.97	408.08	408.86
Initial Effective Stress, σ'_i (kPa /psf)	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640
Final Effective Stress, σ'_f(kPa/psf)	1,727	1,765	1,850	1,850	2,098	2,210	2,311	2,296	2,257	2,218
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,279	3,279	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.11%	0.11%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.001	0.001	0.057	0.057	0.116	0.140	0.161	0.158	0.150	0.142
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.001	0.001	0.057	0.057	0.116	0.140	0.161	0.158	0.150	0.142
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 14 (m / ft)	0.001	0.001	0.057	0.057	0.116	0.140	0.161	0.158	0.150	0.142
Layer No. 15 **Zone2-Above-GW-10**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	405.03	405.09	405.15	405.15	405.27	405.32	405.58	405.61	405.73	406.51
Initial Effective Stress, σ'_i (kPa /psf)	1,832	1,832	1,833	1,833	1,833	1,833	1,833	1,833	1,833	1,833
Final Effective Stress, σ'_f(kPa/psf)	1,933	1,971	2,053	2,054	2,283	2,388	2,497	2,485	2,450	2,406
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	1,832	1,832	1,833	1,833	1,833	1,833	1,833	1,833	1,833	1,833
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.025	0.034	0.053	0.053	0.103	0.124	0.145	0.143	0.136	0.128
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.025	0.034	0.053	0.053	0.103	0.124	0.145	0.143	0.136	0.128
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 15 (m / ft)	0.025	0.034	0.053	0.053	0.103	0.124	0.145	0.143	0.136	0.128
Layer No. 16 **Zone2-Above-GW-11**										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	402.68	402.74	402.79	402.80	402.92	402.97	403.23	403.26	403.37	404.15
Initial Effective Stress, σ'_i (kPa /psf)	2,025	2,025	2,026	2,026	2,026	2,026	2,026	2,026	2,026	2,026
Final Effective Stress, σ'_f(kPa/psf)	2,137	2,176	2,256	2,256	2,470	2,567	2,682	2,673	2,642	2,593
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,025	2,025	2,026	2,026	2,026	2,026	2,026	2,026	2,026	2,026
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.025	0.034	0.051	0.051	0.093	0.111	0.132	0.130	0.125	0.116
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.025	0.034	0.051	0.051	0.093	0.111	0.132	0.130	0.125	0.116
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 16 (m / ft)	0.025	0.034	0.051	0.051	0.093	0.111	0.132	0.130	0.125	0.116

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Layer No. *17* **Zone2-Above-GW-12**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	400.33	400.39	400.44	400.44	400.56	400.61	400.87	400.90	401.02	401.80
Initial Effective Stress, σ'_i (kPa /psf)	2,218	2,218	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219
Final Effective Stress, σ'_f (kPa/psf)	2,341	2,379	2,457	2,457	2,656	2,748	2,867	2,860	2,833	2,781
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,218	2,218	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.025	0.033	0.048	0.048	0.085	0.100	0.120	0.119	0.115	0.106
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.025	0.033	0.048	0.048	0.085	0.100	0.120	0.119	0.115	0.106
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 17 (m / ft)	0.025	0.033	0.048	0.048	0.085	0.100	0.120	0.119	0.115	0.106
Layer No. *18* **Zone2-Above-GW-13**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	397.98	398.04	398.09	398.09	398.21	398.26	398.52	398.55	398.67	399.45
Initial Effective Stress, σ'_i (kPa /psf)	2,411	2,411	2,412	2,412	2,412	2,412	2,412	2,412	2,412	2,412
Final Effective Stress, σ'_f (kPa/psf)	2,553	2,591	2,663	2,664	2,838	2,919	3,044	3,041	3,021	2,962
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,411	2,411	2,412	2,412	2,412	2,412	2,412	2,412	2,412	2,412
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.027	0.034	0.047	0.047	0.076	0.090	0.109	0.109	0.106	0.097
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.027	0.034	0.047	0.047	0.076	0.090	0.109	0.109	0.106	0.097
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 18 (m / ft)	0.027	0.034	0.047	0.047	0.076	0.090	0.109	0.109	0.106	0.097
Layer No. *19* **Zone2-Above-GW-14**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	395.62	395.68	395.74	395.74	395.86	395.91	396.17	396.20	396.32	397.10
Initial Effective Stress, σ'_i (kPa /psf)	2,604	2,604	2,605	2,605	2,605	2,605	2,605	2,605	2,605	2,605
Final Effective Stress, σ'_f (kPa/psf)	2,755	2,792	2,861	2,862	3,026	3,102	3,228	3,227	3,211	3,149
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,604	2,604	2,605	2,605	2,605	2,605	2,605	2,605	2,605	2,605
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.026	0.033	0.044	0.044	0.070	0.082	0.101	0.101	0.098	0.089
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.026	0.033	0.044	0.044	0.070	0.082	0.101	0.101	0.098	0.089
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 19 (m / ft)	0.026	0.033	0.044	0.044	0.070	0.082	0.101	0.101	0.098	0.089

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Layer No. 20 Zone2-Above-GW-15										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	393.27	393.33	393.38	393.38	393.50	393.55	393.81	393.84	393.96	394.74
Initial Effective Stress, σ'_i (kPa /psf)	2,797	2,797	2,798	2,798	2,798	2,798	2,798	2,798	2,798	2,798
Final Effective Stress, σ'_f (kPa/psf)	2,956	2,992	3,059	3,060	3,214	3,286	3,412	3,412	3,400	3,336
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,797	2,797	2,798	2,798	2,798	2,798	2,798	2,798	2,798	2,798
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.026	0.032	0.042	0.042	0.065	0.075	0.093	0.093	0.092	0.083
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.026	0.032	0.042	0.042	0.065	0.075	0.093	0.093	0.092	0.083
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 20 (m / ft)	0.026	0.032	0.042	0.042	0.065	0.075	0.093	0.093	0.092	0.083
Layer No. 21 Zone2-Above-GW-16										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	390.92	390.98	391.03	391.03	391.15	391.20	391.46	391.49	391.61	392.39
Initial Effective Stress, σ'_i (kPa /psf)	2,990	2,990	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991
Final Effective Stress, σ'_f (kPa/psf)	3,156	3,192	3,256	3,257	3,402	3,470	3,597	3,598	3,589	3,522
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	2,990	2,990	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.025	0.031	0.040	0.040	0.061	0.070	0.087	0.087	0.086	0.077
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.025	0.031	0.040	0.040	0.061	0.070	0.087	0.087	0.086	0.077
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 21 (m / ft)	0.025	0.031	0.040	0.040	0.061	0.070	0.087	0.087	0.086	0.077
Layer No. 22 Zone2-Above-GW-17										
Initial Stress Reference Layer (top of layer)	6	6	6	6	6	6	6	6	6	6
Final Stress Reference Layer (top of layer)	1	1	1	1	1	1	1	1	1	1
Midpoint Elevation, (m / ft)	388.57	388.63	388.68	388.68	388.80	388.85	389.11	389.14	389.26	390.04
Initial Effective Stress, σ'_i (kPa /psf)	3,183	3,183	3,184	3,184	3,184	3,184	3,184	3,184	3,184	3,184
Final Effective Stress, σ'_f (kPa/psf)	3,356	3,391	3,452	3,453	3,591	3,655	3,781	3,784	3,777	3,709
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
OCR Manual Input Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,183	3,183	3,184	3,184	3,184	3,184	3,184	3,184	3,184	3,184
Modified Primary Compression Index, $C_{c\varepsilon}$	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
Modified Recompression Index, $C_{r\varepsilon}$	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
ratio of t2 / t1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Settlements										
Primary Settlement, (m / ft)	0.025	0.030	0.038	0.038	0.056	0.065	0.081	0.081	0.080	0.072
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.025	0.030	0.038	0.038	0.056	0.065	0.081	0.081	0.080	0.072
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 22 (m / ft)	0.025	0.030	0.038	0.038	0.056	0.065	0.081	0.081	0.080	0.072

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Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

Layer No. *23* **Zone3-Above-GW-1**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	384.80	384.89	384.91	384.90	384.89	384.89	384.86	384.85	384.85	385.40
Initial Effective Stress, σ'_i (kPa /psf)	3,491	3,490	3,493	3,494	3,504	3,509	3,533	3,536	3,545	3,564
Final Effective Stress, σ'_f (kPa/psf)	3,671	3,703	3,764	3,766	3,907	3,972	4,121	4,127	4,134	4,084
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,491	3,490	3,493	3,494	3,504	3,509	3,533	3,536	3,545	3,564
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*
Modified Recompression Index, $C_{r\varepsilon}$	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m/ ft)	0.043	0.050	0.064	0.064	0.098	0.114	0.156	0.159	0.164	0.156
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.043	0.050	0.064	0.064	0.098	0.114	0.156	0.159	0.164	0.156
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 23 (m/ ft)	0.043	0.050	0.064	0.064	0.098	0.114	0.156	0.159	0.164	0.156
Layer No. *24* **Zone3-Above-GW-2**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	379.63	379.76	379.72	379.71	379.44	379.32	378.71	378.64	378.38	378.47
Initial Effective Stress, σ'_i (kPa /psf)	3,916	3,910	3,918	3,920	3,952	3,966	4,037	4,045	4,075	4,132
Final Effective Stress, σ'_f (kPa/psf)	4,095	4,124	4,190	4,192	4,354	4,429	4,625	4,637	4,664	4,652
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	3,916	3,910	3,918	3,920	3,952	3,966	4,037	4,045	4,075	4,132
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*
Modified Recompression Index, $C_{r\varepsilon}$	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m/ ft)	0.038	0.045	0.057	0.057	0.087	0.101	0.138	0.140	0.144	0.135
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.038	0.045	0.057	0.057	0.087	0.101	0.138	0.140	0.144	0.135
Elastic or Plastic (E/P)	p	p	p	p	p	p	p	p	p	p
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 24 (m/ ft)	0.038	0.045	0.057	0.057	0.087	0.101	0.138	0.140	0.144	0.135
Layer No. *25* **Zone2-Below-GW-18**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m/ ft)	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Initial Effective Stress, σ'_i (kPa /psf)	4,128	4,121	4,130	4,133	4,175	4,194	4,289	4,300	4,340	4,417
Final Effective Stress, σ'_f (kPa/psf)	4,313	4,339	4,405	4,407	4,574	4,650	4,869	4,884	4,923	4,930
Elastic Method										
Modulus, E (kPa/psf)= Strain										
Settlement (m/ ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,128	4,121	4,130	4,133	4,175	4,194	4,289	4,300	4,340	4,417
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Secondary Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Elastic or Plastic (E/P)										
	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 25 (m/ ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

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Layer No. *26* **Zone2-Below-GW-19**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m / ft)	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Initial Effective Stress, σ'_i (kPa /psf)	4,128	4,121	4,130	4,133	4,175	4,194	4,289	4,300	4,340	4,417
Final Effective Stress, σ'_f (kPa/psf)	4,328	4,351	4,410	4,413	4,562	4,631	4,844	4,861	4,900	4,907
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,128	4,121	4,130	4,133	4,175	4,194	4,289	4,300	4,340	4,417
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*	*0.460*
Modified Recompression Index, $C_{r\varepsilon}$	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*	*0.014*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*	*0.91%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 26 (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Layer No. *27* **Zone3-Below-GW-3**										
Initial Stress Reference Layer (top of layer)	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
Final Stress Reference Layer (top of layer)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Midpoint Elevation, (m / ft)	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Initial Effective Stress, σ'_i (kPa /psf)	4,128	4,121	4,130	4,133	4,175	4,194	4,289	4,300	4,340	4,417
Final Effective Stress, σ'_f (kPa/psf)	4,332	4,354	4,411	4,414	4,558	4,625	4,828	4,846	4,893	4,895
Elastic Method										
Modulus, E (kPa/psf)= ______ Strain										
Settlement (m / ft)										
1-D Consolidation Theory (Plastic Method)										
Consolidation Properties										
OCR Manual or Auto Input (MW/MS: Manual waste/soil, A:Automatic)	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*	*MS*
OCR Manual Input Value	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
OCR Computation Input										
Preconsolidation pressure, σ'_p (kPa / psf)	4,128	4,121	4,130	4,133	4,175	4,194	4,289	4,300	4,340	4,417
Modified Primary Compression Index, $C_{c\varepsilon}$	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*	*0.380*
Modified Recompression Index, $C_{r\varepsilon}$	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*	*0.70%*
ratio of t2 / t1	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Settlements										
Primary Settlement, (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Secondary Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Settlement (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Elastic or Plastic (E/P)	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D	1-D
Settlement of Layer 27 (m / ft)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Written by: **Fan Zhu** Date: **12/10/2010** Reviewed by: **R. Kulasingam/Jay Beech** Date: **12/13/2010**

Client: **Honeywell** Project: **Onondaga Lake SCA Final Design** Project/ Proposal No.: **GJ4299** Task No.: **05**

LAYER SETTLEMENT

Layer No.	Material										
1											
2											
3											
4	*Preload*										
5	*Dike*										
6	*Zone2-Above-GW-1*	0.000	0.000	0.003	0.003	0.205	0.345	0.330	0.269	0.245	0.243
7	*Zone2-Above-GW-2*	0.000	0.000	0.002	0.002	0.015	0.018	0.018	0.017	0.016	0.016
8	*Zone2-Above-GW-3*	0.000	0.000	0.002	0.002	0.011	0.013	0.013	0.012	0.012	0.012
9	*Zone2-Above-GW-4*	0.000	0.001	0.002	0.002	0.008	0.010	0.010	0.010	0.009	0.009
10	*Zone2-Above-GW-5*	0.000	0.001	0.002	0.002	0.007	0.008	0.008	0.008	0.008	0.007
11	*Zone2-Above-GW-6*	0.000	0.001	0.002	0.002	0.005	0.007	0.007	0.007	0.007	0.006
12	*Zone2-Above-GW-7*	0.001	0.001	0.002	0.002	0.005	0.006	0.006	0.006	0.006	0.005
13	*Zone2-Above-GW-8*	0.001	0.001	0.002	0.002	0.004	0.005	0.005	0.005	0.005	0.005
14	*Zone2-Above-GW-9*	0.001	0.001	0.057	0.057	0.116	0.140	0.161	0.158	0.150	0.142
15	*Zone2-Above-GW-10*	0.025	0.034	0.053	0.053	0.103	0.124	0.145	0.143	0.136	0.128
16	*Zone2-Above-GW-11*	0.025	0.034	0.051	0.051	0.093	0.111	0.132	0.130	0.125	0.116
17	*Zone2-Above-GW-12*	0.025	0.033	0.048	0.048	0.085	0.100	0.120	0.119	0.115	0.106
18	*Zone2-Above-GW-13*	0.027	0.034	0.047	0.047	0.076	0.090	0.109	0.109	0.106	0.097
19	*Zone2-Above-GW-14*	0.026	0.033	0.044	0.044	0.070	0.082	0.101	0.101	0.098	0.089
20	*Zone2-Above-GW-15*	0.026	0.032	0.042	0.042	0.065	0.075	0.093	0.093	0.092	0.083
21	*Zone2-Above-GW-16*	0.025	0.031	0.040	0.040	0.061	0.070	0.087	0.087	0.086	0.077
22	*Zone2-Above-GW-17*	0.025	0.030	0.038	0.038	0.056	0.065	0.081	0.081	0.080	0.072
23	*Zone3-Above-GW-1*	0.043	0.050	0.064	0.064	0.098	0.114	0.156	0.159	0.164	0.156
24	*Zone3-Above-GW-2*	0.038	0.045	0.057	0.057	0.087	0.101	0.138	0.140	0.144	0.135
25	*Zone2-Below-GW-18*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	*Zone2-Below-GW-19*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	*Zone3-Below-GW-3*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28											
29	*Soil Above GW*										
30	*Soil Below GW*										
	TOTAL SETTLEMENT	**0.29**	**0.36**	**0.56**	**0.56**	**1.17**	**1.48**	**1.72**	**1.65**	**1.60**	**1.50**

POST-SETTLEMENT ELEVATION(M/FT)

Line												
Line	1		427.09	427.08	426.94	426.95	430.99	432.77	432.53	431.32	431.48	432.36
Line	2		427.09	427.08	426.94	426.95	430.99	432.77	432.53	431.32	431.48	432.36
Line	3		427.09	427.08	426.94	426.95	430.99	432.77	432.53	431.32	431.48	432.36
Line	4	Top of Preload	427.09	427.08	426.94	426.95	430.99	432.77	432.53	431.32	431.48	432.36
Line	5	Top of Dike	427.09	427.08	426.94	426.95	430.99	432.77	432.53	431.32	426.48	427.36
Line	6	Top of Subgrade	427.09	427.08	426.94	426.95	426.46	426.20	426.22	426.32	426.48	427.36
Line	7		424.74	424.73	424.59	424.60	424.31	424.19	424.19	424.23	424.37	425.25
Line	8		422.39	422.37	422.24	422.25	421.97	421.85	421.86	421.89	422.03	422.91
Line	9		420.03	420.02	419.89	419.90	419.63	419.51	419.52	419.55	419.69	420.57
Line	10		417.68	417.67	417.54	417.55	417.28	417.17	417.17	417.21	417.35	418.22
Line	11		415.33	415.32	415.19	415.20	414.94	414.82	414.83	414.86	415.00	415.88
Line	12		412.98	412.97	412.84	412.84	412.59	412.48	412.48	412.52	412.66	413.53
Line	13		410.63	410.62	410.49	410.49	410.24	410.13	410.14	410.17	410.31	411.18
Line	14		408.27	408.27	408.14	408.14	407.89	407.78	407.79	407.82	407.96	408.84
Line	15		405.92	405.91	405.84	405.84	405.65	405.57	405.60	405.63	405.76	406.63
Line	16		403.60	403.60	403.54	403.54	403.40	403.34	403.39	403.42	403.54	404.40
Line	17		401.27	401.28	401.24	401.24	401.14	401.09	401.17	401.19	401.31	402.16
Line	18		398.94	398.96	398.93	398.94	398.87	398.84	398.93	398.96	399.07	399.92
Line	19		396.62	396.64	396.63	396.63	396.60	396.58	396.69	396.71	396.83	397.66
Line	20		394.29	394.32	394.32	394.32	394.31	394.31	394.44	394.46	394.57	395.40
Line	21		391.96	392.00	392.01	392.01	392.02	392.03	392.18	392.20	392.31	393.13
Line	22		389.64	389.68	389.69	389.69	389.73	389.74	389.91	389.93	390.04	390.85
Line	23	Bottom of Zone2 Above GW	387.31	387.35	387.38	387.38	387.43	387.45	387.64	387.66	387.77	388.57
Line	24		382.18	382.28	382.26	382.25	382.08	382.00	381.64	381.60	381.47	381.79
Line	25	Bottom of Zone 3 Above GW	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Line	26		377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Line	27	Bottom of Zone 2 Below GW	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Line	28	Top of Incompressible Layer	377.04	377.19	377.13	377.11	376.71	376.53	375.63	375.53	375.15	375.00
Line	29	GND										
Line	30	GW										
Line	31	ROCK										

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: Honeywell **Project:** Onondaga Lake SCA **Project/Proposal #:** GJ4299 **Task #:** 05

TITLE OF COMPUTATIONS **DESIGN OF COLLECTION SYSTEMS FOR SCA BASIN SUMPS**

COMPUTATIONS BY:
Signature
Printed Name and Title: Jesus Sanchez, Senior Staff Engineer
DATE: 9/19/2011

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature: R. Kulasingam
Printed Name and Title: Ramachandran Kulasingam, Senior Engineer
DATE: 9/19/2011

COMPUTATIONS CHECKED BY:
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Printed Name and Title: for Fan Zhu, Senior Staff Engineer
DATE: 9/19/2011

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: Jesus Sanchez, Senior Staff Engineer
DATE: 9/19/2011

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: J.F. Beech, Principal
DATE: 19 Sept 2011

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

9/19/2011

DESIGN OF COLLECTION SYSTEMS FOR SCA BASIN SUMPS

INTRODUCTION

This package was prepared in support of the design of the Sediment Consolidation Area (SCA) for the Onondaga Lake Bottom Site, which will be constructed on Wastebed (WB-13) to contain dredged material from the Lake. This package presents analyses related to the design of the SCA East and West Basin Sumps, which include a system of collection pipes. Figures 1 and 2 show the proposed design of the SCA East and West Basin Sumps. For each basin sump, the purpose of the analyses presented in this package is to:

1. Calculate the dimensions of the primary sump.
2. Calculate the infiltration capacity of the primary sump.
3. Calculate the leakage rate through the primary liner.
4. Calculate the capacity of the leakage collection system, including the secondary sump and pump.
5. Calculate the storage volume and typical pump on and off times for the secondary sump.
6. Calculate the inflow capacity for the primary and secondary collection pipes and risers.
7. Evaluate the requirements for structural stability of the primary and secondary collection pipes and risers, including: (a) wall crushing; (b) wall buckling; (c) excessive ring deflection; and (d) excessive ring bending strain.

The sumps, pumps, collection pipes, and risers analyzed herein are designed for the operational conditions.

METHODOLOGY

The calculations for each basin sump that are presented in this package include seven steps: (1) calculating the dimensions of the primary sump; (2) calculating the infiltration capacity of the primary sump; (3) calculating the leakage rate through the primary liner; (4) calculating the capacity of the leakage collection system; (5) calculating the pore volume and typical pump on and off times for the secondary sumps; (6) calculating the inflow capacity for the primary and secondary collection pipes and risers; and (7) evaluating the requirements for structural stability for the critical section of the collection pipes and risers. Methodologies used for each of these calculations are presented below.

1. Primary Sump Sizing

The primary sump for each basin was designed to contain approximately 30,000 gallons of water at a depth of 6 feet to provide ideal operating conditions for various mobile pumps that are being considered for the project. The target volume of approximately 30,000 gallons was selected to provide for a few minutes of storage for flow equalization and optimal pump operation. The primary sumps were designed with 2.5:1 horizontal-to-vertical side slopes consistent with the SCA berms, as shown in Figure 1. The shape of the primary sumps can be characterized as a truncated pyramid. The volume of a truncated pyramid can be calculated using the following equation:

$$V = \frac{1}{3} h \left(a^2 + a\,b + b^2\right) \qquad (1)$$

Where: *a* = the length of the bottom square,

b = the length of the top square, and

h = the height of the truncated pyramid.

Given a 2.5:1 horizontal-to-vertical side slope, we have the following relationship:

$$b = a + 2\,(2.5 * h) \qquad (2)$$

The sumps are proposed to be filled with gravel. Using a typical value for gravel porosity of 0.4 presented in "*Sump and Riser Calculations for SCA Design*" [Parsons and Geosyntec, 2010b], the storage volume can be expressed as:

$$V_S = 0.4 * V \qquad (3)$$

Where: V = total volume, and

V_S = storage volume.

2. Primary Sump Infiltration Capacity

Prior to designing the primary sump for each basin, the infiltration capacity of the gravel was calculated to verify that it can accommodate the maximum discharge, which is estimated to be 6,000 gpm. Applying Darcy's Law for calculating flow through a porous medium, the primary sumps can be characterized as a vertical conduit with a flow area equal to the bottom area of the primary sumps:

$$Q = k * i * A \quad (4)$$

Where, Q = flow rate,
k = hydraulic conductivity,
i = hydraulic gradient, and
A = outlet area.

3. Flow Rate through the Primary Liner

Leakage through composite liners is primarily due to leakage through defects (e.g., holes) in the geomembrane [Bonaparte et al., 1989]. As shown by Bonaparte et al., leakage due to permeation through geomembranes can be considered negligible for landfills.

For the proposed double-liner system, presented in Figure 2, the geocomposite leak collection layer conveys discharge from the defects to the secondary sump. The geocomposite is located between two layers of geomembrane (i.e., between the primary and secondary liner). The following form of Bernoulli's Equation can be applied to calculate the flow through a single defect:

$$Q = 0.6\, A \sqrt{2\, g\, h} \quad (5)$$

Where, Q = flow through defect,

A = 0.05 in^2, [Bonaparte et al., 1989], defect area,

g = 32.2 ft/s^2, gravitational constant, and

h = head.

To calculate the total flow into the geocomposite, an estimate of the number of defects per acre [Bonaparte et al., 1989] is applied:

$$Q_T = n\, A_T\, Q \quad (6)$$

Where, Q_T = flow into geocomposite,

n = 1 defect per acre, [Bonaparte et al., 1989],

A_T = total area of basin (in acres), and

Q = flow through one defect.

4. Discharge Capacity of the Leakage Collection System

Calculating the discharge capacity of the geocomposite leak collection layer is performed to verify that the discharge capacity exceeds the discharge rate through the defects in the primary liner. Flow through the geocomposite can be analyzed as flow through a porous medium, and thus, calculated using Darcy's Law:

$$Q = k\, i\, A \quad (7)$$

Where, Q = flow rate,

k = hydraulic conductivity,

i = hydraulic gradient, and

A = area of discharge.

The discharge capacity of a geocomposite is described using transmissivity, which is proportional to the product of the thickness and hydraulic conductivity of the geocomposite. Thus, using transmissivity to describe horizontal hydraulic flow, Equation 7 above can be modified as follows:

$$Q = \Theta \, i \, L \tag{8}$$

Where, Q = flow rate,

Θ = transmissivity,

i = hydraulic gradient, and

L = average length perpendicular to the flow area.

The discharge capacity of the geocomposite is evaluated for each basin using estimates of average hydraulic gradient and average length perpendicular to the flow area.

5. Secondary Sump Storage Volume and Pump Sizing

The storage volume of the secondary sump is calculated as the volume between the pump-off and -on level. This volume is comprised of pore volume for areas outside of the lateral collection and riser pipes.

Pump-on time is calculated by dividing the storage volume by the selected pumping rate minus the leakage rate. Pump-off time is calculated by dividing the storage volume by the leakage rate to the sump.

6. Perforated Pipe Flow Capacity

The methodology for calculating the number and size of pipe perforations, and the resulting flow capacity of the perforated pipes is presented in a calculation package titled "*Sump and Riser Calculations for SCA Design*" as part of the SCA Final Design [Parsons and Geosyntec, 2010b]. It was assumed that pump intakes will be placed in the pipes to pump out water from the bottom of the lateral collection pipes and riser pipes.

7. Evaluation of Structural Stability

Calculations were performed to verify that the proposed lateral collection pipes are able to withstand the loads applied on them with adequate factors of safety. Failure mechanisms that were checked include: (a) wall crushing; (b) wall buckling; (c) excessive ring deflection; and (d) excessive bending strain. Plastic pipe can be designed to resist failure by the above mechanisms using design methods presented in the technical literature [Chevron Phillips, 2003].

Stresses applied on the proposed lateral collection pipes will be estimated for the condition when the sump area is fully loaded. The stress applied to the pipe is due to the materials surrounding the pipe. The perforations within the pipe will also increase the stress on the pipe by reducing the area available to handle loads. The vertical stress on a horizontal pipe can be calculated as follows [Qian et al., 2002]:

$$P_t = \frac{\sum \gamma_p * H}{144 * (1 - n * d / 12)} \tag{9}$$

Where,

P_t	=	Vertical stress applied to the pipe, (psi),
γ_p	=	Weighted average unit weight of the overburden materials (pcf),
H	=	Thickness of the overburden materials (ft),
n	=	Number of perforations per row per foot of pipe, and
d	=	Diameter of individual perforation (in).

Wall Crushing: Wall crushing can occur when the stress in the pipe wall, due to external pressure, exceeds the compressive strength of the pipe material. The compressive stress on the pipe wall can be calculated by the following equation [Chevron Phillips, 2003]:

$$S = \frac{P_t * D}{288 \cdot t} \tag{10}$$

Where,

S	=	Pipe wall compressive stress (psi),

P_t = Vertical stress applied to the pipe (psf),
D = Outside diameter of pipe (in), and
t = Minimum wall thickness of pipe (in).

The factor of safety (FS) against pipe wall crushing may be calculated using the following equation:

$$FS_{wc} = \frac{\sigma_y}{S} \tag{11}$$

Where,

FS_{wc} = Factor of safety against pipe wall crushing,
σ_y = Compressive yield strength of the pipe (psi), and
S = Pipe wall compressive stress (psi).

A FS of 2.0 is recommended by Chevron Phillips [2003] for wall crushing.

Wall Buckling: Wall buckling, a longitudinal wrinkling in the pipe wall, can occur if the external pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The critical wall buckling pressure may be calculated using the following equation [Chevron Phillips, 2003]:

$$P_{WB} = 5.65 * \sqrt{R \; * B' * E' \frac{E}{12 * (SDR - 1)^3}} \tag{12}$$

Where,

P_{WB} = Critical wall buckling pressure (psi),
R = Water buoyancy factor,

$$R \; = \; 1 - (0.33 * \frac{H_w}{H}) \tag{13}$$

H_w = Height of water table above pipe (ft),

H = Height of waste + final cover above pipe (ft),

B' = Coefficient of elastic support,

$$B' = \frac{1}{1+4*e^{-0.065\cdot H}} \tag{1}$$

E' = Modulus of soil reaction for pipe bedding (psi),
E = Long-term modulus of elasticity of the pipe material (psi), and
SDR = Standard dimension ratio of the pipe.

The FS against pipe wall buckling may be calculated using the following equation:

$$FS_{WB} = \frac{P_{WB}}{P_t} \tag{2}$$

Where,

FS_{WB} = Factor of safety against pipe wall buckling,
P_{WB} = Critical wall buckling pressure (psi), and
P_t = Vertical stress applied to the pipe (psi).

A FS of 2.0 is recommended by Chevron Phillips [2003] for wall buckling.

Excessive Ring Deflection: Excessive ring deflection, a horizontal over-deflection of the pipe causing a reversal of curvature of the pipe wall, can occur where large external pressures are applied to the pipe/bedding aggregate system. In addition, excessive ring deflection can lead to substantial loss in flow capacity. Ring deflection is calculated using Spangler's Modified Iowa Formula [Chevron Phillips, 2003]:

$$\Delta X\% = \frac{\Delta X}{D_i}*100 = \left[\frac{P_t*K*L}{\left(\frac{2*E}{3}\frac{1}{(SDR-1)^3}\right)+(0.061*E')}\right]*100 \tag{16}$$

Where,

$\Delta X\%$ = Ring deflection (%),
ΔX = Maximum deflection or change in diameter (in),
D_i = Internal pipe diameter (in),
P_t = Vertical stress applied to the pipe (psi),
K = Bedding constant (assume 0.1) [Chevron Phillips, 2003],
L = Deflection lag factor,
E = Short-term modulus of elasticity of the pipe material (psi),
SDR = Standard dimension ratio of the pipe, and
E' = Modulus of soil reaction for pipe bedding material (psi).

Spangler recommends a value between 1.0 and 1.5 for the deflection lag factor (L) to be used in the Modified Iowa Formula, to account for visco-elastic deformation of the pipe [Chevron Phillips, 2003]. An average value of 1.25 is used for the calculations presented herein. An allowable ring deflection of 7.5% is assumed based on guidance from Chevron Phillips [2003].

Excessive Bending Strain: When a pipe deflects under load, bending strains are induced in the pipe wall. Bending strain occurs in the pipe wall as external pressures are applied to the pipe/bedding aggregate system. Bending strain is calculated using the following equation [Chevron Phillips, 2003]:

$$\varepsilon_b = f_d * \frac{\Delta X}{D_m} * \frac{2 \cdot C}{D_m} \qquad (17)$$

Where,

ε_b = Bending strain in the pipe wall (%),
f_d = Deformation shape factor,
ΔX = Maximum deflection or change in diameter (in),
C = Distance from outer fiber to wall centroid, (in)
= 0.5 * (1.06 * pipe wall thickness) [Chevron Phillips, 2003],
D_m = Mean pipe diameter (in)
= D – (1.06 * pipe wall thickness) [Chevron Phillips, 2003], and
D = Outside diameter of pipe (in).

The deformation factor (f_d) or shape factor is a function of pipe stiffness (PS), type of backfill material, and compaction level. Based on the guidance presented in the Design Manual for Corrugated HDPE pipes by Plastics Pipe Institute [PPI, 2007], a deformation factor can be selected based on the calculated PS of the proposed lateral collection pipes and bedding material used. A list of long-term PS values for typical commercially available pipes is presented in Table 1, and the corresponding deformation shape factors are shown in Table 2.

The following are recommendations for allowable bending strain from the literature and plastic pipe manufacturers:

- An allowable bending strain of 5% is recommended by Wilson-Fahmy and Koerner [1994], based on AASHTO guidelines.
- An allowable bending strain of 4.2% is recommended as conservative in Chevron Phillips [2003], where it is noted that strains up to 8% are reported in the literature as acceptable for a design period of 50 years.

Based on the above recommendations and the calculation of a very conservative maximum deflection (ΔX) value since the effect of arching was neglected, an allowable strain of 5% was selected for this application.

INPUT PROPERTIES

1. Primary Sump Sizing

The gravel depth is set to h = 6 feet, as shown in the proposed design in Figure 2.

2. Primary Sump Infiltration Capacity

The flow area is calculated as the bottom area of the primary sump, 625 ft^2. Calculating the hydraulic gradient over the full depth of the sump, without standing water above the top of gravel, yields i = 1. A hydraulic conductivity of 10 cm/s is assumed for the gravel.

3. Flow Rate through the Primary Liner

West Basin: Area equivalent to surface area of basin, 2.39 acres. East Basin: Area equivalent to surface area of basin, 3.86 acres. Height above primary liner is calculated as equivalent to the height at half volume to represent a reasonable condition to evaluate leakage.

4. Discharge Capacity of the Leakage Collection System

The average length perpendicular to the flow area and average hydraulic gradient are estimated using the grades shown in Figure 3. The length of outlet flow area, L, is measured at approximately half way along the flow path, and is estimated to be 350 ft and 400 ft for the West Basin and East Basin, respectively. The average slope expected on the bottom of the basins is used for the hydraulic gradient. The average slope is estimated to be 1.7% and 0.9% for the West Basin and East Basin, respectively. The transmissivity is selected to be $2x10^{-3}$ m^2/s, [Skaps Industries, 2010].

5. Secondary Sump Storage Volume and Pump Sizing

The pump-off level is assumed to be set at 1.5 feet from the bottom of the sump. The pump-on level is assumed to be set at 2.5 feet from the bottom of the sump. The storage volume available between these two heights is approximately 890 gallons. The submersible pump is assumed to have a pumping rate of 10 gpm, and the leakage rates from the geocomposite are input from the results of Step 3 - *Flow Rate through the Primary Liner.*

6. Perforated Pipe Flow Capacity

Each of the 16 lateral collection pipes in the primary collection systems are laid approximately east-west and assumed to have a perforated length of 25 feet, and each primary riser pipe running approximately north-south was assumed to have a perforated length of 15 feet. Each secondary riser pipe of the Secondary Collection System running approximately north-south was assumed to have a perforated length of 25 feet. These dimensions are based on the plan lengths rather than the sloped lengths, which will produce lower (i.e., more conservative) calculations of flow capacity. It is assumed that the lateral collection pipes will be placed along the sloped sides and bottom of the SCA basin primary sumps, as shown in Figure 2.

A v_{ent} = 0.1 ft/s (i.e., entry velocity) for pipe perforation calculations is recommended in the literature [Qian et al., 2002]. However, this recommendation is based on conditions with a limited water head (i.e., h=0.0002 ft). For purposes of this package, a larger value of v_{ent} = 0.33 ft/s has been assumed, corresponding to a calculated water head of h=0.002 ft and a calculated inflow of approximately 0.5 gal/min for each perforation, which is considered to be reasonable. The expected inflow capacity of the gravel calculated using Darcy's Law is also approximately 0.33 ft/s, therefore v_{ent} = 0.33 ft/s is considered to be reasonable.

7. Evaluation of Structural Stability

It is assumed that the lateral collection pipes will be a minimum HDPE SDR 26, with a nominal diameter of 12 inches and an inside diameter of 11.71 inches as shown in Table 3 [IscoIndustries, 2009]. The riser pipes will be a minimum HDPE SDR 32.5, with a nominal diameter of 24 inches and an inside diameter of 22.434 inches, as shown in Table 3 [IscoIndustries, 2009]. The pipes are assumed to have a short-term modulus of elasticity of 110,000 psi at 73°F and a long-term modulus of elasticity of 28,200 psi at 73°F as shown in Table 4 [Chevron Phillips, 2004]. A reduction factor of 0.76 has been conservatively applied to the long-term modulus of elasticity to account for stress concentrations [August et al., 1997]. The pipes are assumed to have a typical compressive yield strength of 1600 psi [IscoIndustries, 2009].

The unit weight and drained friction angle of the gravel are considered to be 120 pcf and 38 degrees, respectively, following recommendations from Appendix G of the Draft SCA Final Design, "Slope Stability Analyses for SCA Design" [Parsons and Geosyntec, 2010a]. A typical value of 0.4 is selected for the porosity of the gravel.

The lateral collection pipe is assumed to be below 5 feet of gravel and a water depth of 5.5 feet. The secondary riser pipe is assumed to be below 4 feet of gravel and a water depth of 4.5 feet. Both of these alignments can be seen on Figure 2. The modulus of soil reaction for pipe bedding material [Chevron Phillips, 2003] was set to 700 psi for coarse grained soils with a depth of up to 5 feet and minimum compaction, as shown in Table 5.

CALCULATIONS AND RESULTS OF ANALYSIS

1. Primary Sump Sizing

Solving Equation 1 using Equations 2 and 3 with a fixed gravel depth of h = 6 feet, a storage volume of V_s = 30,000 gal, and a typical value for gravel porosity of 0.4 results in a bottom width of a = 25 feet and top width of b = 55 feet. Calculations are presented in Attachment 1.

2. Primary Sump Infiltration Capacity

The resulting flow through the gravel (i.e., infiltration capacity) is Q = 90,000 gpm. This calculated infiltration capacity is well over the estimated maximum flow of 6,000 gpm during operational conditions. Calculations are presented in Attachment 2.

Bypass riser pipes are provided, as shown in Figure 2, as an additional measure to route the liquid directly to the collection system pipes if liquid starts ponding above the gravel in the primary sump.

3. Flow Rate through the Primary Liner

The height above the primary liner for each basin to be half full is presented in Attachment 3. The stage-storage data presented in these plots is measured from the grades shown in Figure 1. The height at half volume for the West and East Basins is 7 and 4 feet, respectively. The resulting flow through each defect for the West and East Basins is 2.0 and 1.5 gpm, respectively. The calculated discharge through the primary liner into the geocomposite for the West and East Basins is 4.7 and 5.8 gpm, respectively (i.e., 6,800 gal/day and 8,300 gal/day, respectively). These flow rate calculations are provided in Attachment 4.

4. Discharge Capacity of the Leakage Collection System

The discharge capacity of the geocomposite leakage collection system is estimated to be 34 and 58 gpm for the East and West SCA Basins, respectively (i.e., 48,700 gal/day and 82,800 gal/day, respectively), as shown in the Attachment 5 calculations. These calculations verify that the discharge capacities of the geocomposite leakage collection system for both basins are significantly greater than their respective leakage rates.

5. Secondary Sump Storage Volume and Pump Sizing

As indicated in the calculations presented in Attachment 6, the cycle time for the West Basin secondary sump is 6.0 hours: 2.8 hours to drain and 3.2 to fill the storage volume. The resulting cycle time for the East Basin secondary sump is 6.1 hours: 3.5 hours to drain and 2.6 to fill the storage volume. It is noted that the pump-on and -off levels can be programmed to accommodate varying leakage rates based on water level in the basins. These cycling times and pump capacities are consistent with typical values for similar applications and indicate that the dimensions of the secondary sump are appropriate.

6. Perforated Pipe Flow Capacity

Table 6 summarizes the calculations provided in Attachment 7 that indicate the combined capacity of the collection pipes in the primary sump exceeds the estimated maximum flow rate of 6,000 gpm during operational conditions. Therefore, during operational conditions liquid can be removed using mobile pumps efficiently on an as-needed basis to control liquid levels in the basin sumps.

Table 7 summarizes the calculations in Attachment 8 that indicate the flow capacity of the secondary riser pipe exceeds the estimated flow to the secondary sump.

7. Evaluation of Structural Stability

Each of the structural stability evaluations meet the recommended target values. The evaluations in Attachments 9 and 10 are summarized in Tables 8 and 9.

SUMMARY AND CONCLUSIONS

This package presents analyses related to the design of the collection systems for the SCA East and West Basin Sumps, which include perforated lateral collection and riser pipes. The following seven calculations were performed for each basin sump: (1) calculating the dimensions of the primary sump; (2) calculating the infiltration capacity of the primary sump; (3) calculating the leakage rate through the primary liner; (4) calculating the capacity of the leakage collection system; (5) calculating the pore volume and typical pump-on and -off times for the secondary sump; (6) calculating the inflow capacity for the primary and secondary collection pipes and risers; and (7) evaluating the requirements for structural stability for the critical section of the collection pipes and risers.

Based on the design criteria for the SCA basin sumps during operational conditions, the proposed sump design is a truncated pyramid, with the selected sump dimensions, that has a storage capacity of approximately 30,000 gallons. Calculations for leakage through the proposed primary liner show that a geocomposite collection layer with transmissivity of $2x10^{-3}$ m^2/s has more than sufficient capacity to transmit the calculated leakage through the primary liner of the basins. It is recommended that the expected leakage through the primary liner system of the basins be collected in the specified secondary sumps and pumped out using 10 gpm submersible pumps, which will discharge back into the basin primary sumps.

Based on the calculations, and consistent with applications for similar projects, it is conservatively recommended that SDR 17 be used for both the lateral collection and riser pipes in both the primary and secondary sump collection systems. SDR 17 was a conservative selection due to its higher strength properties, compared to both SDR 26 and 32.5. These systems include both 12- and 24-inch nominal HDPE pipe sizes. The perforated lengths of these pipes are proposed to have a perforation angle of 45 degrees, perforation row offset of 3 inches, and a 1-inch perforation diameter. The resulting infiltration capacity of both systems exceeds the inputs from the SCA during operation conditions and any leakage through the primary liner of the basins. Mobile pumps will be used to remove the liquid from the primary sumps and will have adequate capacity to match the operational flow conditions. The structural integrity evaluations of the pipe collection systems indicate that the calculated strains and deflection on the pipes do not exceed the target ring strains and deflections. In addition, the calculated Factors of Safety (FS) satisfy the target FS for wall buckling and crushing.

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FIGURES

Written by:	Jesus Sanchez	Date:	12/21/10	Reviewed by:	F. Zhu/R. Kulasingam	Date:	12/22/2010
Client:	Honeywell	Project:	Onondaga Lake SCA	Project No.:	GJ4299	Task No.:	05

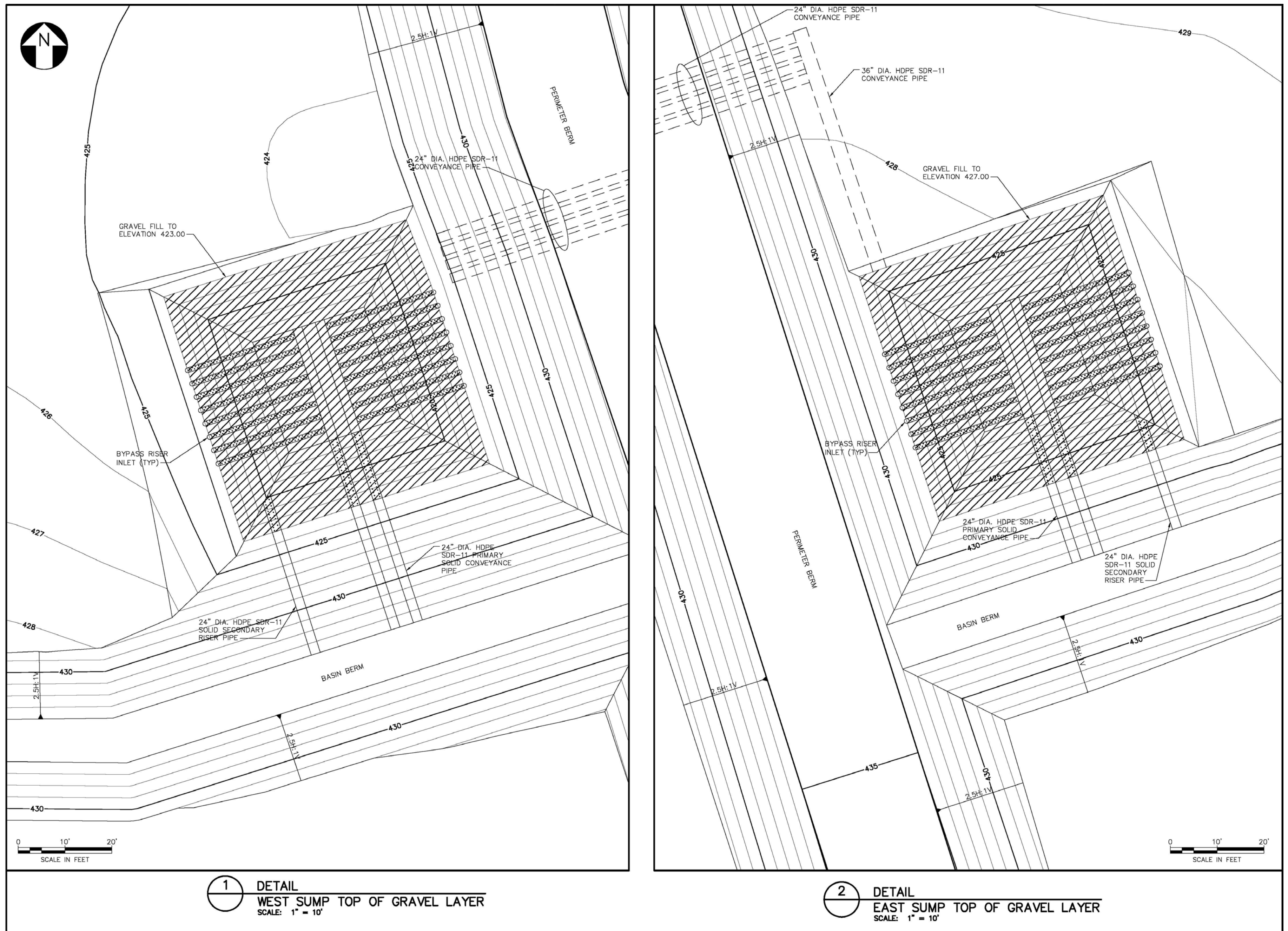

Figure 1: Plan View of SCA Basin Sumps

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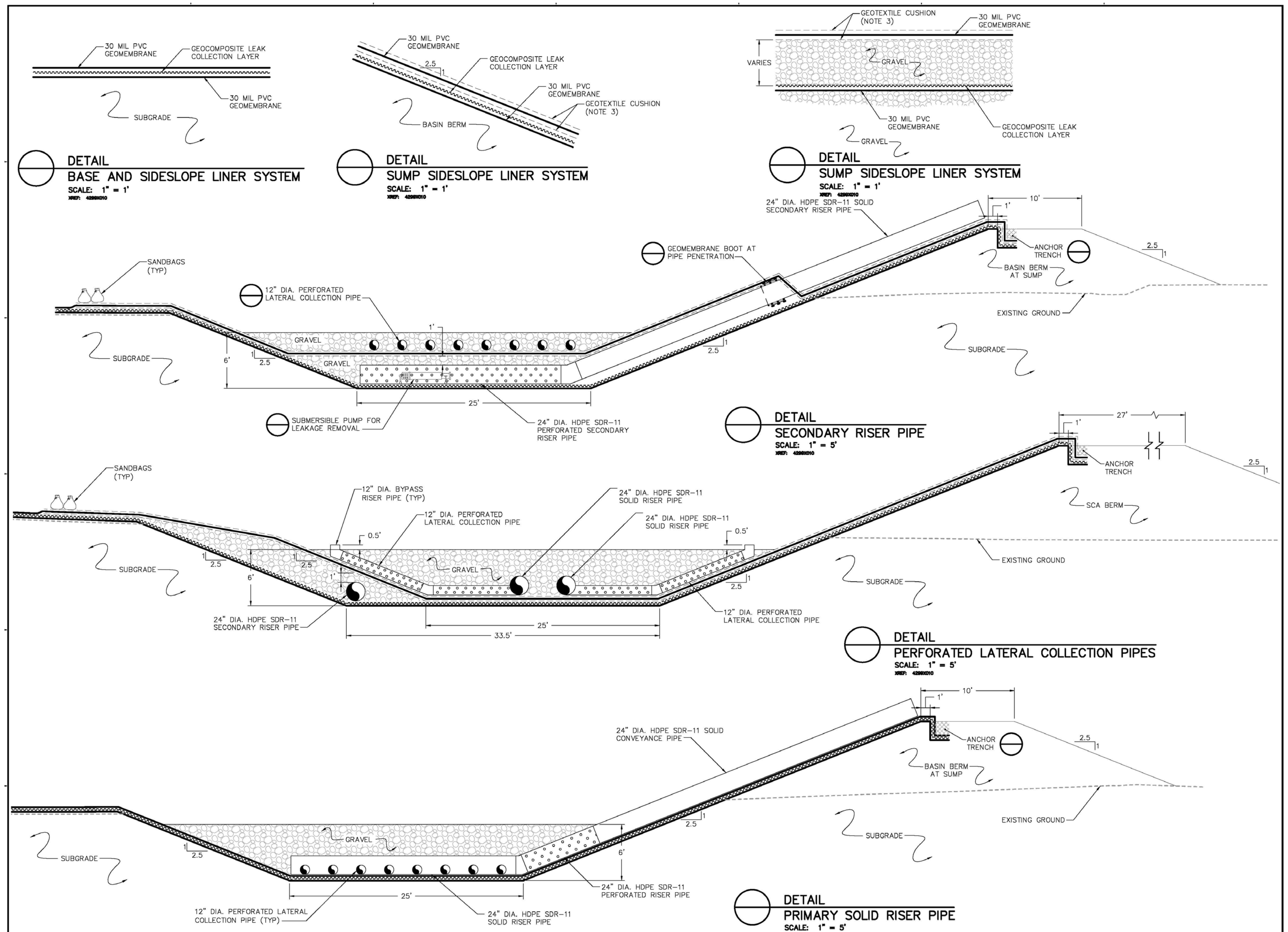

Figure 2: Profile Views of SCA Basins Sumps

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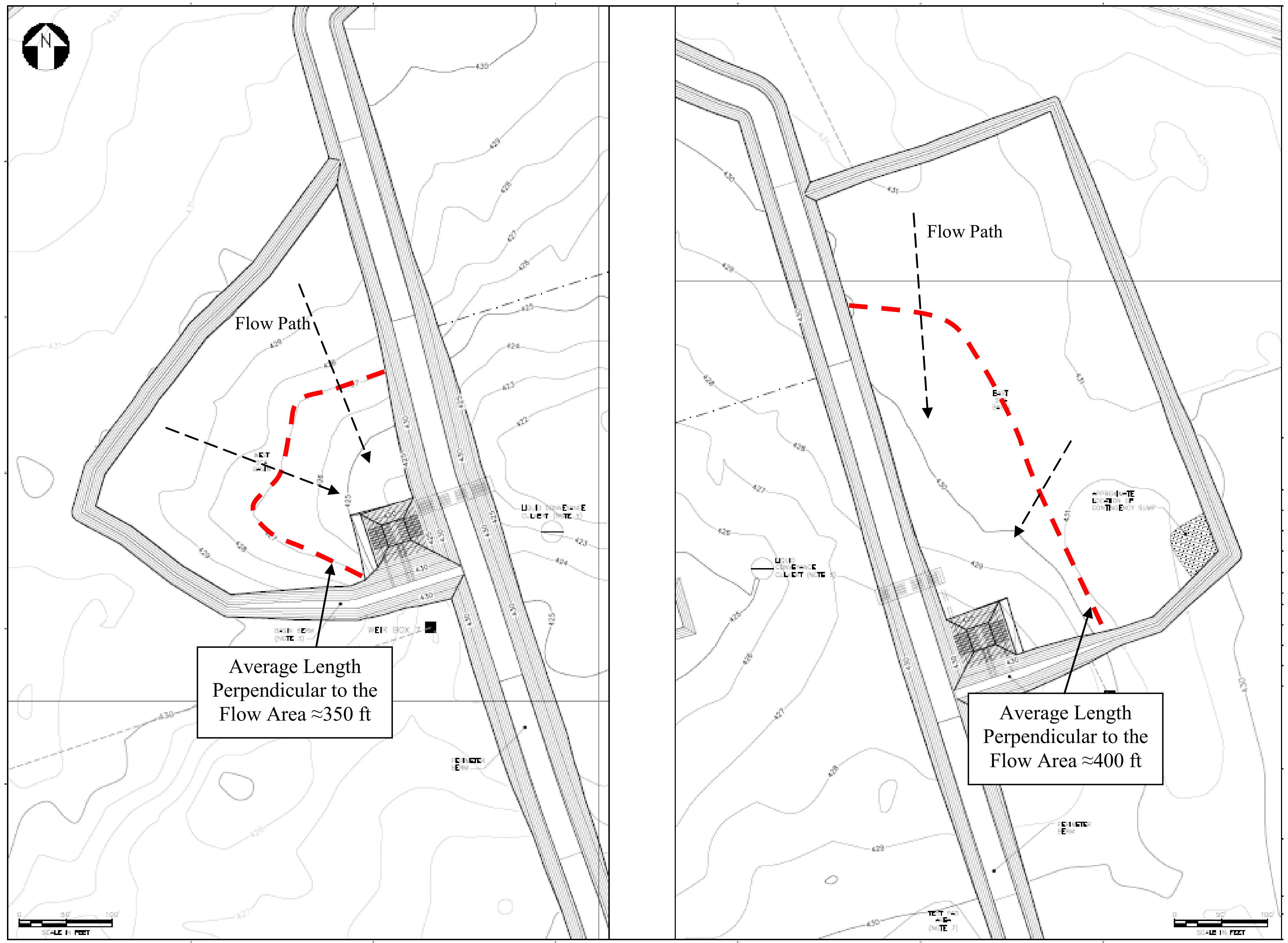

Figure 3: Plan View Estimates of Average Hydraulic Gradient and Average Length Perpendicular to the Flow Area

TABLES

Table 1: Typical Corrugated HDPE Pipe Properties [PPI, 2007]

Inside Diameter, ID		Typical Outside Diameter, OD		Minimum Pipe Stiffness at 5% Deflection, PS		Section Area, A_s		Distance from Inside Diameter to Neutral Axis, c		Moment of Inertia, I	
in	mm	in	mm	pii	N/m/mm**	in²/in	mm²/mm	in	mm	in⁴/in	mm⁴/mm
4	100	4.7	119	35	241	0.0448	1.138	0.139	3.531	0.0	11.5
6	150	7	178	35	241	0.0568	1.443	0.192	4.876	0.0	54.1
8	200	9.9	251	35	241	0.0837	2.126	0.297	7.535	0.0	142.6
10	250	12	305	35	241	0.1044	2.652	0.393	9.97	0.0	303.2
12	300	14.7	373	50	345	0.125	3.175	0.35	8.89	0.0	393.3
15	375	17.7	457	42	290	0.159	4.043	0.45	11.43	0.1	868.5
18	450	21.5	546	40	275	0.195	4.953	0.5	12.70	0.1	1016.0
24	600	28.7	729	34	235	0.262	6.646	0.65	16.51	0.1	1900.9
30	750	36.4	925	28	195	0.327	8.297	0.75	19.05	0.2	2671.1
36	900	42.5	1080	22	150	0.375	9.525	0.9	22.86	0.22	3637.9
42	1050	48	1219	20	140	0.391	9.927	1.11	28.19	0.52	8898.2
48	1200	55	1397	18	125	0.429	10.901	1.15	29.21	0.52	8898.2
54	1350	61	1549	16	110	0.473	12.014	1.25	31.75	0.82	13552.1
60	1500	67.3	1709	14	97	0.538	13.665	1.37	34.798	1.0	16518.2

Notes:

1. These are generic HDPE pipe sizes and dimensions. The exact dimensions may vary based on the manufacturer. Therefore, this chart has only been used to calculate the pipe stiffness (PS) of the lateral collection pipes.
2. The lateral collection pipe chosen has a nominal diameter of 12 in. Therefore the PS for an OD of 12 in was selected. A smaller value of PS will result in larger deformation shape factors and therefore more deformation.
3. The PS value of 35 lb/in/in (pii) selected from this table is used in Table 2 to select the appropriate deformation shape factor to compute the bending strain.

Table 2: Deformation Shape Factors, f_d [PPI, 2007]

	Gravel GW, GP, GW-GC, GW-GM, GP-GC and GP-GM		Sand SW, SP, SM, SC, GM, GC or Mixtures	
Pipe Stiffness, PS pii (kPa)	**Dumped to Slight (<85% SPD)**	**Moderate to High (≥85% SPD)**	**Dumped to Slight (<85% SPD)**	**Moderate to High (≥85% SPD)**
14 (97)	4.9	6.2	5.4	7.2
16 (110)	4.7	5.8	5.2	6.8
17 (117)	4.6	5.7	5.1	6.7
20 (138)	4.4	5.4	4.9	6.4
22 (152)	4.3	5.3	4.8	6.3
28 (193)	4.1	4.9	4.4	5.9
30 (210)	4.0	4.8	4.3	5.8
34 (234)	3.9	4.6	4.1	5.6
35 (241)	3.8	4.6	4.1	5.6
38 (262)	3.8	4.5	4.0	5.4
40 (276)	3.7	4.4	3.9	5.4
42 (290)	3.7	4.4	3.9	5.3
46 (320)	3.7	4.4	3.9	5.2
50 (345)	3.6	4.2	3.8	5.1

Notes:

1. The PS for the lateral collection pipes was considered to be 35 pii, as shown in Table 1.
2. The bedding material was assumed to be dumped gravel.

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Table 3: Typical Pipe Properties [IscoIndustries, 2009]

PE 3608/3408 IPS HDPE PIPE SIZES

Pressure Rating		DR 17 (100psi)			DR 19 (89psi)			DR 21 (80psi)			DR 26 (65psi)			DR 32.5 (50psi)		
Nominal Size	Actual O.D.	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf
3/4"	1.050"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1"	1.315"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1 1/4"	1.660"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1 1/2"	1.900"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2"	2.375"	0.140"	2.079"	0.429	---	---	---	---	---	---	---	---	---	---	---	---
3"	3.500"	0.206"	3.064"	0.932	---	---	---	---	---	---	---	---	---	---	---	---
4"	4.500"	0.265"	3.939"	1.540	0.237"	3.998"	1.387	0.214"	4.046"	1.262	0.173"	4.133"	1.030	0.138"	4.206"	0.831
5"	5.375"	0.316"	4.705"	2.197	0.283"	4.775"	1.980	0.256"	4.832"	1.801	0.207"	4.937"	1.470	0.165"	5.024"	1.186
5"	5.563"	0.327"	4.869"	2.353	0.293"	4.942"	2.120	0.265"	5.001"	1.929	0.214"	5.109"	1.574	0.171"	5.200"	1.270
6"	6.625"	0.390"	5.799"	3.338	0.349"	5.886"	3.007	0.315"	5.956"	2.736	0.255"	6.085"	2.233	0.204"	6.193"	1.801
7"	7.125"	0.419"	6.236"	3.860	0.375"	6.330"	3.478	0.339"	6.406"	3.165	0.274"	6.544"	2.582	0.219"	6.660"	2.083
8"	8.625"	0.507"	7.549"	5.657	0.454"	7.663"	5.097	0.411"	7.754"	4.637	0.332"	7.922"	3.784	0.265"	8.062"	3.053
10"	10.750"	0.632"	9.409"	8.788	0.566"	9.551"	7.918	0.512"	9.665"	7.204	0.413"	9.873"	5.878	0.331"	10.049"	4.742
12"	12.750"	0.750"	11.160"	12.362	0.671"	11.327"	11.138	0.607"	11.463"	10.134	0.490"	11.710"	8.269	0.392"	11.918"	6.671
14"	14.000"	0.824"	12.254"	14.905	0.737"	12.438"	13.429	0.667"	12.587"	12.218	0.538"	12.858"	9.970	0.431"	13.087"	8.044
16"	16.00"	0.941"	14.005"	19.467	0.842"	14.215"	17.540	0.762"	14.385"	15.959	0.615"	14.695"	13.022	0.492"	14.956"	10.506
18"	18.00"	1.059"	15.755"	24.638	0.947"	15.992"	22.199	0.857"	16.183"	20.198	0.692"	16.532"	16.480	0.554"	16.826"	13.296
20"	20.00"	1.176"	17.506"	30.418	1.053"	17.768"	27.406	0.952"	17.981"	24.936	0.769"	18.369"	20.346	0.615"	18.695"	16.415
22"	22.00"	1.294"	19.256"	36.805	1.158"	19.545"	33.162	1.048"	19.779"	30.172	0.846"	20.206"	24.619	0.677"	20.565"	19.863
24"	24.00"	1.412"	21.007"	43.801	1.263"	21.322"	39.465	1.143"	21.577"	35.907	0.923"	22.043"	29.299	0.738"	22.434"	23.638
26"	26.00"	1.529"	22.758"	51.406	1.368"	23.099"	46.316	1.238"	23.375"	42.141	1.000"	23.880"	34.385	0.800"	24.304"	27.742
28"	28.00"	1.647"	24.508"	59.618	1.474"	24.876"	53.716	1.333"	25.173"	48.874	1.077"	25.717"	39.879	0.862"	26.174"	32.174
30"	30.00"	1.765"	26.259"	68.439	1.579"	26.653"	61.664	1.429"	26.971"	56.105	1.154"	27.554"	45.779	0.923"	28.043"	36.934
32"	32.00"	1.882"	28.009"	77.869	1.684"	28.429"	70.160	1.524"	28.770"	63.835	1.231"	29.391"	52.086	0.985"	29.913"	42.023
34"	34.00"	2.000"	29.760"	87.907	1.789"	30.206"	79.204	1.619"	30.568"	72.064	1.308"	31.228"	58.814	1.046"	31.782"	47.440
36"	36.00"	2.118"	31.511"	98.553	1.895"	31.983"	88.796	1.714"	32.366"	80.791	1.385"	33.065"	65.922	1.108"	33.652"	53.186
42"	42.00"	2.471"	36.762"	134.141	2.211"	37.314"	120.861	2.000"	37.760"	109.966	1.615"	38.575"	89.727	1.292"	39.260"	72.392
48"	48.00"	2.824"	42.014"	175.205	2.526"	42.644"	157.857	2.286"	43.154"	143.629	1.846"	44.086"	117.194	1.477"	44.869"	94.552
54"	54.00"	3.176"	47.266"	222.547	2.842"	47.975"	199.791	2.571"	48.549"	182.298	2.077"	49.597"	148.324	1.662"	50.478"	119.668
63"	62.99"	---	---	---	---	---	---	3.000"	56.631"	247.800	2.423"	57.854"	202.010	1.938"	58.881"	162.980

NOTE:
- Items highlighted in Blue indicates standard stocking items that are more readily available.
- Pressures are based on using water at 23°C (73°F).
- Average inside diameter calculated using nominal OD and minimum wall plus 6% for use in estimating fluid flows. Actual ID will vary.
- Service factors should be utilized to compensate for the effect of liquids other than water, and for other temperatures.
- Other piping sizes or DR's may be available upon request.
- Standard Lengths: 40' for 2"-24" / 50' for 26" and larger / Coils available for 3/4"-6"(8" by special order)

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Table 4: Modulus of Elasticity Values for HDPE [Chevron Phillips, 2004]

Table 2-2 **Modulus of Elasticity for HDPE, psi**

LOAD DURATION	TEMPERATURE			
	0° F	73° F	120° F	140°F
Short-term	260,000	110,000	65,000	50,000
1 hour	148,000	69,600	36,900	28,400
10 hours	122,000	57,500	30,500	23,500
1000 hours	92,800	43,700	23,200	17,800
10 years	67,100	31,600	16,800	12,900
50 years	59,900	28,200	15,000	11,500

Notes:
1. The Modulus of Elasticity chosen is for 50 years (long-term) at 73°F.
2. A reduction factor of 0.76 has been applied to the chosen long-term Modulus of Elasticity [August et al., 1997]
3. The selected short-term Modulus of Elasticity is at 73°F.

Table 5: Duncan-Hartley Soil Reaction Modulus [Chevron Phillips, 2003]

Type of Soil	Depth of Cover, ft	E' for Standard AASHTO Relative Compaction, lb.in^2			
		85%	90%	95%	100%
Fine-grained soils with <25% sand content (CL, ML, CL-ML)	0-5	500	700	1000	1500
	5-10	600	1000	1400	2000
	10-15	700	1200	1600	2300
	15-20	800	1300	1800	2600
Coarse-grained soils with fines (SM, SC)	0-5	600	1000	1200	1900
	5-10	900	1400	1800	2700
	10-15	1000	1500	2100	3200
	15-20	1100	1600	1400	3700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0-5	700	1000	1600	2500
	5-10	1000	1500	2200	3300
	10-15	1050	1600	2400	3600
	15-20	1100	1700	2500	3800

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Table 6: Primary Sump Collection System Design Summary

Primary Sump Collection System	No. of Pipes (#)	Dia. Of Pipe (in)	Dia. of Perforation (in)	Offset Angle (°)	Row Offset (in)	Length (ft)	Flow Capacity (gpm)
Primary Riser Pipes	2	24	1	45	3	15	481
Lateral Pipes	16	12	1	45	3	25	6411
							6892

Table 7: Secondary Sump Collection System Design Summary

Secondary Sump Collection System	No. of Pipes (#)	Dia. Of Pipe (in)	Dia. of Perforation (in)	Offset Angle (°)	Row Offset (in)	Length (ft)	Flow Capacity (gpm)
Secondary Riser Pipes	1	24	1	45	3	25	401

Table 8: Lateral Collection Pipe Stability Summary

Calculation	Target	Calculated	OK?
Wall Crushing (FS Value)	≥2.0	19.7	Yes
Wall Buckling (FS Value)	≥2.0	3.3	Yes
Ring Deflection (%)	≤7.5%	1.7%	Yes
Ring Bending Strain (%)	≤5%	0.3%	Yes

Table 9: Primary/Secondary Riser Pipe Stability Summary

Calculation	Target	Calculated	OK?
Wall Crushing (FS Value)	≥2.0	19.7	Yes
Wall Buckling (FS Value)	≥2.0	2.8	Yes
Ring Deflection (%)	≤7.5%	1.4%	Yes
Ring Bending Strain (%)	≤5%	0.2%	Yes

ATTACHMENTS

Written by:	**Jesus Sanchez**	Date:	**12/21/10**	Reviewed by:	**F. Zhu/R. Kulasingam**	Date:	**12/22/2010**
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Attachment 1: Primary Sump Sizing

a =	25	ft.	Bottom Length of Primary Sump
b =	55	ft.	Top Length of Primary Sump
h =	6	ft.	Depth of Gravel

Vol. of Truncated Pyramid = $V = \frac{1}{3}h(a^2 + ab + b^2)$

= 75,174 gal.

Storage Volume = $V_s = 0.4 * V$

= 30,070 gal.

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Attachment 2: Primary Sump Infiltration Capacity

k	0.33	fps	Hydraulic Conductivity (10 cm/s)
i	1	ft/ft.	Hydraulic Gradient
A	625	ft^2	Outlet Area

$$Q = k * i * A$$

Q = 92,034 gpm

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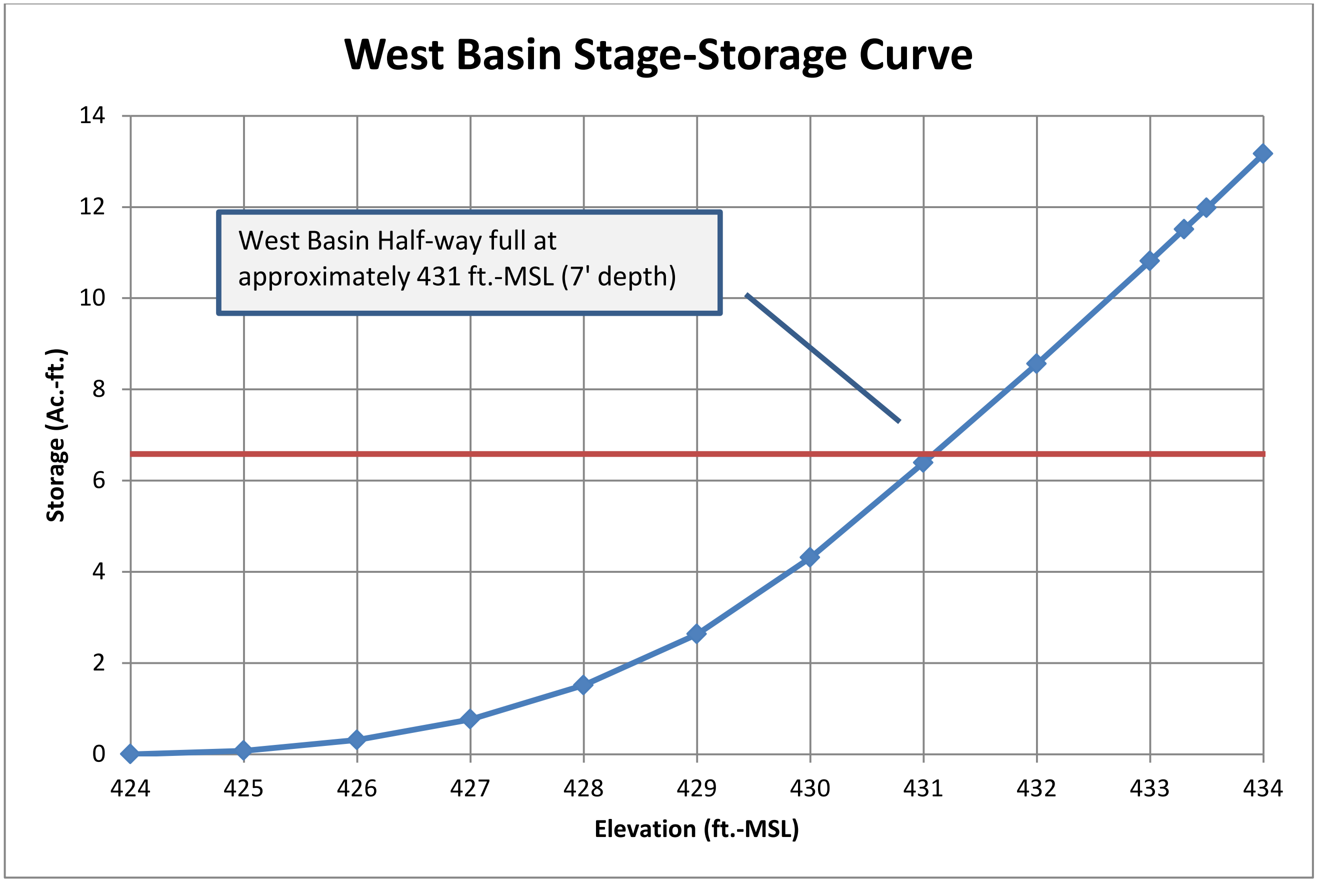
Attachment 3: SCA Basin Average Pond Height



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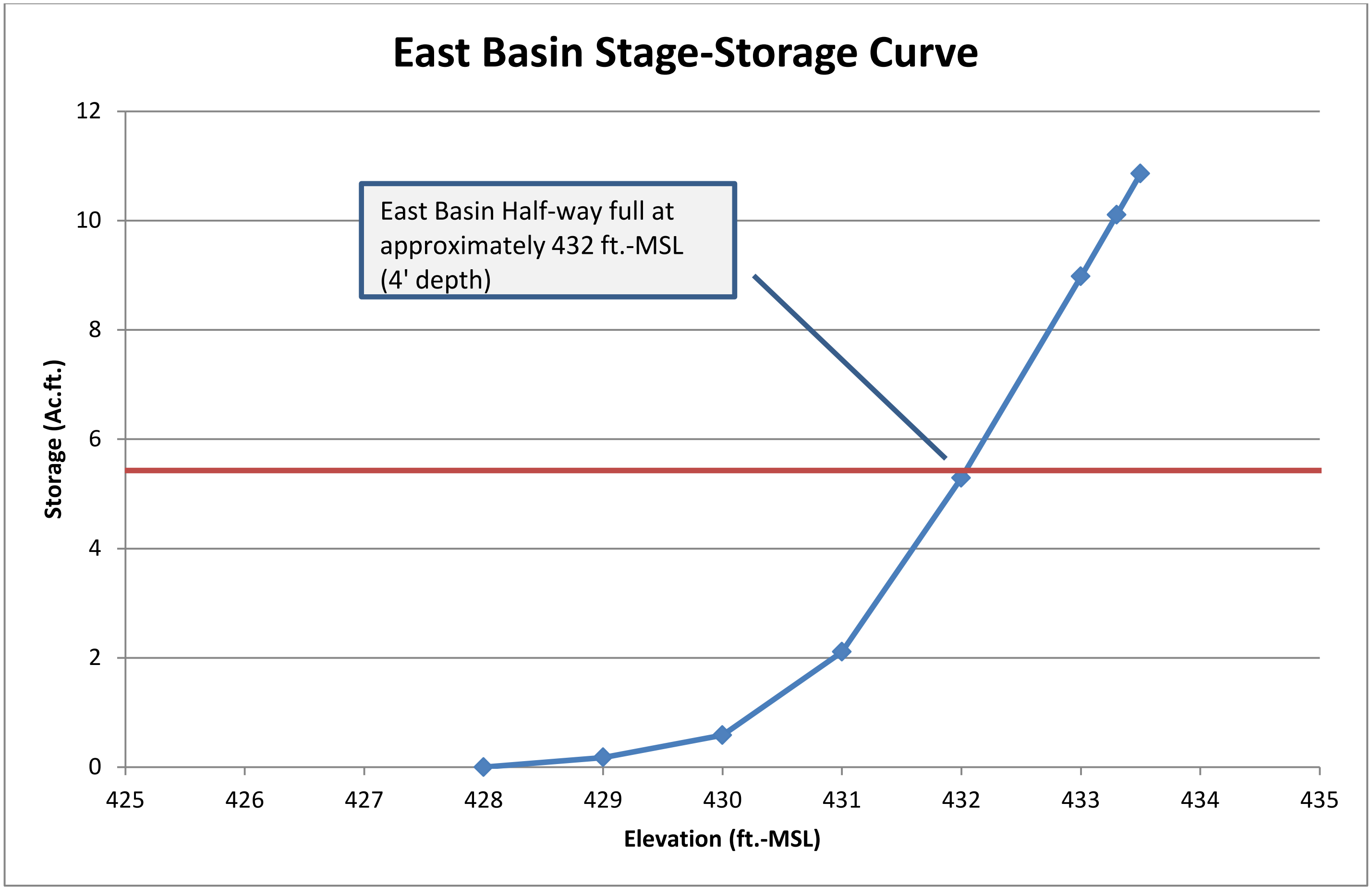
Attachment 3: SCA Basin Average Pond Height



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Attachment 4: Primary Liner Leakage Rate Calculations

	West Basin			East Basin		
Defect Area	A =	0.05	in.^{2}	A =	0.05	in.^{2}
Gravitational Constant	g =	32.2	ft./s^2	g =	32.2	ft./s^2
	h =	7	ft.	h =	4	ft.
Flow through one defect in primary liner	Q =	2.0	gpm	Q =	1.5	gpm
Area of Pond	A_T =	2.39	Ac.	A_T =	3.86	Ac.
Number of Holes per Acre	n =	1		n =	1	
Primary Liner Leakage Rate	**Q_T =**	**4.7**	**gpm**	**Q_T =**	**5.8**	**gpm**

$$Q = 0.6\, A \sqrt{2\, g\, h}$$

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Attachment 5: Discharge Capacity of the Leakage Collection System

Geocomposite Drainage Capacity - East Basin

Θ	0.022 ft^2/s	Hydraulic Transmissivity ($2*10^{-3}$ m^2/s)
i	0.875%	Hydraulic Gradient, average slope
L	400 ft.	Flow outlet length

$$Q = \Theta\ i\ L$$

Q = 33.8 gpm = 48700 gal/day

Geocomposite Drainage Capacity - West Basin

Θ	0.022 ft^2/s	Hydraulic Transmissivity ($2*10^{-3}$ m^2/s)
i	1.70%	Hydraulic Gradient, averageslope
L	350 ft.	Flow outlet length

$$Q = \Theta\ i\ L$$

Q = 57.5 gpm = 82800 gal/day

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Attachment 6: Cycle Time Calculations

Level (ft.)	Area ($ft.^2$)	Incremental Pore Volume (gal.)	Cumulative Storage (gal.)
0.0	213	0	-
0.5	234	334	334
1.0	255	366	699
1.5	276	397	1097
2.0	298	429	1526
2.5	319	461	1987
3.0	340	493	2480
3.5	361	525	3004
4.0	383	556	3560

	West Basin	East Basin		
Pump-on	1987	1987	gal.	Occurs at 2.5 feet above bottom of secondary sump
Pump-off	1097	1097	gal.	Occurs at 1.5 feet above bottom of secondary sump
Storage Volume	890	890	gal.	
Pumping Rate	10	10	gpm	
Leakage Rate	4.7	5.8	gpm	
Drain Time	2.8	3.5	hrs	
Fill Time	3.2	2.6	hrs	
Cycle Time	6.0	6.1	hrs	

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Attachment 7: Primary Collection System Perforated Pipe Flow Capacity Calculations

Flow Capacity into Perforated Riser Pipes for the Primary Sump
Bernoulli's Equation to calculate pipe perforations (15 ft length)

Finding Area of Each Perforation	$A_b = \pi/4*d^2$		
Diameter of Perforation [d] =	1.00 in =	8.33E-02 ft	
Area of Perforation [A_b] =	5.45E-03 ft^2		
Bernoulli Equation [1]	$Q_b = C*A_b*v_{ent}$		
Entry Velocity [v_{ent}] =	0.33 ft/s		
Discharge Coefficient [C] =	0.62		
Inflow per Orifice [Q_b] =	1.12E-03 ft^3/s =	6.70E-02 ft^3/min =	0.50 gal/min
Pipe Design			
Perforation offset angle [θ] =	45 degrees		
#Perforations in each row [N_{row}] =	8		
Offset between rows [δ] =	3.00 in		
Number of Rows [R] =	4		
Pipe Length [L] =	15 ft		
Maximum Flow	$Q_{in} = Q_b * N_{row} * R * L$		
Maximum Inflow Rate [Q_{in}] =	32.14 ft^3/min =	**240.40** gal/min	
Number of Pipes [Nlateral] =	2		
Total Inflow [Q_{total}] = $Q_{in} * N_{lateral}$ =	480.8 gal/min		

Note:

1. Qian et al. [2002]

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Attachment 7: Primary Collection System Perforated Pipe Flow Capacity Calculations (continued)

Flow Capacity into Perforated Lateral Collection Pipes for the Primary Sump
Bernoulli's Equation to calculate pipe perforations (25 ft length)

Finding Area of Each Perforation	$A_b=\pi/4*d^2$			
Diameter of Perforation [d] =	1.00	in =	8.33E-02 ft	
Area of Perforation [A_b] =	5.45E-03	ft^2		
Bernoulii Equation [1]	$Q_b=C*A_b*v_{ent}$			
Entry Velocity [v_{ent}] =	0.33	ft/s		
Discharge Coefficient [C] =	0.62			
Inflow per Orifice [Q_b] =	1.12E-03	ft^3/s =	6.70E-02 ft^3/min =	0.50 gal/min
Pipe Design				
Perforation offset angle [θ] =	45	degrees		
#Perforations in each row [N_{row}] =	8			
Offset between rows [δ] =	3.00	in		
Number of Rows [R] =	4			
Pipe Length [L] =	25	ft		
Maximum Flow	$Q_{in} = Q_b * N_{row} * R * L$			
Maximum Inflow Rate [Q_{in}] =	53.56	ft^3/min =	**400.66** gal/min	
Number of Pipes [Nlateral] =	16			
Total Inflow [Q_{total}] = $Q_{in} * N_{lateral}$ =	6410.6	gal/min		

Note:
1. Qian et al. [2002]

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Attachment 8: Secondary Collection System Perforated Pipe Flow Capacity Calculations

Flow Capacity into Secondary Riser Pipe for the Secondary Sump
Bernoulli's Equation to calculate pipe perforations (25 ft length)

Finding Area of Each Perforation	$A_b=\pi/4*d^2$			
Diameter of Perforation [d] =	1.00	in =	8.33E-02 ft	
Area of Perforation [A_b] =	5.45E-03	ft^2		
Bernoulli Equation [1]	$Q_b=C*A_b*v_{ent}$			
Entry Velocity [v_{ent}] =	0.33	ft/s		
Discharge Coefficient [C] =	0.62			
Inflow per Orifice [Q_b] =	1.12E-03	ft^3/s =	6.70E-02 ft^3/min =	0.50 gal/min
Pipe Design				
Perforation offset angle [θ] =	45	degrees		
#Perforations in each row [N_{row}] =	8			
Offset between rows [δ] =	3.00	in		
Number of Rows [R] =	4			
Pipe Length [L] =	25	ft		
Maximum Flow	$Q_{in} = Q_b * N_{row} * R * L$			
Maximum Inflow Rate [Q_{in}] =	53.56	ft^3/min =	**400.66** gal/min	
Number of Pipes [Nlateral] =	1			
Total Inflow [Q_{total}] = $Q_{in} * N_{lateral}$ =	400.7	gal/min		

Note:

1. Qian et al. [2002]

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Attachment 9: Lateral Collection Pipe Stability Calculations

Pipe Type:

Name: **12-in nominal diameter HDPE Pipe**

Outside Diameter	D =	**12.75**	in
Minimum wall thickness	t =	**0.49**	in
Average inner diameter	D_i =	**11.71**	in
Standard Dimension Ratio of pipe	SDR =	**26**	

# of perforations/linear ft	*n* =	4
diameter of perforations (in)	*d* =	1

Stress on collector pipe

Operational Condition

Operational Conditions

Layer No.	γ_p (pcf)	H (ft)	γ_p x H/(1-*n* **d*/12) (psf)
1 (Gravel)	**120**	**5.0**	**900**
2			
3			
4			
5			
6			
		Total =	**900** psf = **6.25** psi

Maximum Vertical Stress = P_t = **900** psf = **6.25** psi

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Wall Crushing

Yield Compressive Strength σ_y = 230400 psf = 1600 psi

Actual Wall compressive stress $S = \frac{P_t \cdot D}{288 \cdot t}$ From Chevron Phillips, 2003

= 81.31 psi

Factor of Safety against Wall Crushing $F_{WC} = \frac{\sigma_y}{S}$

= 19.68 <-- OK

Wall Buckling

Height of water table above Pipe	H_w =	5.5	ft			
Height of Waste+Final Cover above Pipe	H =	5.0	ft			From Chevron Phillips, 2003
modulus of elasticity of pipe	E =	3086208	psf =	21432	psi	For 50 years @ 73°F
modulus of soil reaction	E' =	100800	psf =	700	psi	From Chevron Phillips, 2003

$$P_{WC} = 5.65 \cdot \sqrt{R \cdot B' \cdot E' \cdot \frac{E}{12 \cdot (SDR - 1)^3}}$$ From Chevron Phillips, 2003

where

$$R = 1 - \left(0.33 \cdot \frac{H_w}{H}\right) \quad \text{and} \quad B' = \frac{1}{1 + 4 \cdot e^{-0.065 \cdot H}}$$ From Chevron Phillips, 2003

Water Buoyancy Factor	R =	0.6370	
Coefficient of Elastic Support	B' =	0.2571	
Critical Wall Buckling Pressure	P_{WC} =	2945	psf

Factor of Safety against Wall Buckling $F_{WB} = \frac{P_{WC}}{P_t}$

= 3.27 <--OK

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Ring Deflection Using the Modified Spangler Equation:

$$\frac{\Delta X}{D_i} = \frac{P_t \cdot K \cdot L}{\left(\frac{2 \cdot E}{3} \frac{1}{(SDR-1)^3}\right) + (0.061 \cdot E')}$$

ΔX = maximum horizontal deflection or change in diameter, in;
L = deflection lag factor;
K = bedding constant (assume 0.1) [Chevron Phillips, 2003];
D_i = internal pipe diameter, in
P_t = vertical stress applied to pipe, psi;
E = short-term modulus of elasticity of the pipe material @ 73 ° F, [Chevron Phillips, 2004], psi;
E' = the modulus of soil reaction for pipe bedding material [Chevron Phillips, 2003], psi;
SDR = standard Dimension Ratio [Chevron Phillips, 2003]
$\Delta X\%$ = ring deflection, %,
= 100 (DX/D_i).

L	**1.25**	
K	**0.1**	
P_t	**6.25**	psi
D_i	**11.710**	in.
E	**110000**	psi
E'	**700**	psi
SDR	**26**	

Change in diameter, ΔX = **0.19** in.

$$\Delta X\% = \frac{\Delta X}{D_i}.100$$

= **1.65** % <-- Ring Deflection < 7.5%, OK

Ring Bending Strain

$$\varepsilon_b = f_d \cdot \frac{\Delta X}{D_m} \cdot \frac{2 \cdot C}{D_m}$$

ε_b = bending strain, %;
ΔX = maximum horizontal deflection or change in diameter, in;
D_m = mean pipe diameter, in,
= D - (1.06* pipe wall thickness); [Chevron Phillips, 2003]
f_d = deformation shape factor
C = distance from outer fiber to wall centroid, in.
= 0.5 * (1.06* pipe wall thickness); [Chevron Phillips, 2003].

D_m	**12.231**	
f_d	**3.8**	
C	**0.260**	in

Bending strain, ε_b = **0.3** % <-- Bending Strain < 5%, OK

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Attachment 10: Riser Pipe Stability Calculations

Pipe Type:

Name: **24-in nominal diameter HDPE Pipe**

Outside Diameter	$D =$	**24**	in	# of perforations/linear ft	n =	**4**	
Minimum wall thickness	$t =$	**0.738**	in	diameter of perforations (in)	d =	**1**	
Average inner diameter	$D_i =$	**22.434**	in				
Standard Dimension Ratio of pipe	SDR =	**32.5**					

Stress on collector pipe

Operational Condition

Operational Conditions

Layer No.	γ_p (pcf)	H (ft)	g_p x H/(1-n * d /12) (psf)
1 (Gravel)	**120**	**4.0**	**720**
2			
3			
4			
5			
6			
		Total =	**720** psf = **5.00** psi

Maximum Vertical Stress = P_t = **720** psf = **5.00** psi

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Wall Crushing

Yield Compressive Strength σ_y = 230400 psf = 1600 psi

Actual Wall compressive stress

$$S = \frac{P_t \cdot D}{288 \cdot t}$$

From Chevron Phillips, 2003

= 81.30 psi

Factor of Safety against Wall Crushing

$$F_{WC} = \frac{\sigma_y}{S}$$

= 19.68 <-- OK

Wall Buckling

Height of water table above Pipe	H_w =	4.5	ft			
Height of Waste+Final Cover above Pipe	H =	4.0	ft			From Chevron Phillips, 2003
modulus of elasticity of pipe	E =	3086208	psf =	21432	psi	For 50 years @ 73°F
modulus of soil reaction	E' =	100800	psf =	700	psi	From Chevron Phillips, 2003

$$P_{WC} = 5.65 \cdot \sqrt{R \cdot B' \cdot E' \cdot \frac{E}{12 \cdot (SDR - 1)^3}}$$

From Chevron Phillips, 2003

where

$$R = 1 - \left(0.33 \cdot \frac{H_w}{H}\right) \quad \text{and} \quad B' = \frac{1}{1 + 4 \cdot e^{-0.065 \cdot H}}$$

From Chevron Phillips, 2003

Water Buoyancy Factor	R =	0.6288
Coefficient of Elastic Support	B' =	0.2448
Critical Wall Buckling Pressure	P_{WC} =	2019 psf

Factor of Safety against Wall Buckling

$$F_{WB} = \frac{P_{WC}}{P_t}$$

= 2.80 <--OK

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Ring Deflection Using the Modified Spangler Equation:

$$\frac{\Delta X}{D_i} = \frac{P_t \cdot K \cdot L}{\left(\frac{2 \cdot E}{3} \frac{1}{(SDR-1)^3}\right) + (0.061 \cdot E')}$$

ΔX = maximum horizontal deflection or change in diameter, in;
L = deflection lag factor;
K = bedding constant (assume 0.1) [Chevron Phillips, 2003];
D_i = internal pipe diameter, in
P_t = vertical stress applied to pipe, psi;
E = short-term modulus of elasticity of the pipe material @ 73 °F, [Chevron Phillips, 2004], psi;
E' = the modulus of soil reaction for pipe bedding material [Chevron Phillips, 2003], psi;
SDR = standard Dimension Ratio [Chevron Phillips, 2003]
ΔX% = ring deflection, %,
= 100 (DX/D_i).

L	**1.25**	
K	**0.1**	
P_t	**5.00**	psi
D_i	**22.434**	in.
E	**110000**	psi
E'	**700**	psi
SDR	**32.5**	

Change in diameter, ΔX = **0.31** in.

$$\Delta X\ \% = \frac{\Delta X}{D_i} .100$$

= **1.39** % <-- Ring Deflection < 7.5%, OK

Ring Bending Strain

$$\varepsilon_b = f_d \cdot \frac{\Delta X}{D_m} \cdot \frac{2 \cdot C}{D_m}$$

ε_b = bending strain, %;
ΔX = maximum horizontal deflection or change in diameter, in;
D_m = mean pipe diameter, in,
= D - (1.06* pipe wall thickness); [Chevron Phillips, 2003]
f_d = deformation shape factor
C = distance from outer fiber to wall centroid, in.
= 0.5 * (1.06* pipe wall thickness); [Chevron Phillips, 2003].

D_m	**23.218**	
f_d	**3.8**	
C	**0.391**	in

Bending strain, ε_b = **0.2** % <-- Bending Strain < 5%, OK