
ATTACHMENT 6
SLOPE STABILITY ANALYSIS FOR BSC AND BCC

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GEOTECHNICAL STUDY
HSC-ECIP Preliminary Slope Evaluation
Barbours Cut and Bayport Channels
Galveston Bay, Texas

SUBMITTED TO
Turner, Collie, and Braden/GBA Joint Venture
c/o Gahagan & Bryant Associates, Inc.
9330 Kirby Drive, Suite 100
Houston, Texas 77054

BY
HVJ ASSOCIATES, INC.
HOUSTON, TEXAS
AUGUST 14, 2018

REPORT NO. HG1710448





Houston | 6120 S. Dairy Ashford Rd.
Austin | Houston, TX 77072-1010
Dallas | 281.933.7388 Ph
San Antonio | 281.933.7293 Fax
www.hvj.com

August 14, 2018

Ms. Dana Cheney
Turner, Collie, and Braden/GBA Joint Venture
c/o Gahagan & Bryant Associates, Inc.
9330 Kirby Drive, Suite 100
Houston, TX 77054

Re: Geotechnical Study
HSC-ECIP Preliminary Slope Evaluation
Barbours Cut and Bayport Channels
Owner: Port of Houston Authority
HVJ Report No. HG1710448

Dear Ms. Cheney:

Submitted herein is the report of our geotechnical study for the above referenced project. This report presents the stability analysis of the proposed channel slopes for the widening of Barbours Cut and Bayport channels. The study was conducted in general accordance with our proposal number HG1710448 dated November 16, 2017 and is subject to the limitations presented in this report. We appreciate the opportunity of working with you on this project. Please read the entire report and notify us if there are questions concerning this report or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.
Firm License No. F-646

A handwritten signature in blue ink, appearing to read 'Michael Hasen'.

Michael Hasen, PE
Executive Vice President



A handwritten signature in blue ink, appearing to read 'Anil Raavi'.

Anil K. Raavi, PE
Project Manager

MH/AR:ar

Copies submitted: 1 (electronic)

The seal appearing on this document was authorized by Michael Hasen, PE 57498 on August 14, 2018. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

The following lists the pages which complete this report:

- Main Text – 14 pages
- Plates – 10 pages
- Appendix A – 123 pages
- Appendix B – 224 pages
- Appendix C – 135 pages

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1 EXECUTIVE SUMMARY

HVJ Associates, Inc. was retained by Turner, Collie, and Braden/GBA Joint Venture (TCB/GBA) to perform slope stability analysis for the widening of Barbour's Cut Channel (BCC) and Bayport Ship Channel (BSC). Both channels will be widened to a final base width of about 455 feet by extending the base width by 55 to 155 feet to the north of the current channel centerline. The overall channel bottom elevation will remain at El. -50.5 feet MLLW. The purpose of this study is to assess the stability of the proposed channel slopes based on the existing soil data from our previous studies.

Geotechnical exploration was performed previously along the north shoreline of BSC for the deepening and widening of the ship channel to a total base width of 350 to 400 feet. A similar study was performed along the north shoreline of BCC to support the deepening and widening of BCC to a base width of 300 feet. We submitted reports previously that present our assessment of the soil shear strength characteristics and our recommendations for the proposed improvements at that time. The soil properties used in the current analysis are based on our previous exploration reports. For a detailed discussion of the geotechnical data please see reports HVJ Report No. HG1010561 dated October 17, 2013 for BCC and HVJ Report No. HG1019742 dated May 2, 2013 for BSC.

Slope stability analyses were performed for the long term (LT), rapid drawdown (RDD) and short term (ST) conditions. The following assumptions and design considerations were used in the analyses.

- a. **Barbour's Cut Channel** – The proposed widening will shift the channel toe about 155 feet north towards the Spilman Island Placement Area. Based on the cross sections provided to us and the soils information obtained from subsurface investigation conducted for the previous studies, we have analyzed the slope stability at sections 34+00, 44+00, 56+00, and 64+00. These cross sections were chosen to be representative of the slope configuration and soil conditions along the proposed project.

The new shoreline will be immediately adjacent to the Spilman Island dike and increase in the dike height in future will impact the stability of the channel slope. In order to account for the future storage capacity increase at Spilman Island Placement Area, we assumed future dike raising to a crest elevation of +45.14 feet MLLW with 2 feet freeboard and 2 feet ponding depth in the interior for long term and rapid drawdown conditions. We assumed that the future dike will have 15 feet crown width with 3H:1V side slopes.

- b. **Bayport Ship Channel** – The proposed widening will be about 55 to 105 feet towards the north (away from container terminal). Based on the cross sections provided to us and the soils information obtained from subsurface investigation conducted for the previous studies, we have analyzed the slope stability at sections 40+00, 66+00, 76+00, 92+00, 98+00, 110+00, 166+00, and 186+00. In the area north of the turning basin, the 3H:1V bank slope from the proposed channel toe will result in the cut extending to the adjacent San Jacinto College building as shown in the cross sections. In order to provide proposed channel base width and to retain the existing building, a bulkhead is required at this location.

We analyzed several cross sections based on the historic soil data and proposed channel templates provided to us as shown on Plates 3 and 4. The global stability analysis results are summarized below:

Slope Stability Analyses Results – Proposed Template

Location	Station	Factor of Safety			
		Short Term		Long Term (circular)	Rapid Drawdown (circular)
		Circular	Block		
Barbours Cut Channel	34+00	1.47	1.56	1.28*	1.32
	44+00	1.24*	1.37	1.26*	1.24*
	56+00	1.06*	1.02*	1.50	1.49
	64+00	1.34	1.36	1.43*	1.43
Bayport Ship Channel	40+00	1.56	1.53	1.56	1.42
	66+00	1.50	1.40	1.74	1.54
	76+00	2.47	2.37	1.89	1.62
	92+00	2.42	2.38	1.72	1.50
	98+00	2.51	2.45	1.77	1.49
	110+00	2.33	2.31	1.56	1.41
	166+00	3.85	3.83	2.09	2.09
	186+00	5.60	4.05	2.17	2.16

* Does not meet the minimum required.

According to US Army Corps of Engineers EM 1110-2-1902 Slope Stability, Chapter 3, Table 3-1, the recommended minimum factors of safety are 1.3, 1.5, and 1.3 for short term (end-of-construction), long term, and rapid drawdown conditions, respectively.

Barbours Cut Channel: The calculated factors of safety for the proposed 3H:1V slope does not meet the minimum required. We understand that a flatter channel slope from the proposed channel toe is not an option considering the reduction in the placement area capacity. In order to provide proposed channel base width while maintaining the Spilman Island placement area, a bulkhead is required along the entire length adjacent to Spilman Island. Based on our global stability analysis, the 3H:1V channel slope requires a bulkhead installed between Sta. 30+00 and Sta. 67+00 at an offset of about 530 feet from the existing centerline and embedded to El. -52 feet MLLW to achieve the required factors of safety. The results of our analyses including the proposed bulkhead are presented in Appendix C. The global stability analysis results are summarized in the following table.

Slope Stability Analyses Results with Bulkhead

Location	Station	Factor of Safety			
		Short Term		Long Term (circular)	Rapid Drawdown (circular)
		Circular	Block		
Barbours Cut Channel	34+00	1.85	2.04	1.53	1.64
	44+00	1.89	1.89	1.61	1.64
	56+00	1.64	1.89	1.51	1.49
	64+00	1.72	1.89	1.56	1.55

Note that the soil conditions of the Spilman Island dike are important to the analysis. We suggest additional borings be performed for final design.

Bayport Ship Channel: The calculated factor of safety exceeds the required minimum factor of safety at all sections we analyzed. However, installation of a bulkhead is required for the area north of the turning basin adjacent to the San Jacinto College building. Our analysis indicates that the bulkhead must be installed between about Sta. 35+00 and Sta. 43+50 at about 400 feet from the existing centerline embedded to an elevation of -40 feet MLLW to achieve the required factor of safety for global stability.

Bulkheads: For analyses purposes, we modeled the bulkheads as a high strength material. The bottom elevation of the bulkhead was adjusted to achieve the required factor of safety for global stability. The SLOPE/W program assumes the strength of bulkhead to be infinity, therefore, the slip surfaces passing through the bulkhead are considered very stable. A detailed analysis must be performed to assess the bulkhead against rotational and flexural failures. Rotational failures are caused due to inadequate penetration length and flexural failures are resulted by overstressing the retaining structure. An analysis of the bulkhead was beyond the scope of this study.

Please note that this executive summary does not fully relate our findings and opinions. Those findings and opinions are only presented through our full report.

2 INTRODUCTION

2.1 Project Description

HVJ Associates, Inc. was retained by TCB/GBA Joint Venture to perform slope stability analysis for the widening of two tributary channels of the Houston Ship Channel (HSC), Barbours Cut Channel (BCC) and Bayport Ship Channel (BSC). The BCC extends to the west from the main HSC approximately 1.5 miles to the Barbours Cut Turning Basin and the BSC extends west from the main HSC approximately 4 miles to the Bayport Turning Basin. Both channels will be widened to a final base width of about 455 feet by extending the base width by 55 to 155 feet to the north of the current channel centerline. The channel bottom elevation will remain at about El. -46.5 feet MLLW with an allowance of 2 feet for advance maintenance and an additional 2 feet of over dredge resulting in an overall bottom elevation of -50.5 feet MLLW. The purpose of this study is to assess the stability of the proposed channel slopes based on the existing soil data from our previous studies.

2.2 Geotechnical Study Program

Geotechnical exploration was performed previously along the north shoreline of BSC that consisted of drilling twelve 60-foot deep borings for the deepening and widening of the ship channel to a total base width of 350 to 400 feet. A similar study was performed along the north shoreline of BCC and twelve borings were performed to depths varying between 80 and 100 feet below the existing grade. The study was performed to support the widening and deepening of BCC for a base width of 300 feet. The borings were drilled at the approximate locations indicated on the Plan of Borings included in Plates 1 and 2 at BCC and BSC, respectively. The geotechnical data from these borings in conjunction with the historic soil borings were used to determine the subsurface conditions. We submitted reports previously that present our assessment of the soil shear strength characteristics and our recommendations for the proposed improvements at that time.

The soil properties used in the current analysis are based on our previous exploration reports. For a detailed discussion of the geotechnical data please see reports HVJ Report No. HG1010561 dated October 17, 2013 for BCC and HVJ Report No. HG1019742 dated May 2, 2013 for BSC.

3 PRELIMINARY SLOPE STABILITY ANALYSIS AND RECOMMENDATIONS

3.1 General

The proposed channel cross sections are shown on Plates 3 and 4. Slope stability analyses were performed for the long term (LT), rapid drawdown (RDD) and short term (ST) conditions. The following assumptions and design considerations were used in the analyses.

- c. **Barbours Cut Channel** – The proposed widening will shift the channel toe about 155 feet north towards the Spilman Island Placement Area. Based on the cross sections provided to us and the soils information obtained from subsurface investigation conducted for the previous studies, we have analyzed the slope stability at sections 34+00, 44+00, 56+00, and 64+00. These cross sections were chosen to be representative of the slope configuration and soil conditions along the proposed project.

The new shore line will be immediately adjacent to the Spilman Island dike and increase in the dike height in future will impact the stability of the channel slope. In order to account for the future storage capacity increase at Spilman Island Placement Area, we assumed future dike raising to a crest elevation of +45.14 feet MLLW with 2 feet freeboard and 2 feet

ponding depth in the interior for long term and rapid drawdown conditions. We assumed that the future dike will have 15 feet crown width with 3H:1V side slopes.

- d. **Bayport Ship Channel** – The proposed widening will be about 55 to 105 feet towards the north (away from container terminal). Based on the cross sections provided to us and the soils information obtained from subsurface investigation conducted for the previous studies, we have analyzed the slope stability at sections 40+00, 66+00, 76+00, 92+00, 98+00, 110+00, 166+00, and 186+00. In the area north of the turning basin, the 3H:1V bank slope from the proposed channel toe will result in the cut extending to the adjacent San Jacinto College building as shown in the cross sections. In order to provide proposed channel base width and to retain the existing building, a bulkhead is required at this location.

3.2 Method of Analysis and Required Factor of Safety

Slope stability analyses were conducted using the 2012 version of slope stability program SLOPE/W by the Morgenstern-Price method for circular rotational failure and block failure. Block failure evaluates non-circular failure surfaces and is particularly helpful in evaluating the potential for translational failures. During block failure analysis we avoided analyses configured with slip surfaces that are inadmissible for the software (i.e. comprising too short of a horizontal section to avoid convergence errors). The program calculates the factor of safety against slope failure using a two-dimensional limiting equilibrium method.

According to US Army Corps of Engineers EM 1110-2-1902 Slope Stability, Chapter 3, Table 3-1, the recommended minimum factors of safety are 1.3, 1.5, and 1.3 for short term (end-of-construction), long term, and rapid drawdown conditions, respectively. The factor of safety represents the calculated resisting forces and moments divided by the calculated driving forces and moments of the various potential failure surfaces analyzed. These forces and moments are based on the estimated unit weights and shear strengths of the various soils in the slope profile. Accordingly, a factor of safety of 1.0 indicates impending failure. The larger the factor of safety is above 1.0, the lower the risk is that the slope will fail. As a practical matter, and in consideration of the variables and unknowns involved, the risk cannot be reduced to zero. The goal is to reduce the risk of slope failure to a reasonable and acceptable level, with due consideration of the consequences of failure.

3.3 Soil Parameters and Water Level

Based on the cross-sections provided to us and the soils information obtained from subsurface investigation conducted for the previous studies, we have analyzed the slope stability at the BCC centerline stations 34+00, 44+00, 56+00, 64+00 and at the BSC centerline stations 40+00, 66+00, 76+00, 92+00, 98+00, 110+00, 166+00, 186+00.

The soil parameters were determined based on the stratigraphy and material properties determined from borings located in the vicinity of the cross section. For detailed discussion and our interpretation of shear strengths see our previous geotechnical reports HVJ Report No. HG1019742 dated May 2, 2013 for BSC and HVJ Report No. HG1010561 dated October 17, 2013 for BCC.

Short Term: The short term case models the initial undrained condition of the soil. For this analysis, unconfined compression and unconsolidated undrained soil parameters were used.

Long Term: The long-term design case represents steady state piezometric and stress conditions. When a slope is constructed, altered stress conditions create changes within the slope and the

undrained strength of the soils is mobilized. With time, the soil pore pressures adjust to the imposed stress and piezometric conditions, and the bank soils rely on their available strength for long-term stability. Drained or effective shear strength parameters (from Consolidated Undrained Tests and engineering judgment) were used in this analysis.

Rapid Drawdown. The rapid drawdown design case represents the rapid lowering of water level and associated stress conditions. When the water level is lowered in a short duration of time, it destabilizes the slope due to the development of excess pore pressures in the embankment consisting of low permeability materials (e.g. clay) and removal of stabilizing force on the upstream face of the slope due to water. In this analysis, a drawdown of the water level was taken from El. +12.54 to El. -3.64 feet MLLW at BCC and from El. +12.49 to El. -3.69 feet MLLW at BSC to reflect the impact of hurricane surge on the slope. The program SLOPE/W utilizes the Duncan et al.'s (1992) staged rapid drawdown method to evaluate slope stability after rapid drawdown. This is a 3-stage process:

The first stage involves the stability analysis of the embankment before drawdown when the water level is high and the pore water pressure in the soils is at steady state condition. Both the effective normal stress and the shear stress along the slip surface are used to determine the undrained shear strength of the soils that do not drain freely.

The second stage involves the stability analysis of the embankment after drawdown when the water level is low and the pore water pressure in the soils is in steady state condition. The effective normal stress obtained from stage two, together with the effective strength parameters are used to compute the drained strength along the slip surface. Both the drained and undrained strength at the slice base along the slip surface are compared and the smaller strength is chosen as the computed shear strength to be used.

The third stage involves stability analysis using the computed shear strength and final drawdown water level. The computed factor of safety from the first and second stages are ignored, and only the factor of safety computed from the third stage analysis is used to represent the stability after rapid drawdown.

The Long-Term and Rapid Drawdown strength parameters in clay were determined from Consolidated Undrained Triaxial Compression tests with pore pressure measurements. Long-term strength parameters were based on effective stress parameters and rapid drawdown strengths were based on total stress parameters. The soil parameters used for the analyses are presented in Table 3-1.

Table 3-1 – Soil Parameters for Slope Stability Analysis

Station & Boring Numbers	Soil Description	Unit Weight γ (pcf)	Short Term		Long Term		Rapid Drawdown	
			c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)	c _{cu} (psf)	ϕ_{cu} (deg)
Barbours Cut Channel								
Sta. 34+00 S-04, L-08, L-04	Fat Clay 1	125	1000	0	300	22	500	15
	Fat Clay 2	125	2200	0	300	22	500	15
	Soft Fat Clay	115	300	0	100	15	150	10
	Loose Clayey Sand	110	0	28	0	28	0	28
	Clayey Sand	120	0	30	0	30	0	30
	Dredge Fill	90	50	0	16	15	50	0
	Fill	110	10 psf/ft (50 psf – 150 psf)				100	20
	Levee	125	NA		100	25	150	22
Sta. 44+00 S-03, L-07, L-03	Fat Clay 1	125	1000	0	300	22	500	15
	Fat Clay 2	125	2200	0	300	22	500	15
	Clayey Sand	120	0	30	0	30	0	30
	Dredge Fill	90	50	0	16	15	50	0
	Fill	110	300	0	100	20	150	15
	Levee	125	NA		100	25	150	22
	Sediment	90	50	0	16	15	50	0
Sta. 56+00 S-02, L-06, L-02	Lean Clay	125	500	0	100	25	150	20
	Fat Clay 1	125	1000	0	300	22	500	15
	Fat Clay 2	125	2200	0	300	22	500	15
	Clayey Sand	120	0	30	0	30	0	30
	Dredge Fill	90	50	0	16	15	50	0
	Levee	125	NA		100	25	150	22
	Sediment	90	50	0	16	15	50	0
Sta. 64+00 S-01, L-05, L-01	Lean Clay	125	500	0	100	25	150	20
	Fat Clay 1	125	1000	0	400	18	500	14
	Fat Clay 2	125	2200	0	300	22	500	15
	Clayey Sand	120	0	30	0	30	0	30
	Dredge Fill	90	50	0	16	15	50	0
	Levee	125	NA		100	25	150	22
	Sediment	90	50	0	16	15	50	0
Bayport Ship Channel								
Sta. 40+00 12-59, B-1, B-2, B-18	Lean Clay	123	532	0	200	23	300	19
	Fat Clay	115	1200	0	200	18	300	14
	Clayey Sand	120	0	28	0	28	0.1	27.9
	Silty Sand	120	0	31	0	31	0.1	30.9

Station & Boring Numbers	Soil Description	Unit Weight γ (pcf)	Short Term		Long Term		Rapid Drawdown	
			c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)	c _{cu} (psf)	ϕ_{cu} (deg)
Bayport Ship Channel								
Sta. 66+00 12-60, B-4, B-5, B-15	Lean Clay	125	1000	0	200	23	300	19
	Silt	110	0	30	0	30	0.1	29.9
	Silty Clay	115	500	0	100	30	200	25
	Fat Clay	115	1200	0	300	17	310	14
	Silty Sand	120	0	34	0	34	0.1	33.9
Sta. 76+00 12-61, B-6	Silt	110	0	31	0	31	0.1	30.9
	Lean Clay	125	1000	0	200	23	300	19
	Fat Clay	115	1200	0	300	16	310	14
	Silty Sand	120	0	33	0	33	0.1	32.9
Sta. 92+00 12-63, B-8	Lean Clay	125	1000	0	200	23	300	19
	Clayey Sand	115	0	32	0	32	0.1	31.9
	Fat Clay	115	1200	0	200	18	300	14
Sta. 98+00 12-64, B-9	Silty Sand	120	0	32	0	32	0.1	31.9
	Clayey Sand	115	0	33	0	33	0.1	32.9
	Lean Clay	125	1200	0	200	23	300	19
	Silt	110	0	32	0	32	0.1	31.9
	Fat Clay	115	1200	0	200	18	300	14
Sta. 110+00 12-65, B-10, B-11	Silt	110	0	33	0	33	0.1	32.9
	Fat Clay	115	1200	0	200	18	300	14
	Lean Clay	125	1000	0	200	23	300	19
	Silty sand	120	0	31	0	31	0.1	30.9
Sta. 166+00 12-68	Silty Clay	115	1400	0	100	30	200	25
	Fat Clay 1	115	900	0	200	17	300	14
	Fat Clay 2	115	1500	0	200	17	300	14
	Lean Clay	120	2000	0	200	23	300	19
	Silty Sand	120	0	34	0	34	0.1	33.9
	Clayey Sand	115	0	32	0	32	0.1	31.9
Sta. 186+00 12-69	Lean Clay	120	1200	0	200	23	300	19
	Fat Clay	115	1200	0	200	17	300	14
	Clayey Sand	115	0	32	0	32	0.1	31.9

Where:

γ :	Moist Unit Weight of Soil	c':	Consolidated Drained Cohesion
c:	Unconsolidated Undrained Cohesion	ϕ' :	Consolidated Drained Friction Angle
ϕ :	Unconsolidated Undrained Friction Angle	c _{cu} :	Consolidated Undrained Cohesion
		ϕ_{cu} :	Consolidated Undrained Friction Angle

3.4 Results of Slope Stability Analysis

Based on the soil parameters and water level discussed earlier, slope stability analyses were performed for the short-term, long-term, and rapid drawdown loading conditions. The results of our analyses are presented in Appendix A. The global stability analysis results are summarized below:

Table 3-2 – Slope Stability Analyses Results – Proposed Template

Location	Station	Factor of Safety			
		Short Term		Long Term (circular)	Rapid Drawdown (circular)
		Circular	Block		
Barbours Cut Channel	34+00	1.47	1.56	1.28*	1.32
	44+00	1.24*	1.37	1.26*	1.24*
	56+00	1.06*	1.02*	1.50	1.49
	64+00	1.34	1.36	1.43*	1.43
Bayport Ship Channel	40+00	1.56	1.53	1.56	1.42
	66+00	1.50	1.40	1.74	1.54
	76+00	2.47	2.37	1.89	1.62
	92+00	2.42	2.38	1.72	1.50
	98+00	2.51	2.45	1.77	1.49
	110+00	2.33	2.31	1.56	1.41
	166+00	3.85	3.83	2.09	2.09
	186+00	5.60	4.05	2.17	2.16

* Does not meet the minimum required.

Barbours Cut Channel: The calculated factors of safety for the proposed 3H:1V slope does not meet the minimum required. We understand that a flatter channel slope from the proposed channel toe is not an option considering the reduction in the placement area capacity. In order to provide proposed channel base width while maintaining the Spilman Island placement area, a bulkhead is required along the entire length adjacent to Spilman Island. Based on our global stability analysis, the 3H:1V channel slope requires a bulkhead installed between Sta. 30+00 and Sta. 67+00 at an offset of about 530 feet from the existing centerline and embedded to El. -52 feet MLLW to achieve the required factors of safety. The results of our analyses including the proposed bulkhead are presented in Appendix C. The global stability analysis results are summarized in Table 3-3.

Table 3-3 – Slope Stability Analyses Results with Bulkhead

Location	Station	Factor of Safety			
		Short Term		Long Term (circular)	Rapid Drawdown (circular)
		Circular	Block		
Barbours Cut Channel	34+00	1.85	2.04	1.53	1.64
	44+00	1.89	1.89	1.61	1.64
	56+00	1.64	1.89	1.51	1.49
	64+00	1.72	1.89	1.56	1.55

Note that the soil conditions of the Spilman Island dike are important to the analysis. We suggest additional borings be performed for final design.

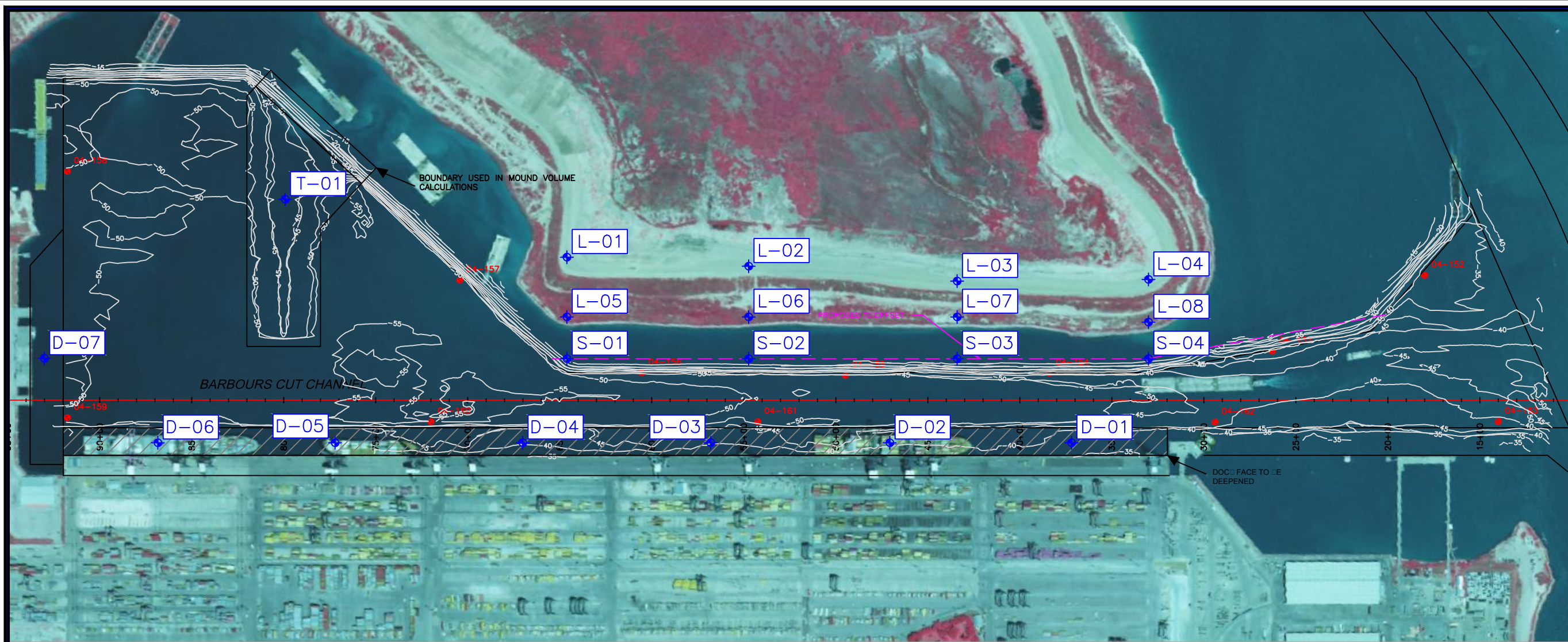
Bayport Ship Channel: The calculated factor of safety exceeds the required minimum factor of safety at all sections we analyzed. However, installation of a bulkhead is required for the area north of the turning basin adjacent to the San Jacinto College building. Our analysis indicates that the bulkhead must be installed between about Sta. 35+00 and Sta. 43+50 at about 400 feet from the existing centerline embedded to an elevation of -40 feet MLLW to achieve the required factor of safety for global stability.

Bulkheads: For analyses purposes, we modeled the bulkheads as a high strength material. The bottom elevation of the bulkhead was adjusted to achieve the required factor of safety for global stability. The SLOPE/W program assumes the strength of bulkhead to be infinity, therefore, any slip surfaces passing through the bulkhead are considered very stable. A detailed analysis must be performed to assess the bulkhead stability against rotational and flexural failures. Rotational failures are caused due to inadequate penetration length and flexural failures are resulted by overstressing the retaining structure. An analysis of the bulkhead was beyond the scope of this study.

4 LIMITATIONS

This investigation was performed for the exclusive use of Tuner, Collie, and Braden/GBA Joint Venture for specific application to HSC-ECIP Preliminary Slope Evaluation Project. HVJ Associates, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ Associates, Inc. makes no warranty, express or implied. The analyses and recommendations contained in this report are based on data obtained from subsurface exploration, laboratory testing, the project information provided to us and our experience with similar soils and site conditions. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any subsurface conditions other than those described in our boring logs be encountered, HVJ Associates should be immediately notified so that further investigation and supplemental recommendations can be provided.

ILLUSTRATIONS



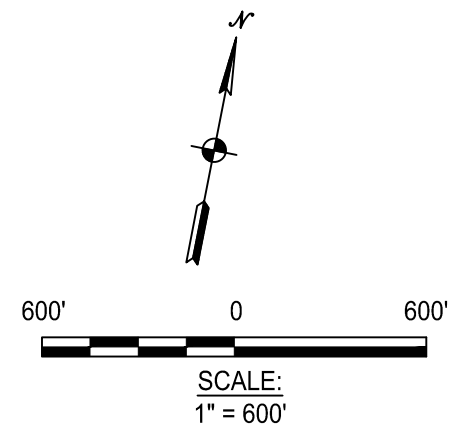
- NOTES:
1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES SHOWN AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.
 2. AERIAL IMAGERY OBTAINED FROM TEXAS NATURAL RESOURCES INFORMATION SYSTEM AND IS DATED 2010.
 3. CONTOURS BASED ON SURVEY CONDUCTED BY THE USACE ON JANUARY 26, 2010.

SURVEY DATA	
Survey Date:	26 JANUARY 2010
Horizontal Projection:	U.S. State Plane, NAD 83
Zone:	Texas South Central - 4204
Vertical Reference:	MLT
Survey Units:	U.S. Survey Feet

PRELIMINARY DRAFT

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.

ENGINEER:	C. HEDDERMAN
LICENSE NO.:	100209
DATE:	08 MARCH 2012



Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

GABA
ENGINEERS & SURVEYORS

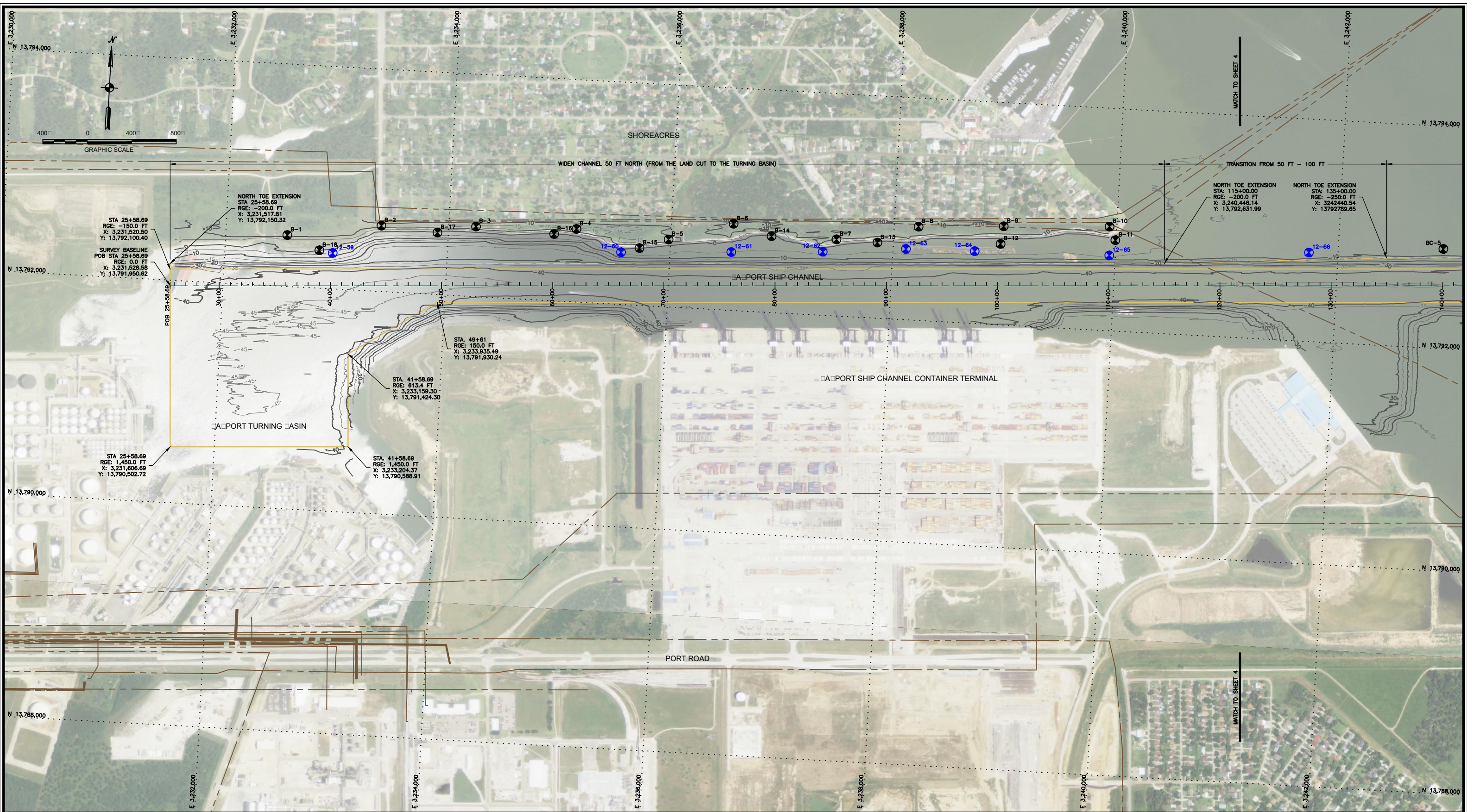
GAHAGAN & BRYANT ASSOCIATES, INC.
9330 KIRBY DRIVE, SUITE 100
HOUSTON, TEXAS 77054
TEL: 832.377.4800
FAX: 832.377.4802
WWW.GBA-INC.COM
TX REGISTERED ENGINEERING FIRM F-408

Drawing Name:	XXXX.DWG
Drawing Scale:	AS SHOWN
Sheet: 1 OF X	Rev. No. 0

REV	REVISIONS	DATE	APP

BARBOURS CUT
CHANNEL WIDENING INVESTIGATION

PROPOSED BORING LOCATIONS



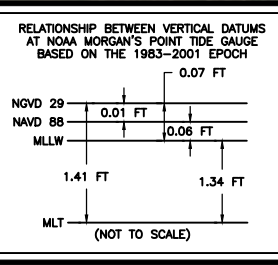
REV	REVISIONS	DATE	APP

NOTES:

1. INFORMATION DEPICTED HERE REPRESENTS THE RESULTS OF SURVEYS AND GEOTECHNICAL INVESTIGATIONS MADE ON THE DATES PROVIDED BELOW AND CAN ONLY INDICATE GENERAL CONDITIONS EXISTING AT THAT TIME.
2. 2012 BORINGS WERE CONDUCTED BY TRIANGLE RESOURCES AND HVJ ASSOCIATES FROM NOVEMBER 29 TO DECEMBER 17, 2012.
3. 2012 BORING POSITIONS WERE OBTAINED USING A MAGELLAN TRITON 200 HANDHELD GPS UNIT WITH WIDE AREA AUGMENTATION SYSTEM (WAAS) WITH DIFFERENTIAL CORRECTIONS CAPABILITIES.
4. COORDINATES ARE IN SURVEY FEET AND ARE REFERENCED TO U.S. STATE PLANE TEXAS SOUTH CENTRAL ZONE 4204, NAD83.
5. CONTOURS AND 2012 BORING ELEVATIONS ARE IN SURVEY FEET AND ARE REFERENCED TO MLLW USING THE RELATIONSHIPS SHOWN.
6. CONTOURS AND BORING ELEVATIONS ARE BASED ON SURVEYS CONDUCTED BY THE JOINT VENTURE FROM FEBRUARY 16-23, 2011.
7. AERIAL IMAGERY WAS OBTAINED FROM THE USDA/FSA - AERIAL PHOTOGRAPHY FIELD OFFICE AND WAS DATED 2012.

LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- CHANNEL EXTENSION
- 5-FT CONTOURS
- 10-FT CONTOURS
- 2012 BORINGS
- PREVIOUS BORINGS



PRELIMINARY DRAFT

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ENGINEER: C. HEDDERMAN
 LICENSE NO.: 100209
 DATE: 24 JAN. 2013

TurnerCollie & Braden Inc.
 JOINT VENTURE - PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES

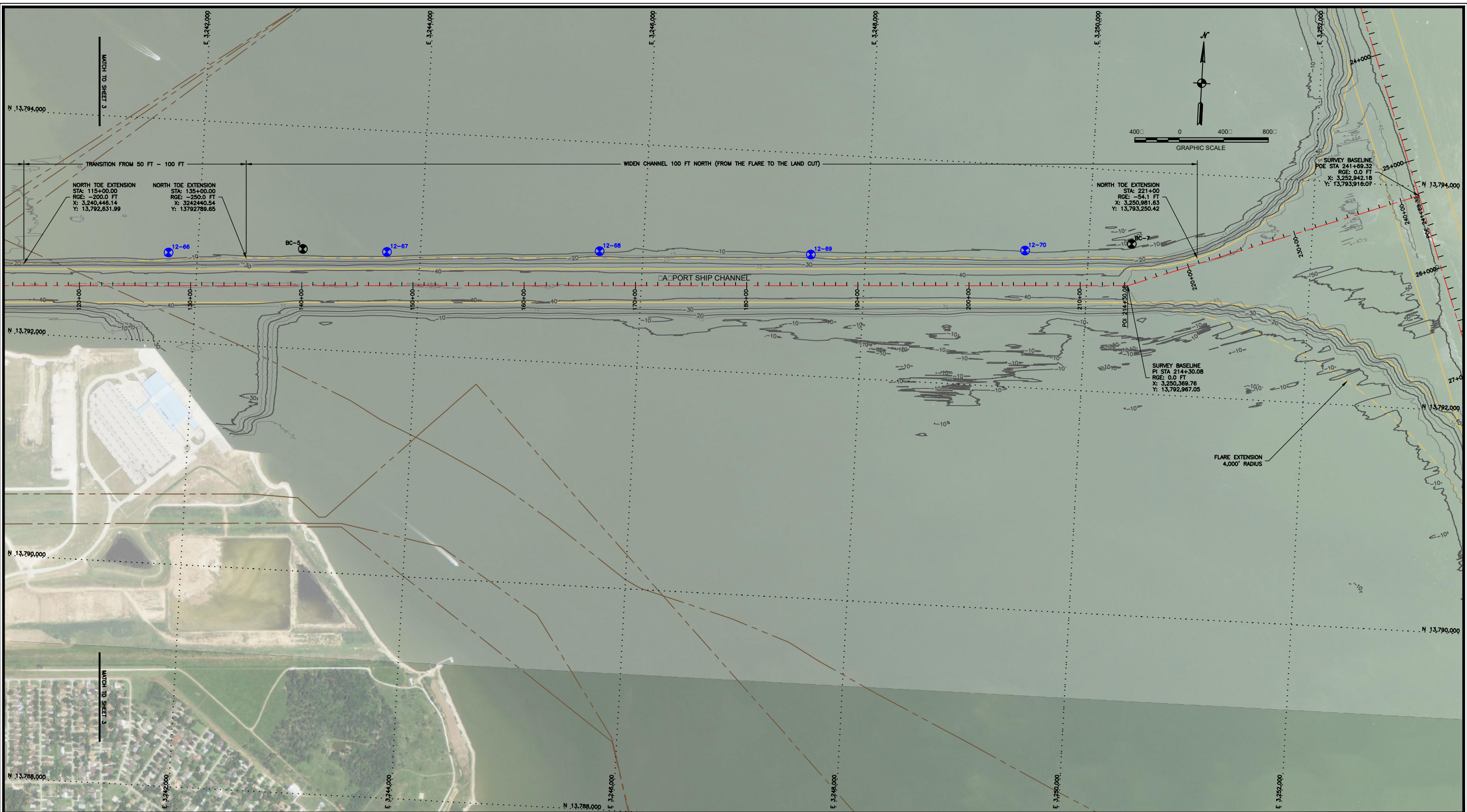
GAHAGAN & BRYANT ASSOCIATES
 TEXAS ENGINEERING FIRM F-10788
 5757 WOODWA DRIVE
 HOUSTON, TEXAS 77057-1500
 TEL. 713.780.4100

PORT OF HOUSTON AUTHORITY

BAYPORT CHANNEL DEEPENING AND WIDENING PROJECT

BAYPORT BORINGS

DWG DATE: 24 JANUARY 2013 | DWG: Bayport2012_Borings.dwg
 DRAWN: J. MCCLURE | CHECKED: S. HALPIN | ENGR: C. HEDDERMAN
 SCALE: AS SHOWN | SHEET: 3 OF 39 | REV: 0



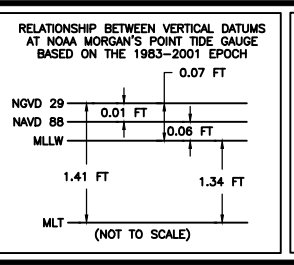
REV	REVISIONS	DATE	APP

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7. AERIAL IMAGERY WAS OBTAINED FROM THE USDA/FSA - AERIAL PHOTOGRAPHY FIELD OFFICE AND WAS DATED 2012.

LEGEND

- PIPELINES
- CHANNEL/LEVEE ALIGNMENTS
- CHANNEL TOES
- CHANNEL EXTENSION
- 5-FT CONTOURS
- 10-FT CONTOURS
- 2012 BORINGS
- PREVIOUS BORINGS



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ENGINEER: C. HEDDERMAN
 LICENSE NO. 100209
 DATE: 24 JAN. 2013

TurnerCollie & Braden Inc.
 JOINT VENTURE - PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES

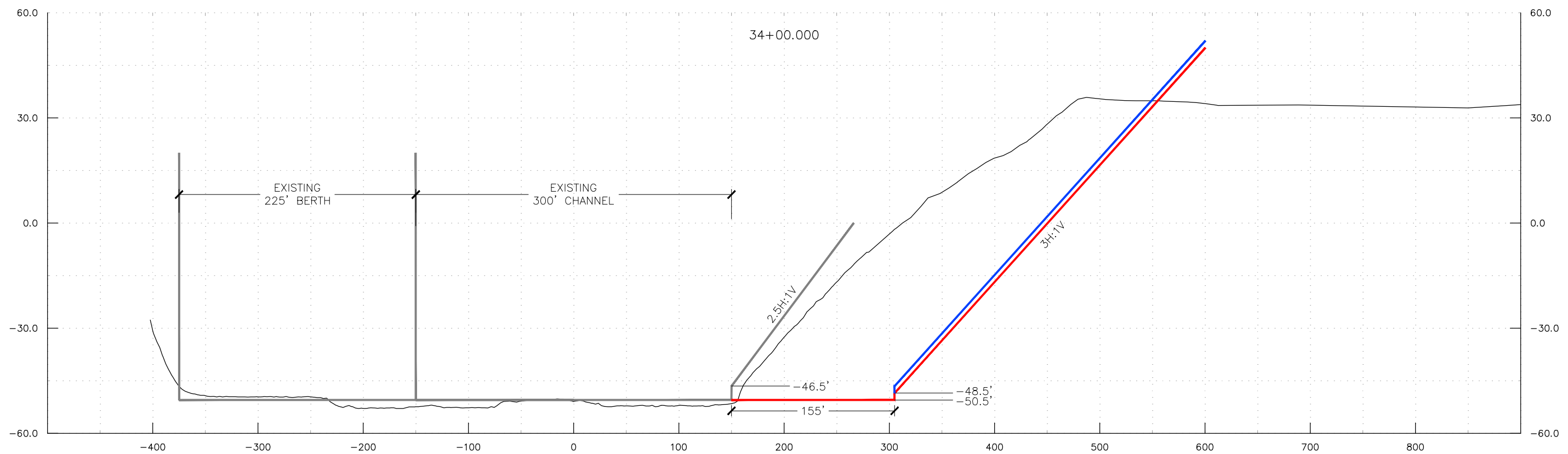
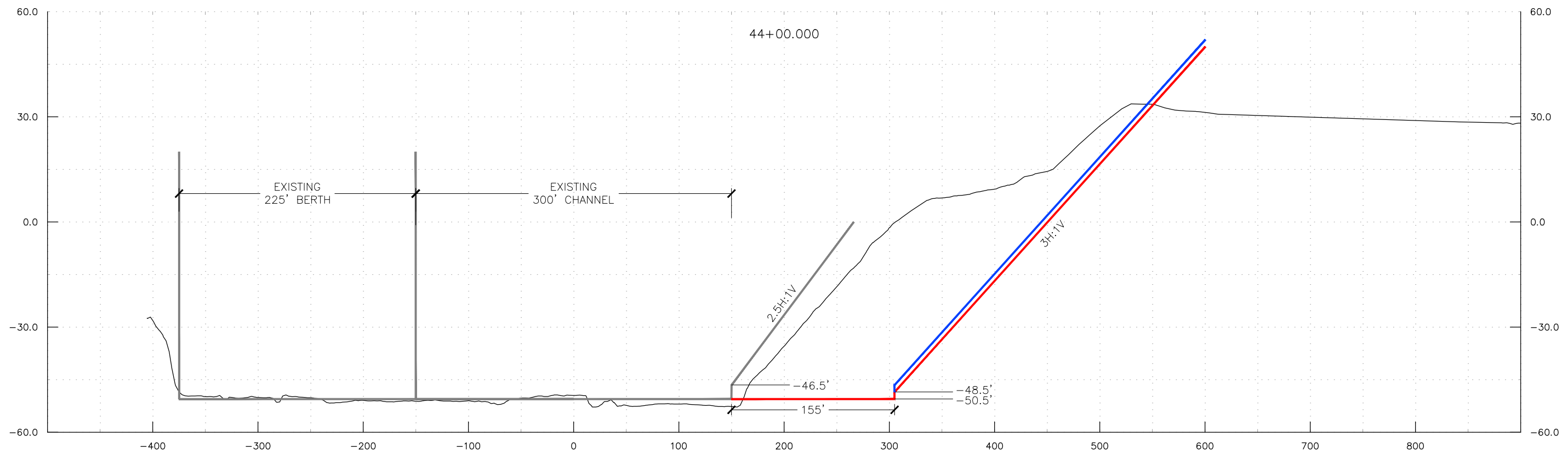
GAHAGAN & BRYANT ASSOCIATES
 TEXAS ENGINEERING FIRM F-10788
 5757 WOODWA DRIVE
 HOUSTON, TEXAS 77057-1500
 TEL. 713.780.4100

PORT OF HOUSTON AUTHORITY

BAYPORT CHANNEL DEEPENING AND WIDENING PROJECT

BAYPORT BORINGS

DWG DATE: 24 JANUARY 2013	DWG: Bayport2012_Borings.dwg
DRAWN: J. MCCLURE	CHECKED: S. HALPIN
ENGR: C. HEDDERMAN	SCALE: AS SHOWN
SHEET: 4 OF 39	REV: 0



REV	REVISIONS	DATE	APP

NOTES:

- SURVEY LAYER REPRESENTS A COMBINED DATASET COMPILATION OF SURVEYS PERFORMED BY THE JV ON THE DATES OF 09/14-17/15 AND 06/12/14, AS WELL AS TOPOGRAPHIC SURVEY DATA PROVIDED BY THE JV (AUG 2013), HTI (MAY 2013), AND ORION MARINE GROUP (2015) PERFORMED AND/OR PREPARED IN CONJUNCTION WITH THE BCC IMPROVEMENTS PROJECT (2014-2015).
- ADDITIONAL DATA IN UPDATED SURVEY LAYER INCLUDES USACE 2011 LIDAR DATA OF SPILMAN ISLAND.
- SURVEY DATA PROVIDED RELATIVE TO MEAN LOWER LOW WATER (MLLW). ORIGINAL DATA COLLECTED IN MEAN LOW TIDE (MLT) AND CONVERTED TO MLLW AS FOLLOWS: ELEV. MLLW = ELEV. MLT - 1.26'
- HORIZONTAL SCALE IS 1" = 100'. VERTICAL SCALE IS 1" = 30'. (VERTICAL EXAGGERATION = 3.33X)
- CENTERLINE SHOWN REPRESENTS EXISTING (POST-BCC IMPROVEMENTS PROJECT) CHANNEL CENTERLINE.

LEGEND:

- 455' WIDTH WIDENED CHANNEL
- EXISTING CHANNEL
- COMPOSITE SURVEY SURFACE
- 455' WIDTH WIDENED CHANNEL SLOPE FROM -46.5'

PRELIMINARY DRAFT

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ENGINEER:	C.HEDDERMAN
LICENSE NO.:	100209
DATE:	01/23/18

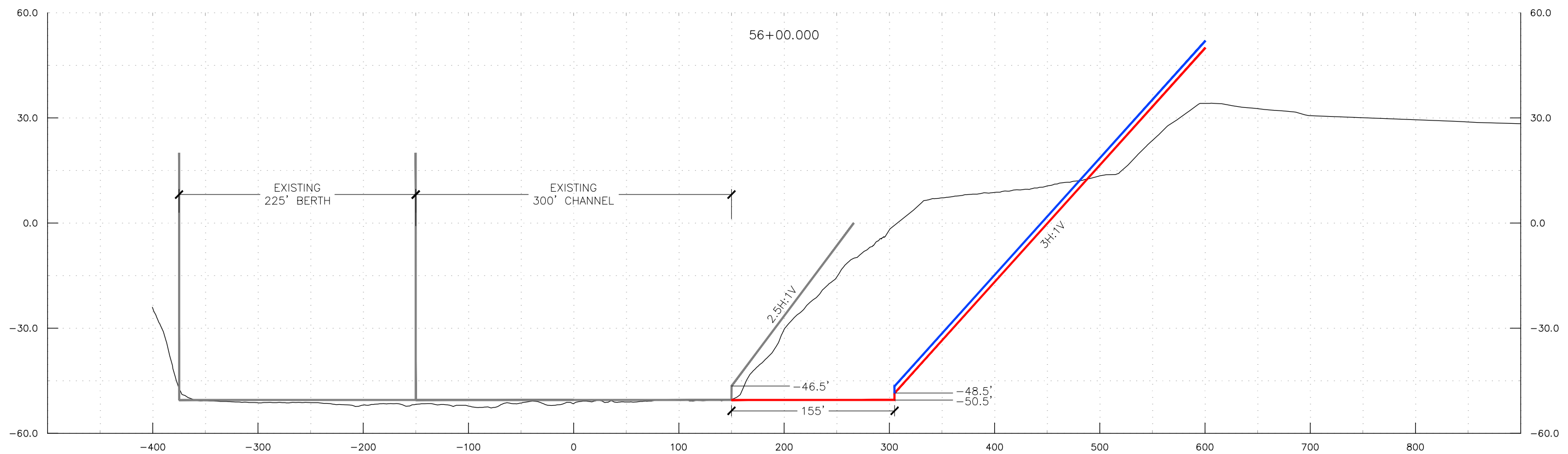
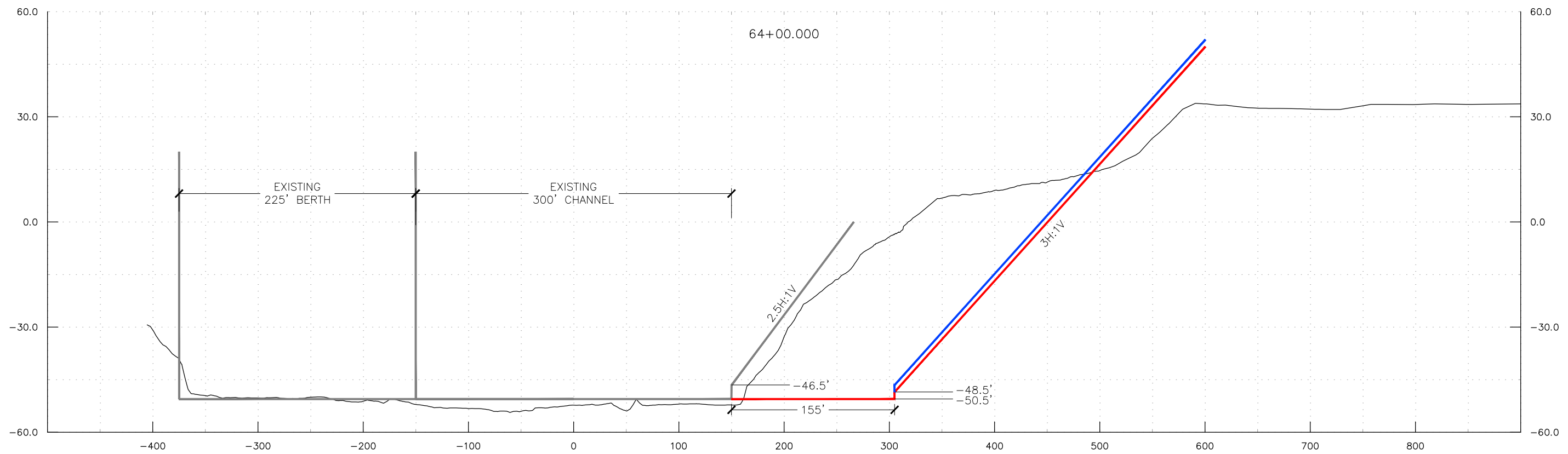
TurnerCollie&Braden Inc.
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GAHAGAN & BRYANT ASSOCIATES
 TEXAS ENGINEERING FIRM F-10788
 5444 WESTHEIMER, SUITE 200
 HOUSTON, TEXAS 77056
 TEL. 713.780.4100

PORT OF HOUSTON AUTHORITY

HOUSTON SHIP CHANNEL
 EXPANSION CHANNEL IMPROVEMENTS PROJECT

CHANNEL WIDENING MEASURE: CW3_BCC_455

DWG DATE:	23 JANUARY 2018	DWG:	HSC-ECIP BCC SECTIONS.dwg
DRAWN:	C.HEDDERMAN	CHECKED:	...
SCALE:	SEE NOTES	SHEET:	01 OF 02
		ENGR:	C.HEDDERMAN
		REV:	00



REV	REVISIONS	DATE	APP

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LEGEND:

—	455' WIDTH WIDENED CHANNEL
—	EXISTING CHANNEL
—	COMPOSITE SURVEY SURFACE
—	455' WIDTH WIDENED CHANNEL SLOPE FROM -46.5'

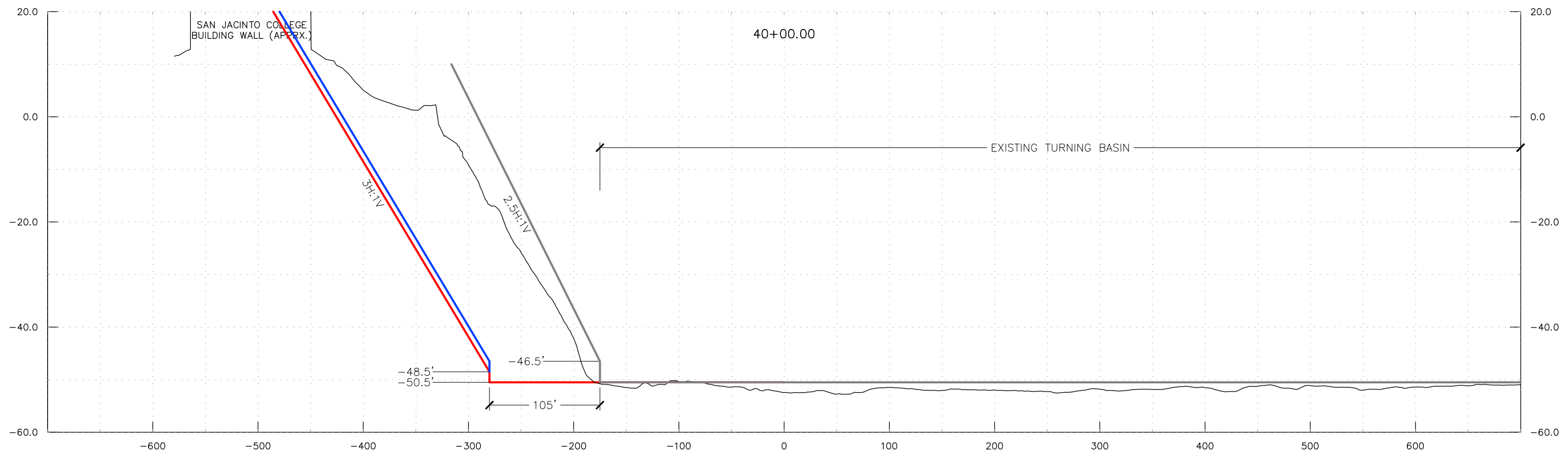
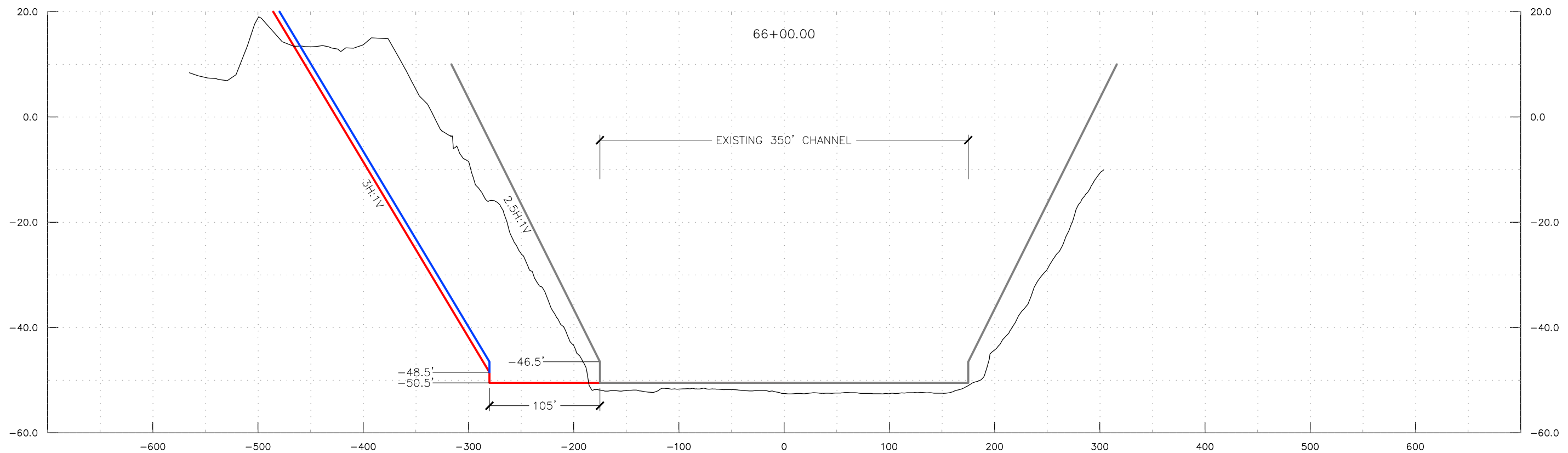
PRELIMINARY DRAFT

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ENGINEER:	C.HEDDERMAN
LICENSE NO.:	100209
DATE:	01/23/18

TurnerCollie&Braden Inc.
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GAHAGAN & BRYANT ASSOCIATES
 TEXAS ENGINEERING FIRM F-10788
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 HOUSTON, TEXAS 77056
 TEL. 713.780.4100

PORT OF HOUSTON AUTHORITY			
HOUSTON SHIP CHANNEL EXPANSION CHANNEL IMPROVEMENTS PROJECT			
CHANNEL WIDENING MEASURE: CW3_BCC_455			
DWG DATE:	23 JANUARY 2018	DWG:	HSC-ECIP BCC SECTIONS.dwg
DRAWN:	C.HEDDERMAN	CHECKED:	...
SCALE:	SEE NOTES	SHEET:	02 OF 02
ENGR:	C.HEDDERMAN	REV:	00



REV	REVISIONS	DATE	APP

NOTES:

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5. CENTERLINE SHOWN REPRESENTS EXISTING (POST-BSC IMPROVEMENTS PROJECT) CHANNEL CENTERLINE.

LEGEND	
—	455' WIDTH WIDENED CHANNEL
—	EXISTING CHANNEL
—	COMPOSITE SURVEY SURFACE
—	455' WIDTH WIDENED CHANNEL SLOPE FROM -46.5'

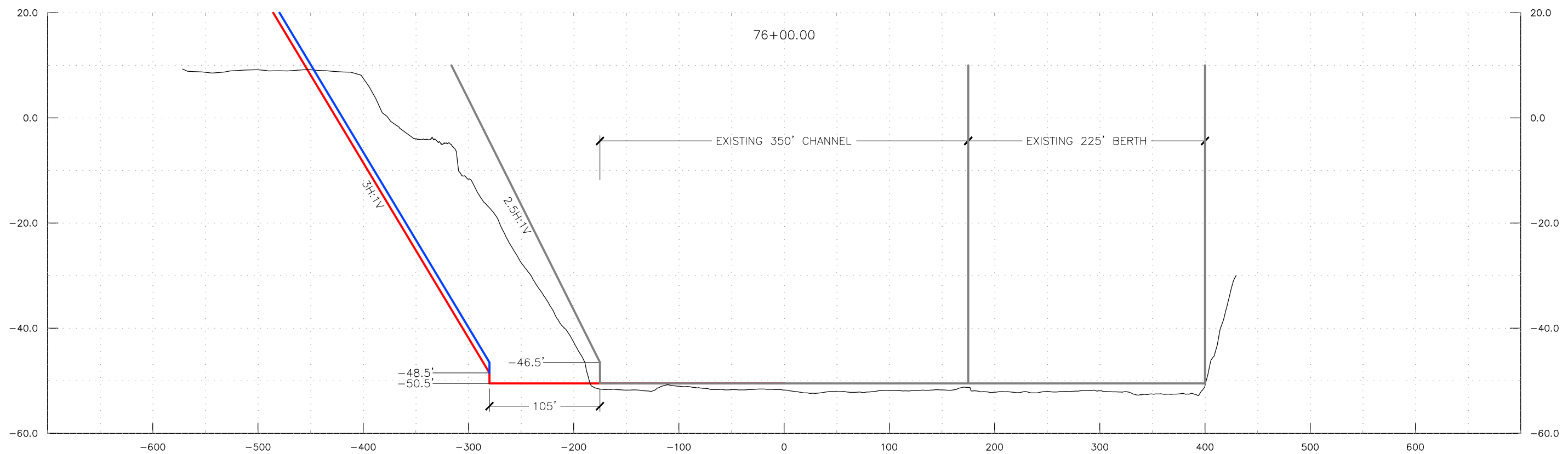
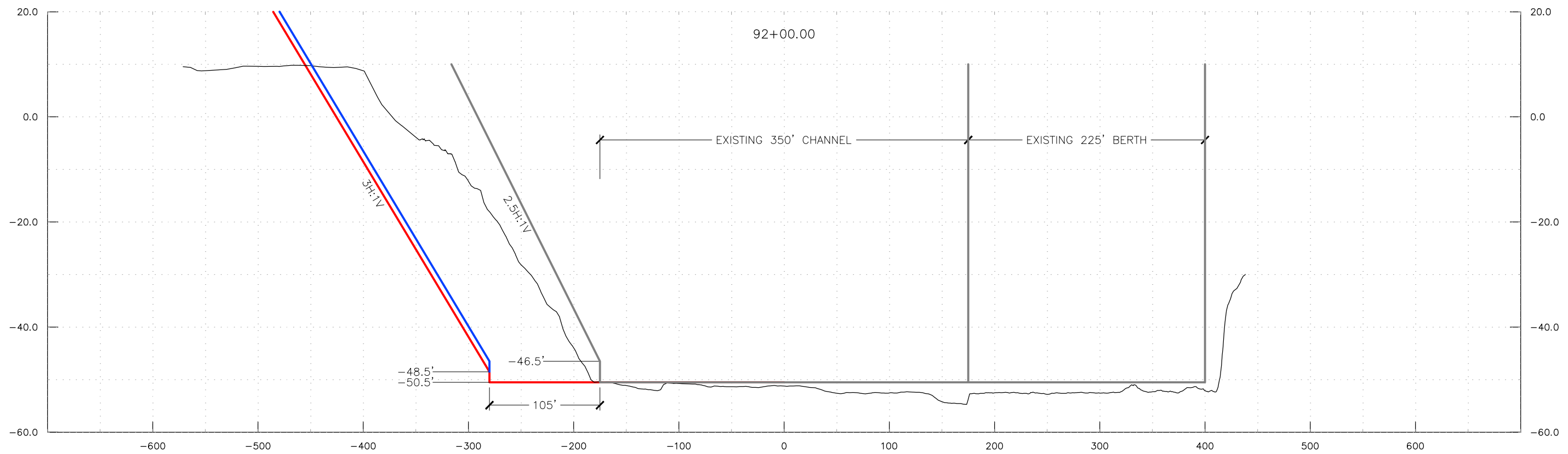
PRELIMINARY DRAFT

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ENGINEER:	C.HEDDERMAN
LICENSE NO.:	100209
DATE:	01/23/18

TurnerCollie&Braden Inc.
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GAHAGAN & BRYANT ASSOCIATES
 TEXAS ENGINEERING FIRM F-10788
 5444 WESTHEIMER, SUITE 200
 HOUSTON, TEXAS 77056
 TEL. 713.780.4100

PORT OF HOUSTON AUTHORITY			
HOUSTON SHIP CHANNEL EXPANSION CHANNEL IMPROVEMENTS PROJECT			
CHANNEL WIDENING MEASURE: CW2_BSC_455			
DWG DATE:	23 JANUARY 2018	DWG:	HSC-ECIP_BSC_SECTIONS.dwg
DRAWN:	C.HEDDERMAN	CHECKED:	...
SCALE:	SEE NOTES	SHEET:	01 OF 04
ENGR:	C.HEDDERMAN	REV:	00



REV	REVISIONS	DATE	APP

NOTES:

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LEGEND:	
—	455' WIDTH WIDENED CHANNEL
—	EXISTING CHANNEL
—	COMPOSITE SURVEY SURFACE
—	455' WIDTH WIDENED CHANNEL SLOPE FROM -46.5'

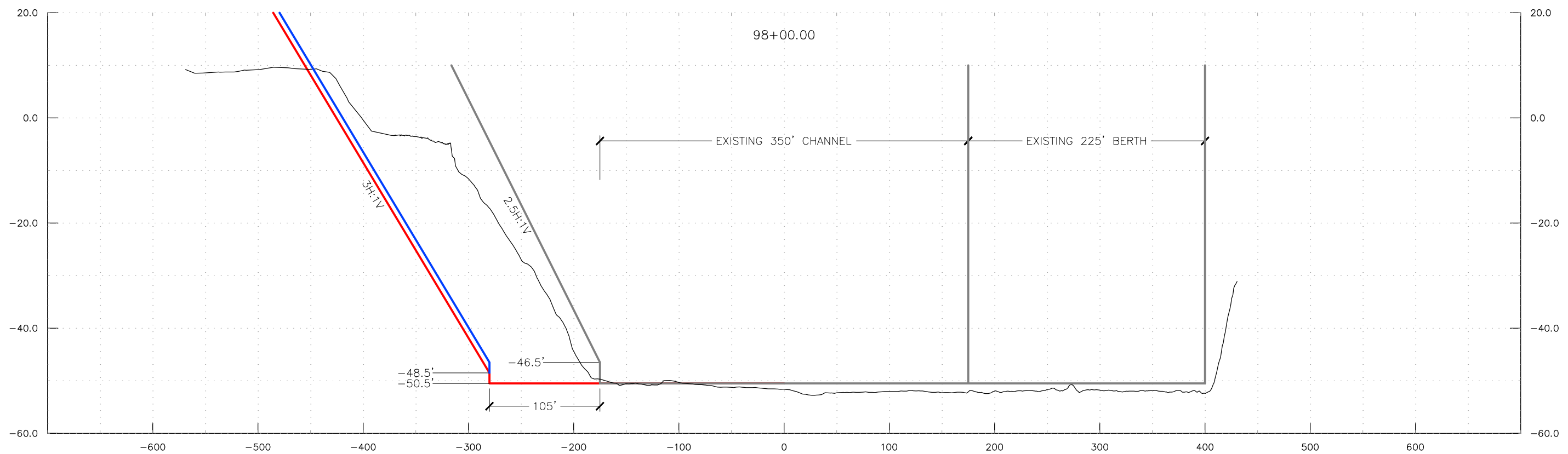
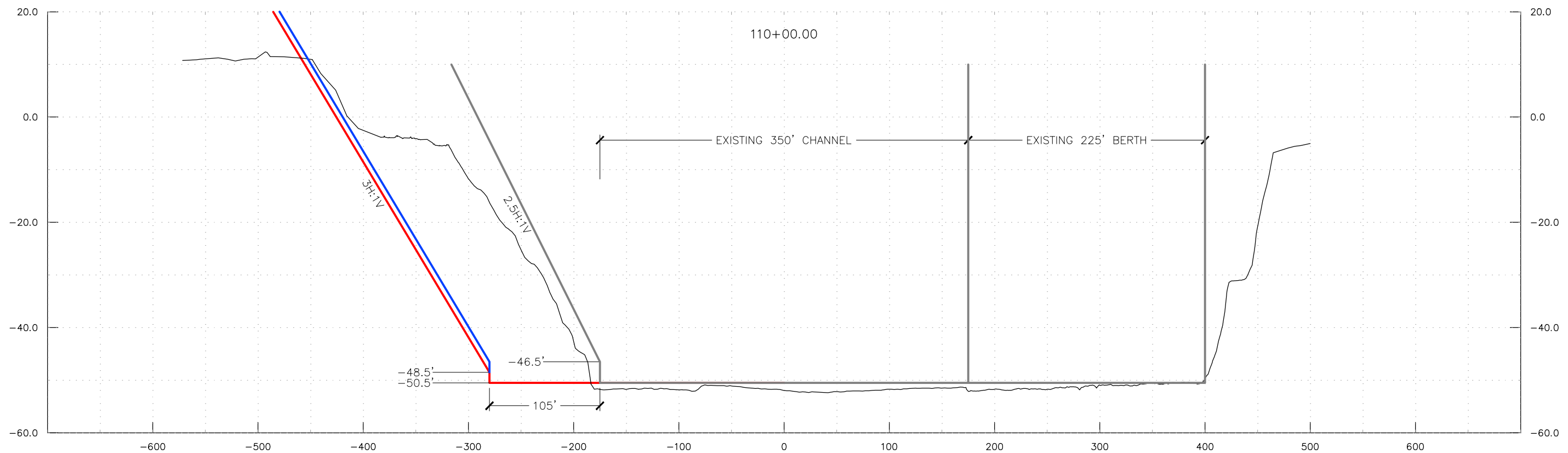
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ENGINEER:	C.HEDDERMAN
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GAHAGAN & BRYANT ASSOCIATES
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PORT OF HOUSTON AUTHORITY			
HOUSTON SHIP CHANNEL EXPANSION CHANNEL IMPROVEMENTS PROJECT			
CHANNEL WIDENING MEASURE: CW2_BSC_455			
DWG DATE:	23 JANUARY 2018	DWG:	HSC-ECIP BSC SECTIONS.dwg
DRAWN:	C.HEDDERMAN	CHECKED:	...
SCALE:	SEE NOTES	SHEET:	02 OF 04
ENGR:	C.HEDDERMAN	REV:	00



REV	REVISIONS	DATE	APP

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—	EXISTING CHANNEL
—	COMPOSITE SURVEY SURFACE
—	455' WIDTH WIDENED CHANNEL SLOPE FROM -46.5'

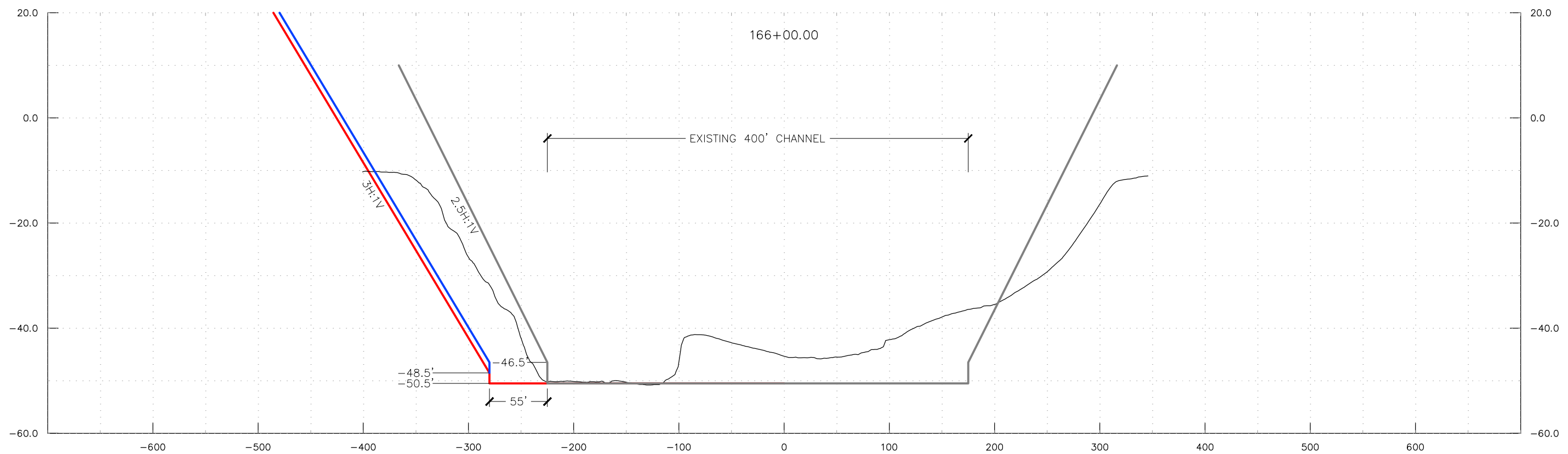
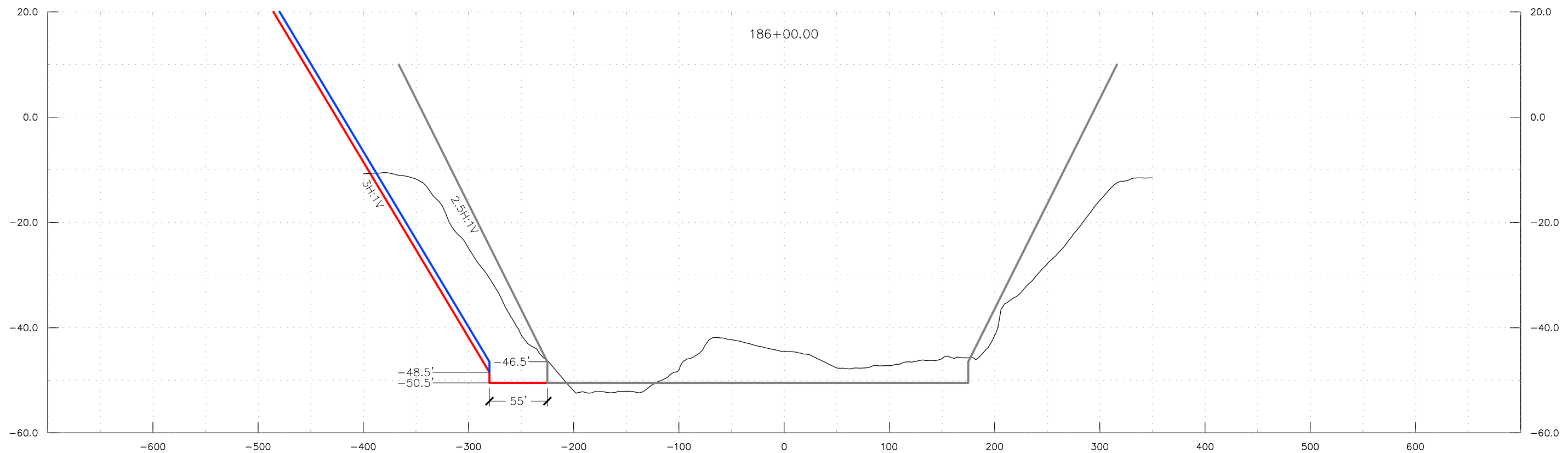
PRELIMINARY DRAFT

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ENGINEER:	C.HEDDERMAN
LICENSE NO.:	100209
DATE:	01/23/18

TurnerCollie&Braden Inc.
 JOINT VENTURE - PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES
 TEXAS ENGINEERING FIRM F-10788
 5444 WESTHEIMER, SUITE 200
 HOUSTON, TEXAS 77056
 TEL. 713.780.4100

PORT OF HOUSTON AUTHORITY			
HOUSTON SHIP CHANNEL EXPANSION CHANNEL IMPROVEMENTS PROJECT			
CHANNEL WIDENING MEASURE: CW2_BSC_455			
DWG DATE:	23 JANUARY 2018	DWG:	HSC-ECIP_BSC SECTIONS.dwg
DRAWN:	C.HEDDERMAN	CHECKED:	...
SCALE:	SEE NOTES	SHEET:	03 OF 04
ENGR:	C.HEDDERMAN	REV:	00



REV	REVISIONS	DATE	APP

NOTES:

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LEGEND	
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—	EXISTING CHANNEL
—	COMPOSITE SURVEY SURFACE
—	455' WIDTH WIDENED CHANNEL SLOPE FROM -46.5'

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HOUSTON SHIP CHANNEL EXPANSION CHANNEL IMPROVEMENTS PROJECT			
CHANNEL WIDENING MEASURE: CW2_BSC_455			
DWG DATE:	23 JANUARY 2018	DWG:	HSC-ECIP_BSC_SECTIONS.dwg
DRAWN:	C.HEDDERMAN	CHECKED:	...
SCALE:	SEE NOTES	SHEET:	04 OF 04
ENGR:	C.HEDDERMAN	REV:	00

APPENDIX A

SLOPE STABILITY ANALYSIS: PROPOSED AT BARBOURS CUT CHANNEL

Project Name: HSC - ECIP Preliminary Slope Evaluation

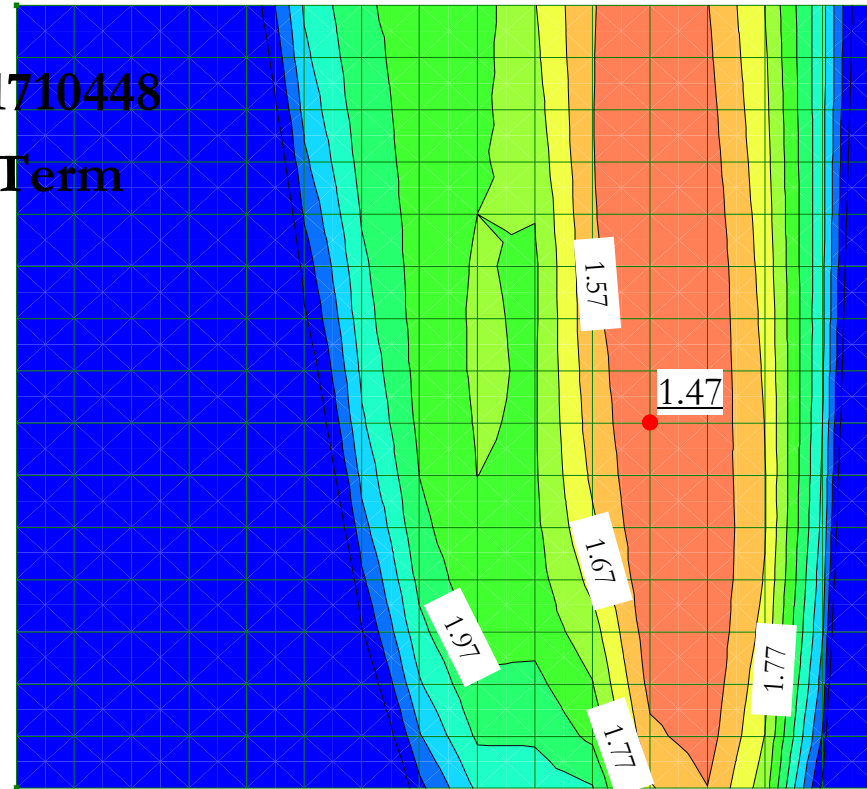
Location: Barbours Cut Ship Channel

Station Analyzed: 34+00

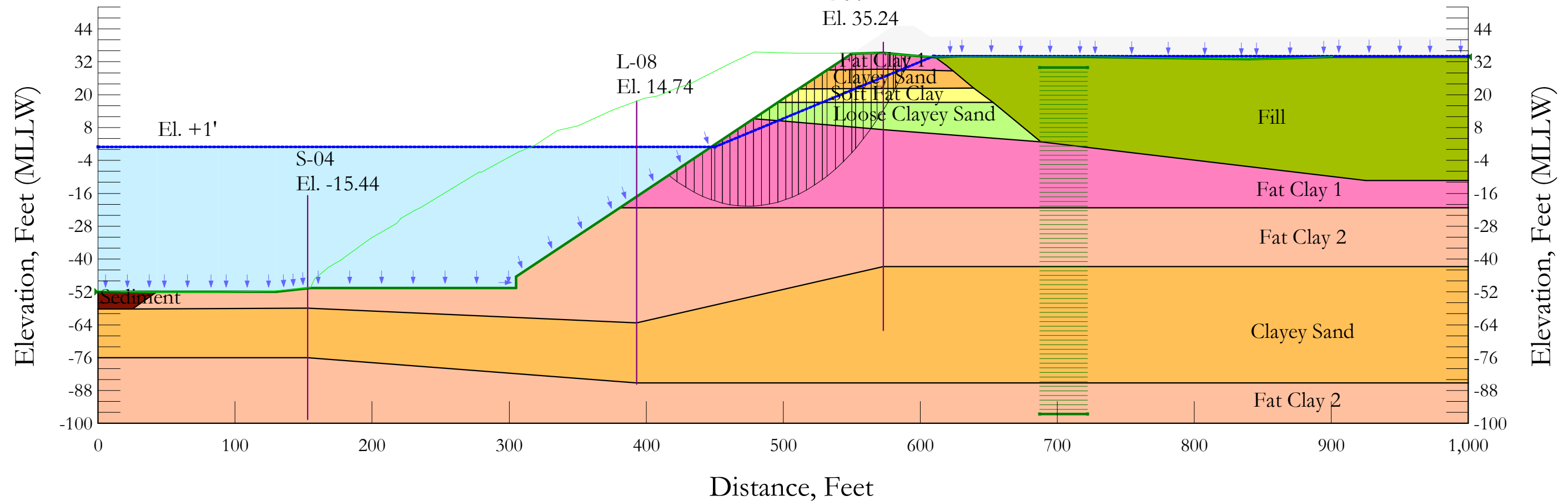
HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)	C-Top of Layer (psf)	C-Rate of Change ((lbs/ft²)/ft)	C-Maximum (psf)
Orange	Clayey Sand	120	0	30				
Pink	Fat Clay 1(U)	125			1,000			
Green	Fill	110				50	10	150
Dark Brown	Sediment (U)	90			50			
Light Orange	Fat Clay 2 (U)	125			2,200			
Yellow	Soft Fat Clay (U)	115			300			
Light Green	Loose Clayey Sand	110	0	28				



Short Term 34+00

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 212

Date: [4/25/2018](#)

Time: [1:19:25 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\](#)

Last Solved Date: [4/25/2018](#)

Last Solved Time: [1:19:42 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

Short Term 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 0 psf

Phi: 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fill

Model: S=f(depth)

Unit Weight: 110 pcf

C-Top of Layer: 50 psf

C-Rate of Change: 10 (lbs/ft²)/ft

C-Maximum: 150 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: Undrained (Phi=0)

Unit Weight: 90 pcf

Cohesion: 50 psf

Pore Water Pressure
Piezometric Line: 1

Fat Clay 2 (U)

Model: [Undrained \(Phi=0\)](#)
Unit Weight: [125 pcf](#)
Cohesion: [2,200 psf](#)
Pore Water Pressure
Piezometric Line: 1

Soft Fat Clay (U)

Model: [Undrained \(Phi=0\)](#)
Unit Weight: [115 pcf](#)
Cohesion: [300 psf](#)
Pore Water Pressure
Piezometric Line: 1

Loose Clayey Sand

Model: [Mohr-Coulomb](#)
Unit Weight: [110 pcf](#)
Cohesion: [0 psf](#)
Phi': [28 °](#)
Phi-B: [0 °](#)
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: [\(217.8737, 219.00031\) ft](#)
Lower Left: [\(217.8737, 60.51432\) ft](#)
Lower Right: [\(568.0477, 60.51432\) ft](#)
Grid Horizontal Increment: 15
Grid Vertical Increment: 15
Left Projection Angle: [0 °](#)
Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(687.0189, 29.85921\) ft](#)
Upper Right Coordinate: [\(722.1145, 29.85921\) ft](#)
Lower Left Coordinate: [\(687.0189, -96.57772\) ft](#)
Lower Right Coordinate: [\(722.1145, -96.57772\) ft](#)
Number of Increments: 75
Left Projection: [No](#)
Left Projection Angle: [135 °](#)
Right Projection: [No](#)
Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -52\) ft](#)
Right Coordinate: [\(1,000, 33.75\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	610	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76
Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74
Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5

Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
Point 50	550	35
Point 51	580.42	45.14
Point 52	595.42	45.14
Point 53	607.42	41.14
Point 54	704	41.14
Point 55	717.6	36.74
Point 56	722	33.7
Point 57	1,000	41.14
Point 58	900	33.75
Point 59	502	10.23641
Point 60	502	17.19722
Point 61	502	19.1605

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1(U)	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2 (U)	26,3,9,27,28,29	17,271
Region 3	Fill	20,19,18,33,32,31,23,41,17,58,22,56,30	13,510
Region 4	Loose Clayey Sand	14,31,32,13,60,47,46,59	1,852
Region 5	Soft Fat Clay (U)	47,60,13,32,33,12,48,61	716.27
Region 6	Clayey Sand	33,18,11,49,48,12	748.17
Region 7	Clayey Sand	25,38,1,6,15,24,27,9,3,26	31,487
Region 8	Fat Clay 2 (U)	39,38,1,6,15,24,34,35,36,45,44,37,43,42	19,681
Region 9	Fat Clay 1(U)	36,46,59,14,31,23,41,34,35	12,273
Region 10	Sediment (U)	39,40,25,38	212.84
Region 11		51,50,10,21,20,30,53,52	502.37
Region 12		53,54,55,56,30	699.64
Region 13		54,55,56,22,58,17,57	2,180.1

Current Slip Surface

Slip Surface: 9,379

F of S: 1.47

Volume: 4,679.2221 ft³

Weight: 568,802.71 lbs

Resisting Moment: 27,796,495 lbs-ft

Activating Moment: 18,961,422 lbs-ft

Resisting Force: 165,415.55 lbs

Activating Force: 112,845.39 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (416.40698, -9.3643396) ft
 Entry: (593.18805, 34.289977) ft
 Radius: 155.19001 ft
 Center: (474.66797, 134.47445) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	419.51628	-10.546809	720.52089	1,146.9584	0	1,000
Slice 2	425.73489	-12.762631	858.78816	1,578.4753	0	1,000
Slice 3	431.95349	-14.686379	978.83002	1,972.5523	0	1,000
Slice 4	438.17209	-16.329254	1,081.3454	2,325.464	0	1,000
Slice 5	444.3907	-17.700372	1,166.9032	2,634.2447	0	1,000
Slice 6	448.75	-18.530751	1,218.7189	2,854.5903	0	1,000
Slice 7	452.822	-19.143807	1,240.522	3,097.2336	0	1,000
Slice 8	458.466	-19.84141	1,351.9507	3,405.0528	0	1,000
Slice 9	464.11	-20.330164	1,450.8789	3,674.3907	0	1,000
Slice 10	469.754	-20.612045	1,537.425	3,905.2406	0	1,000
Slice 11	475.398	-20.688184	1,611.6566	4,098.2378	0	1,000
Slice 12	481.18333	-20.550364	1,674.8267	4,241.5888	0	1,000
Slice 13	487.11	-20.187431	1,726.2676	4,335.38	0	1,000
Slice 14	493.03667	-19.595743	1,764.0167	4,393.3257	0	1,000
Slice 15	499	-18.766096	1,787.9756	4,420.3068	0	1,000
Slice 16	504.25	-17.852795	1,798.1215	4,421.8792	0	1,000
Slice 17	508.75	-16.909287	1,797.2008	4,403.611	0	1,000
Slice 18	513.93495	-15.634978	1,784.9359	4,367.1756	0	1,000
Slice 19	519.80486	-13.974837	1,758.0332	4,308.421	0	1,000
Slice 20	525.67476	-12.060833	1,715.9358	4,225.2586	0	1,000
Slice 21	530.30486	-10.388171	1,672.9784	4,145.3812	0	1,000
Slice 22	535	-8.4709323	1,616.1852	4,048.2619	0	1,000
Slice 23	541	-5.7859801	1,529.5496	3,907.8915	0	1,000
Slice 24	547	-2.7863145	1,424.0771	3,740.7243	0	1,000
Slice 25	551.38877	-0.4155239	1,336.3549	3,552.1372	0	1,000
Slice 26	555.59851	2.0990197	1,237.8184	3,240.0466	0	1,000
Slice 27	561.24044	5.7204559	1,090.7102	2,794.8576	0	1,000

Slice 28	566.29605	9.252383	941.72156	2,465.3433	810.12405	0
Slice 29	570.76535	12.650267	793.51789	2,149.9689	721.2378	0
Slice 30	574.67452	15.824409	651.79142	1,849.717	636.94836	0
Slice 31	578.38452	19.065064	503.62507	1,664.4893	0	300
Slice 32	581.14058	21.57387	387.48647	1,381.9669	0	300
Slice 33	584.07534	24.455285	251.25177	966.97386	413.22234	0
Slice 34	587.43808	27.872167	88.250722	616.78431	305.14901	0
Slice 35	588.86846	29.393468	14.852906	-75.619857	0	1,000
Slice 36	590.57514	31.300452	-78.218778	-356.7201	0	1,000
Slice 37	592.59403	33.595567	-190.66746	-701.30903	0	1,000

Project Name: HSC - ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

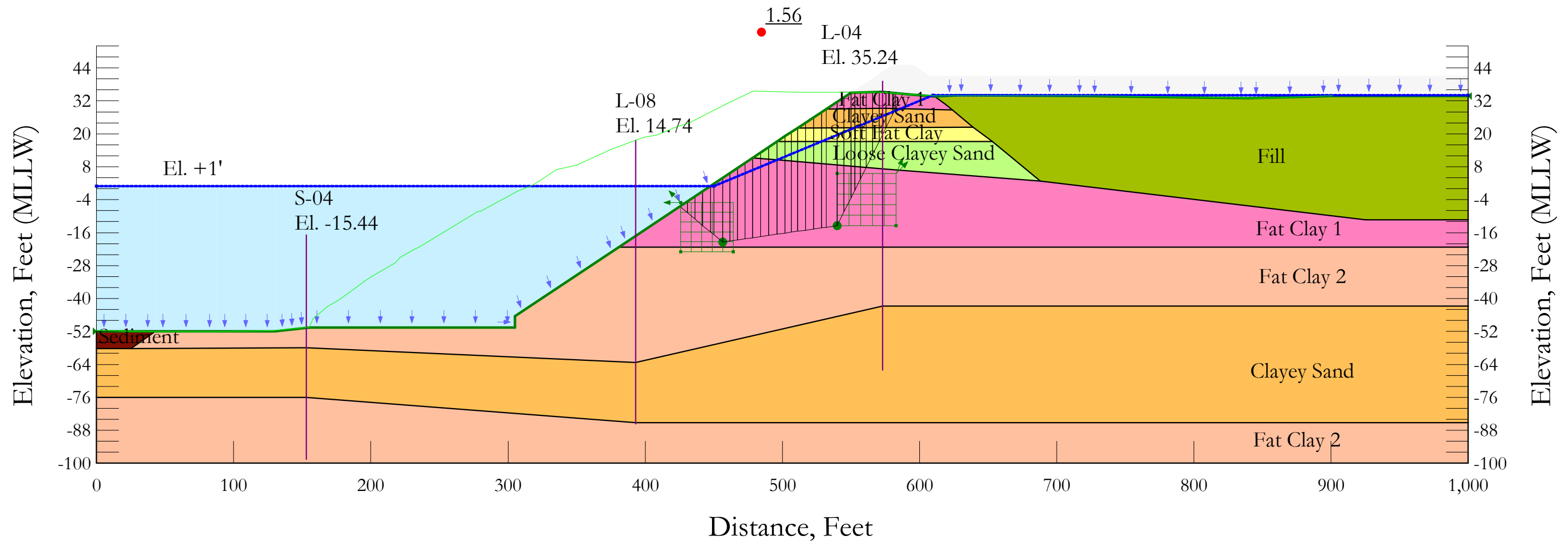
Station Analyzed: 34+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)	C-Top of Layer (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)
Orange	Clayey Sand	120	0	30				
Pink	Fat Clay 1(U)	125			1,000			
Green	Fill	110				50	10	150
Dark Red	Sediment (U)	90			50			
Light Orange	Fat Clay 2 (U)	125			2,200			
Yellow	Soft Fat Clay (U)	115			300			
Light Green	Loose Clayey Sand	110	0	28				



Short Term - Block 34+00

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 212

Date: [4/25/2018](#)

Time: [1:19:25 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\](#)

Last Solved Date: [4/25/2018](#)

Last Solved Time: [1:20:48 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

Short Term - Block 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Block](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: [No](#)

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fill

Model: S=f(depth)

Unit Weight: 110 pcf

C-Top of Layer: 50 psf

C-Rate of Change: 10 (lbs/ft²)/ft

C-Maximum: 150 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: Undrained (Phi=0)

Unit Weight: 90 pcf

Cohesion: 50 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Soft Fat Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 300 psf

Pore Water Pressure

Piezometric Line: 1

Loose Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (0, -52) ft

Right Coordinate: (1,000, 33.75) ft

Slip Surface Block

Left Grid

Upper Left: (426.0139, -4.99326) ft

Lower Left: (426.0139, -23.02716) ft

Lower Right: (464.0721, -23.02716) ft

X Increments: 5

Y Increments: 5

Starting Angle: 135 °

Ending Angle: 180 °

Angle Increments: 2

Right Grid

Upper Left: (539.8834, 5.56181) ft

Lower Left: (539.8834, -13.44051) ft

Lower Right: (582.9256, -13.44051) ft

X Increments: 5

Y Increments: 5

Starting Angle: 45 °

Ending Angle: 65 °

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	610	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76
Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74
Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5

Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
Point 50	550	35
Point 51	580.42	45.14
Point 52	595.42	45.14
Point 53	607.42	41.14
Point 54	704	41.14
Point 55	717.6	36.74
Point 56	722	33.7
Point 57	1,000	41.14
Point 58	900	33.75
Point 59	502	10.23641
Point 60	502	17.19722
Point 61	502	19.1605

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1(U)	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2 (U)	26,3,9,27,28,29	17,271
Region 3	Fill	20,19,18,33,32,31,23,41,17,58,22,56,30	13,510
Region 4	Loose Clayey Sand	14,31,32,13,60,47,46,59	1,852
Region 5	Soft Fat Clay (U)	47,60,13,32,33,12,48,61	716.27
Region 6	Clayey Sand	33,18,11,49,48,12	748.17
Region 7	Clayey Sand	25,38,1,6,15,24,27,9,3,26	31,487
Region 8	Fat Clay 2 (U)	39,38,1,6,15,24,34,35,36,45,44,37,43,42	19,681
Region 9	Fat Clay 1(U)	36,46,59,14,31,23,41,34,35	12,273
Region 10	Sediment (U)	39,40,25,38	212.84
Region 11		51,50,10,21,20,30,53,52	502.37
Region 12		53,54,55,56,30	699.64
Region 13		54,55,56,22,58,17,57	2,180.1

Current Slip Surface

- Slip Surface: 3,349
- F of S: 1.56
- Volume: 4,384.4382 ft³
- Weight: 533,141.12 lbs
- Resisting Moment: 11,399,001 lbs-ft
- Activating Moment: 7,331,185.5 lbs-ft
- Resisting Force: 152,350.91 lbs
- Activating Force: 97,980.669 lbs

F of S Rank (Analysis): 1 of 11,664 slip surfaces
 F of S Rank (Query): 1 of 11,664 slip surfaces
 Exit: (425.14844, -6.4505185) ft
 Entry: (587.86001, 34.536105) ft
 Radius: 80.160415 ft
 Center: (498.76091, 44.78276) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	427.94239	-7.6078082	537.12723	959.93795	0	1,000
Slice 2	433.53028	-9.9223875	681.55698	1,423.4743	0	1,000
Slice 3	439.11817	-12.236967	825.98673	1,895.1647	0	1,000
Slice 4	444.70606	-14.551546	970.41649	2,373.3783	0	1,000
Slice 5	448.75	-16.226603	1,074.94	2,750.186	0	1,000
Slice 6	453.23023	-18.082375	1,182.0308	3,240.8575	0	1,000
Slice 7	459.1804	-19.225411	1,323.9	3,175.4753	0	1,000
Slice 8	464.62029	-18.835472	1,367.7153	3,351.2601	0	1,000
Slice 9	470.06017	-18.445534	1,411.5306	3,523.0101	0	1,000
Slice 10	475.50006	-18.055596	1,455.3459	3,690.7817	0	1,000
Slice 11	481.18333	-17.648211	1,501.1215	3,845.9281	0	1,000
Slice 12	487.11	-17.223379	1,548.8576	3,988.2351	0	1,000
Slice 13	493.03667	-16.798548	1,596.5937	4,126.5525	0	1,000
Slice 14	499	-16.371088	1,644.6251	4,264.5979	0	1,000
Slice 15	504.25	-15.994761	1,686.911	4,385.7416	0	1,000
Slice 16	508.75	-15.672195	1,723.156	4,487.7787	0	1,000
Slice 17	513.93495	-15.30053	1,764.918	4,609.5226	0	1,000
Slice 18	519.80486	-14.879767	1,812.1968	4,750.8204	0	1,000
Slice 19	525.67476	-14.459005	1,859.4757	4,890.9388	0	1,000
Slice 20	530.30486	-14.127113	1,896.7686	5,001.0491	0	1,000
Slice 21	535.9417	-13.723056	1,942.1703	5,140.816	0	1,000
Slice 22	542.41255	-10.91136	1,853.7611	3,888.6042	0	1,000
Slice 23	547.47085	-5.85306	1,613.4463	3,573.9822	0	1,000
Slice 24	551.38877	-1.9351372	1,427.3097	3,281.4526	0	1,000
Slice 25	554.85003	1.5261235	1,262.8686	2,940.1924	0	1,000
Slice 26	558.99501	5.6710991	1,065.9449	2,523.2701	0	1,000
Slice 27	563.44123	10.117323	854.70919	2,239.9648	736.55349	0

Slice 28	568.18871	14.864795	629.16148	1,857.3787	653.05466	0
Slice 29	571.78122	18.457311	458.48462	1,719.9198	0	300
Slice 30	574.2839	20.95999	339.58478	1,466.8819	0	300
Slice 31	577.9939	24.66999	163.32635	958.21386	458.92852	0
Slice 32	580.92585	27.601939	24.032377	666.73712	371.06576	0
Slice 33	581.95138	28.627467	-24.689456	569.6949	328.91351	0
Slice 34	585.16554	31.841626	-177.39095	-270.80933	0	1,000

Project Name: HSC - ECIP Preliminary Slope Evaluation

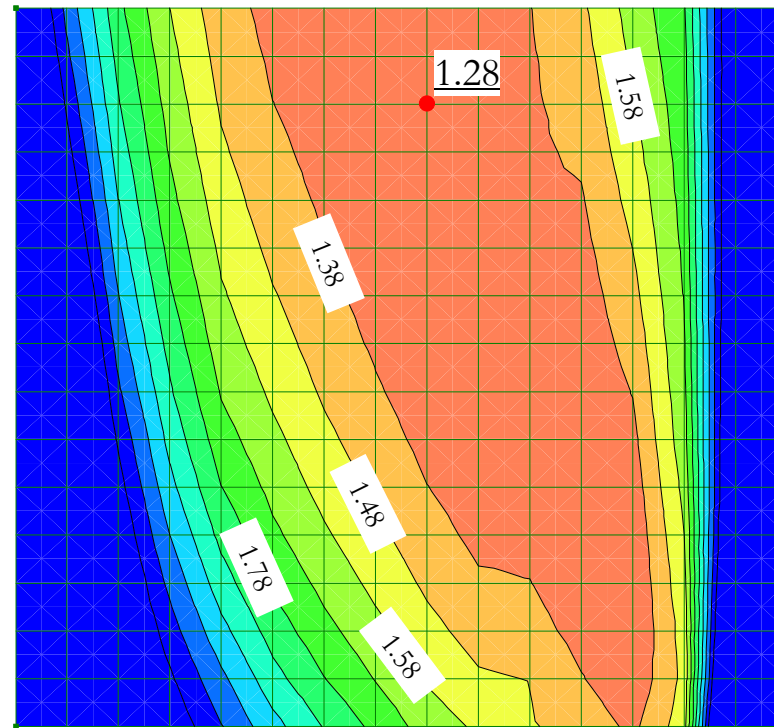
Location: Barbours Cut Ship Channel

Station Analyzed: 34+00

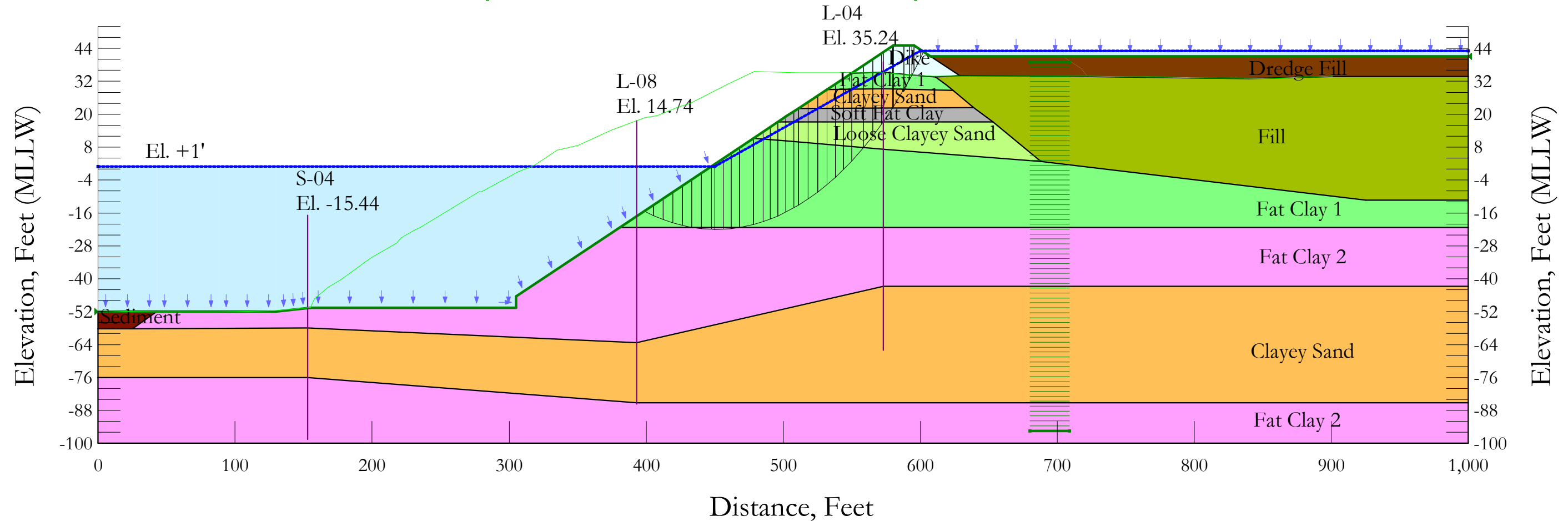
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	C-Top of Layer (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)
Light Green	Fat Clay 1	125	300	22			
Orange	Clayey Sand	120	0	30			
Brown	Dredge Fill	90	16	15			
Light Blue	Dike	125	100	25			
Olive Green	Fill	110			50	10	150
Pink	Fat Clay 2	125	300	22			
Light Green	Loose Clayey Sand	110	0	28			
Grey	Soft Fat Clay	115	100	15			
Dark Red	Sediment	90	16	15			



Long Term 34+00

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 212

Date: [4/25/2018](#)

Time: [1:19:25 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\](#)

Last Solved Date: [4/25/2018](#)

Last Solved Time: [1:19:52 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

Long Term 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fill

Model: $S=f(\text{depth})$
Unit Weight: 110 pcf
C-Top of Layer: 50 psf
C-Rate of Change: 10 (lbs/ft²)/ft
C-Maximum: 150 psf
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 300 psf
Phi': 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Loose Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Soft Fat Clay

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (284.0829, 207.5) ft
Lower Left: (284.0829, 62) ft
Lower Right: (596.7434, 62) ft
Grid Horizontal Increment: 15
Grid Vertical Increment: 15
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (680, 38.97749) ft
Upper Right Coordinate: (709, 38.97749) ft
Lower Left Coordinate: (680, -95.49959) ft
Lower Right Coordinate: (709, -95.49959) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, -52) ft
Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24

Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76
Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74
Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5
Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
Point 50	550	35
Point 51	580.42	45.14
Point 52	595.42	45.14
Point 53	607.42	41.14
Point 54	704	41.14
Point 55	717.6	36.74
Point 56	722	33.7
Point 57	1,000	41.14
Point 58	900	33.75
Point 59	502	10.23641
Point 60	502	17.19722
Point 61	502	19.1605

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2	26,3,9,27,28,29	17,271
Region 3	Fill	20,19,18,33,32,31,23,41,17,58,22,56,30	13,510
Region 4	Loose Clayey Sand	14,31,32,13,60,47,46,59	1,852
Region 5	Soft Fat Clay	47,60,13,32,33,12,48,61	716.27
Region 6	Clayey Sand	33,18,11,49,48,12	748.17
Region 7	Clayey Sand	25,38,1,6,15,24,27,9,3,26	31,487
Region 8	Fat Clay 2	39,38,1,6,15,24,34,35,36,45,44,37,43,42	19,681
Region 9	Fat Clay 1	36,46,59,14,31,23,41,34,35	12,273
Region 10	Sediment	39,40,25,38	212.84
Region 11	Dike	51,50,10,21,20,30,53,52	502.37
Region 12	Dredge Fill	53,54,55,56,30	699.64
Region 13	Dredge Fill	54,55,56,22,58,17,57	2,180.1

Current Slip Surface

Slip Surface: 16,451

F of S: 1.28

Volume: 5,032.1728 ft³

Weight: 613,740.48 lbs

Resisting Moment: 41,185,895 lbs-ft

Activating Moment: 32,160,169 lbs-ft

Resisting Force: 183,827.35 lbs

Activating Force: 143,640.72 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces

F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (398.45088, -15.349708) ft

Entry: (602.53941, 42.766864) ft

Radius: 210.08545 ft

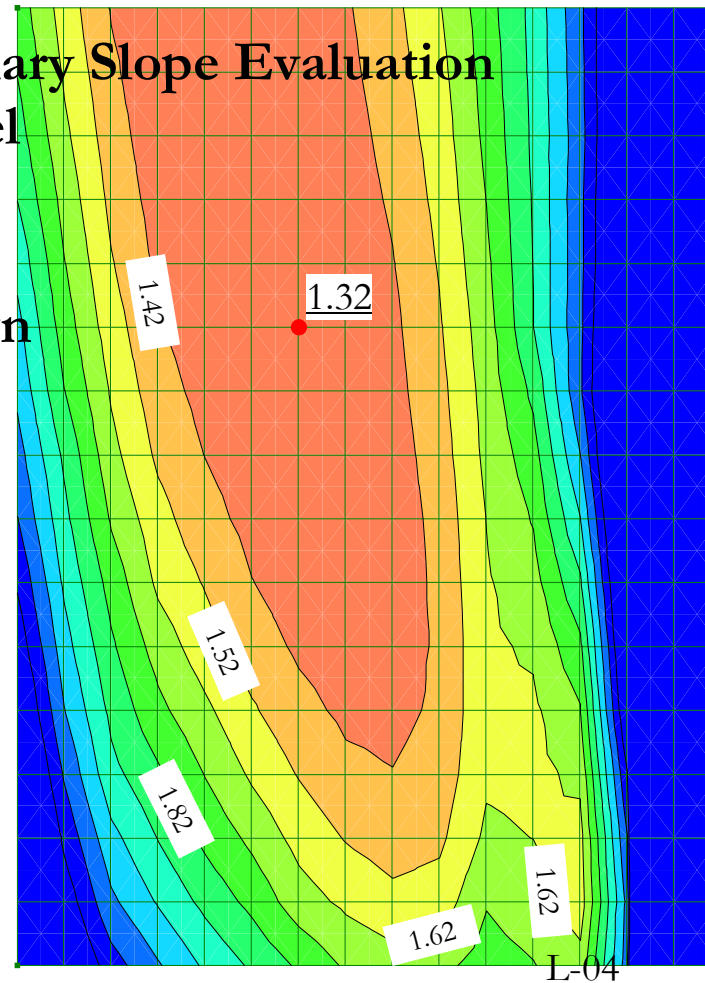
Center: (450.83517, 188.1) ft

Slip Slices

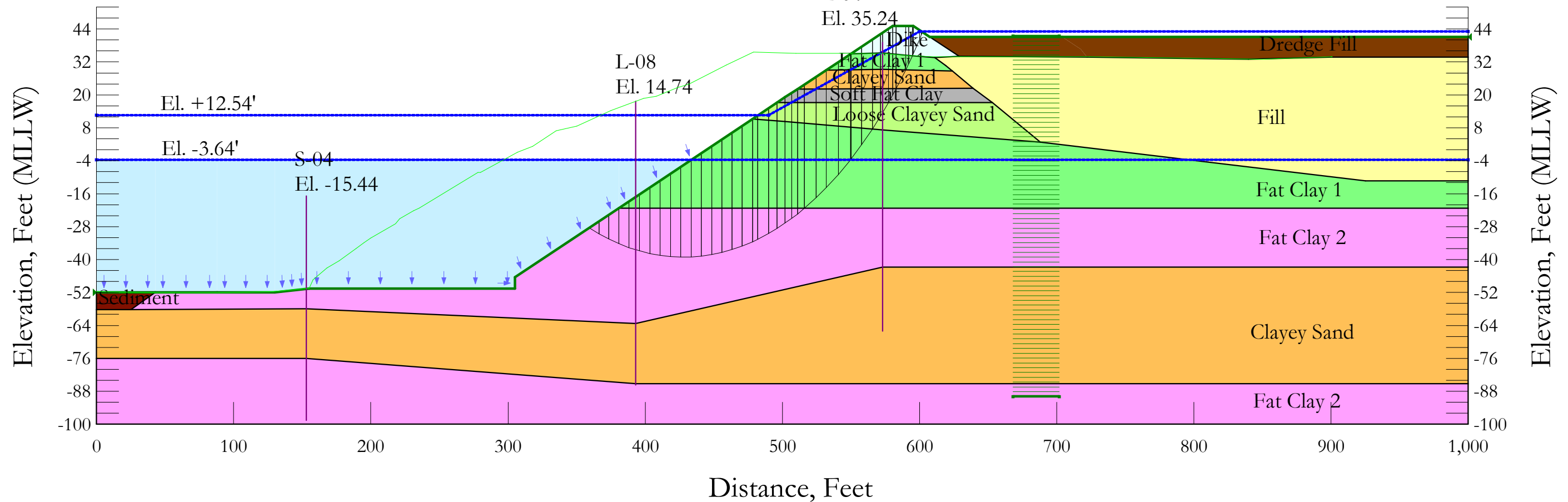
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	401.94492	-16.185912	1,072.4009	1,300.3522	92.098288	300
Slice 2	408.93301	-17.733409	1,168.9647	1,712.7653	219.70969	300
Slice 3	415.9211	-19.033652	1,250.0999	2,088.6933	338.81373	300
Slice 4	422.90918	-20.09128	1,316.0959	2,422.8434	447.15502	300
Slice 5	429.89727	-20.909979	1,367.1827	2,710.708	542.81944	300
Slice 6	436.91849	-21.494198	1,403.6379	2,949.8552	624.71235	300
Slice 7	443.97283	-21.843687	1,425.4461	3,137.7606	691.81995	300
Slice 8	448.75	-21.971385	1,433.4144	3,268.8132	741.54927	300
Slice 9	453.0465	-21.951721	1,376.9218	3,439.9431	833.51471	300
Slice 10	459.13951	-21.799118	1,467.0945	3,640.7545	878.21564	300
Slice 11	465.23251	-21.469294	1,547.0175	3,803.373	911.62681	300
Slice 12	473.24951	-20.726494	1,634.3166	3,956.0858	938.05563	300
Slice						

13	481.79753	-19.659829	1,711.513	4,043.9671	942.37261	300
Slice 14	488.0313	-18.648788	1,754.3246	4,049.4648	927.29683	300
Slice 15	493.34377	-17.622045	1,781.259	4,030.2897	908.6674	300
Slice 16	499	-16.366493	1,800.5455	3,991.4548	885.18482	300
Slice 17	504.83359	-14.906084	1,810.8658	3,934.7338	858.09838	300
Slice 18	509.33359	-13.669228	1,812.4472	3,879.8399	835.28088	300
Slice 19	514.56276	-12.051722	1,803.861	3,805.3313	808.64649	300
Slice 20	521.68827	-9.640772	1,780.1972	3,691.9019	772.37884	300
Slice 21	528.62551	-7.0188426	1,741.2725	3,561.1408	735.2745	300
Slice 22	535	-4.3615734	1,691.1602	3,427.9443	701.70634	300
Slice 23	541	-1.6239249	1,630.3146	3,290.7214	670.8479	300
Slice 24	547	1.3465904	1,556.0009	3,138.2257	639.26031	300
Slice 25	554.36877	5.3666485	1,443.2262	2,926.3025	599.20171	300
Slice 26	562.01221	9.8847756	1,306.1082	2,744.4569	764.78355	0
Slice 27	568.56155	14.143796	1,166.199	2,568.6799	745.71232	0
Slice 28	572.41811	16.772898	1,076.8048	2,457.245	733.99308	0
Slice 29	576.39582	19.718064	971.09927	2,419.4896	388.09501	100
Slice 30	580.10582	22.49554	870.74246	2,158.5749	743.53037	0
Slice 31	584.27928	25.916186	740.71788	1,847.956	639.26422	0
Slice 32	590.06928	30.800568	552.30294	1,311.7585	306.83995	300
Slice 33	592.95268	33.384663	449.69996	1,044.0783	240.14442	300
Slice 34	594.66268	34.971089	385.73225	966.68547	270.90294	100
Slice 35	597.71	37.922036	264.57546	598.65915	155.78578	100
Slice 36	600.71	40.884494	140.74359	206.58324	30.701533	100
Slice 37	601.9797	42.187092	59.461489	35.699552	-11.080373	100

Project Name: HSC - ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 34+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Light Green	Fat Clay 1	125	300	22	500	15	2
Orange	Clayey Sand	120	0	30	0	30	2
Brown	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Yellow	Fill (RDD)	110	50	25	100	20	2
Pink	Fat Clay 2	125	300	22	500	15	2
Light Green	Loose Clayey Sand	110	0	28	0	28	2
Grey	Soft Fat Clay	115	100	15	150	10	2
Dark Red	Sediment	90	16	15	50	0	2



RDD 34+00

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 212

Date: [4/25/2018](#)

Time: [1:19:25 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\](#)

Last Solved Date: [4/25/2018](#)

Last Solved Time: [1:20:42 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

RDD 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [Yes](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fill (RDD)

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 50 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 100 psf

Phi R: 20 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Loose Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 28 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Soft Fat Clay

Model: [Mohr-Coulomb](#)

Unit Weight: [115 pcf](#)

Cohesion': [100 psf](#)

Phi': [15 °](#)

Phi-B: [0 °](#)

Cohesion R: [150 psf](#)

Phi R: [10 °](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Sediment

Model: [Mohr-Coulomb](#)

Unit Weight: [90 pcf](#)

Cohesion': [16 psf](#)

Phi': [15 °](#)

Phi-B: [0 °](#)

Cohesion R: [50 psf](#)

Phi R: [0 °](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Slip Surface Grid

Upper Left: [\(598.9835, 251.50812\) ft](#)

Lower Left: [\(314.0476, 251.50812\) ft](#)

Lower Right: [\(314.0476, 57.52096\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(668, 41.5\) ft](#)

Upper Right Coordinate: [\(702, 41.5\) ft](#)

Lower Left Coordinate: [\(668, -90\) ft](#)

Lower Right Coordinate: [\(702, -90\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -52\) ft](#)

Right Coordinate: [\(1,000, 41.14\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	490	12.54
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64
Coordinate 2	1,000	-3.64

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76
Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74

Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5
Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
Point 50	550	35
Point 51	580.42	45.14
Point 52	595.42	45.14
Point 53	607.42	41.14
Point 54	704	41.14
Point 55	717.6	36.74
Point 56	722	33.7
Point 57	1,000	41.14
Point 58	900	33.75
Point 59	502	10.23641
Point 60	502	17.19722
Point 61	502	19.1605

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2	26,3,9,27,28,29	17,271
Region 3	Fill (RDD)	20,19,18,33,32,31,23,41,17,58,22,56,30	13,510
Region 4	Loose Clayey Sand	14,31,32,13,60,47,46,59	1,852
Region 5	Soft Fat Clay	47,60,13,32,33,12,48,61	716.27
Region 6	Clayey Sand	33,18,11,49,48,12	748.17
Region 7	Clayey Sand	25,38,1,6,15,24,27,9,3,26	31,487
Region 8	Fat Clay 2	39,38,1,6,15,24,34,35,36,45,44,37,43,42	19,681
Region 9	Fat Clay 1	36,46,59,14,31,23,41,34,35	12,273
Region 10	Sediment	39,40,25,38	212.84
Region 11	Dike	51,50,10,21,20,30,53,52	502.37
Region 12	Dredge Fill	53,54,55,56,30	699.64
Region 13	Dredge Fill	54,55,56,22,58,17,57	2,180.1

Current Slip Surface

Slip Surface: 7,723

F of S: 1.32

Volume: 7,746.3833 ft³

Weight: 951,927.47 lbs

Resisting Moment: 67,394,522 lbs-ft

Activating Moment: 50,996,206 lbs-ft

Resisting Force: 274,208.54 lbs

Activating Force: 207,704.33 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces

F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (359.2212, -28.426266) ft

Entry: (602.22578, 42.871406) ft

Radius: 225.99907 ft

Center: (428.02196, 186.84573) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	362.80433	-29.506373	1,614.0617	1,882.7638	108.56271	300
Slice 2	369.9706	-31.538954	1,740.8947	2,377.0461	257.02187	300
Slice 3	377.13687	-33.31957	1,852.0052	2,834.7415	397.05125	300
Slice 4	384.49571	-34.88888	1,949.9301	3,261.6047	529.95093	300
Slice 5	392.04714	-36.238923	2,034.1728	3,650.7895	653.15554	300
Slice 6	399.59857	-37.326531	2,102.0395	3,986.4353	761.34531	300
Slice 7	407.15	-38.155513	2,153.768	4,266.0549	853.41932	300
Slice 8	414.70143	-38.728724	2,189.5364	4,488.4487	928.82088	300
Slice 9	422.25286	-39.048114	2,209.4663	4,653.7416	987.55131	300
Slice 10	429.80429	-39.11476	2,213.625	4,763.3183	1,030.143	300
Slice 11	437.3	-38.93211	2,202.2276	4,907.0222	1,092.8079	300
Slice 12	444.74	-38.503264	2,175.4677	5,086.3962	1,176.0915	300
Slice 13	452.18	-37.827293	2,133.2871	5,204.2738	0	1,425.4463
Slice 14	459.62	-36.901954	2,075.5459	5,284.9218	0	1,418.1188
Slice 15	467.06	-35.724133	2,002.0499	5,325.8877	0	1,402.992
Slice 16	474.5	-34.289791	1,912.547	5,330.8529	0	1,381.59
Slice 17	480.16118	-33.047651	1,835.0374	5,305.531	0	1,358.719
Slice 18	486.05118	-31.53809	1,740.8408	5,234.8919	0	1,354.6535
Slice 19	493	-29.588139	1,619.1639	5,132.5187	0	1,415.9487
Slice 20	499	-27.694964	1,501.0298	5,027.5025	0	1,384.786
Slice 21	504.37597	-25.849521	1,385.8741	4,923.4629	0	1,356.318
Slice 22	508.87597	-24.182781	1,281.8695	4,826.8826	0	1,331.5183
Slice 23	513.57792	-22.314487	1,165.288	4,721.0505	0	1,306.4118
Slice						

24	520.33097	-19.391268	982.87914	4,556.821	0	1,270.7796
Slice 25	528.25305	-15.66804	750.54969	4,345.537	0	1,228.1001
Slice 26	536.40981	-11.402578	484.38484	4,102.8958	0	1,183.7828
Slice 27	545.22943	-6.3158058	166.97028	3,812.2123	0	1,135.2413
Slice 28	549.6568	-3.6287898	-0.69951682	3,658.3376	0	1,110.7177
Slice 29	549.83718	-3.5133848	-7.9007856	3,651.5353	0	1,109.6475
Slice 30	553.90149	-0.79181787	-177.72656	3,488.5634	0	1,084.5446
Slice 31	561.70446	4.6888026	-519.71728	3,156.3251	0	1,034.7943
Slice 32	568.57637	9.9117232	-845.62753	2,656.0974	1,412.2721	0
Slice 33	572.2734	12.873868	-1,030.4654	2,513.4291	1,336.414	0
Slice 34	575.18965	15.355434	-1,185.3151	2,391.8436	1,271.7658	0
Slice 35	578.89965	18.597911	-1,387.6456	2,622.9223	0	511.36403
Slice 36	581.65719	21.108144	-1,544.2842	2,440.08	0	490.53955
Slice 37	586.36545	25.664964	-1,828.6297	1,639.4861	946.55773	0
Slice 38	590.91826	30.199836	-2,111.6058	1,208.2295	488.15642	300
Slice 39	593.35191	32.775446	-2,272.3238	961.82461	388.60237	300
Slice 40	595.06191	34.619091	-2,387.3673	873.60105	407.36686	100
Slice 41	597.71	37.615969	-2,574.3725	535.81034	249.85247	100
Slice 42	600.71	41.060935	-2,789.3383	175.17518	0	126.78127
Slice 43	601.82289	42.386682	-2,872.065	-0.40095205	0	85.635321

Project Name: HSC-ECIP Preliminary Slope Evaluation

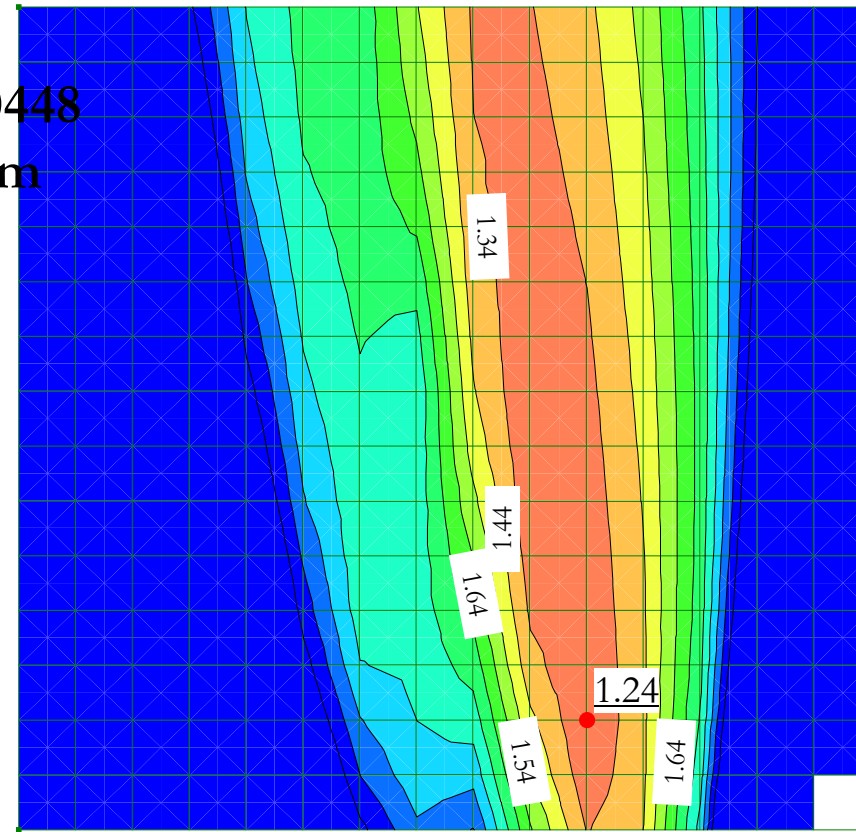
Location: Barbours Cut Ship Channel

Station Analyzed: 44+00

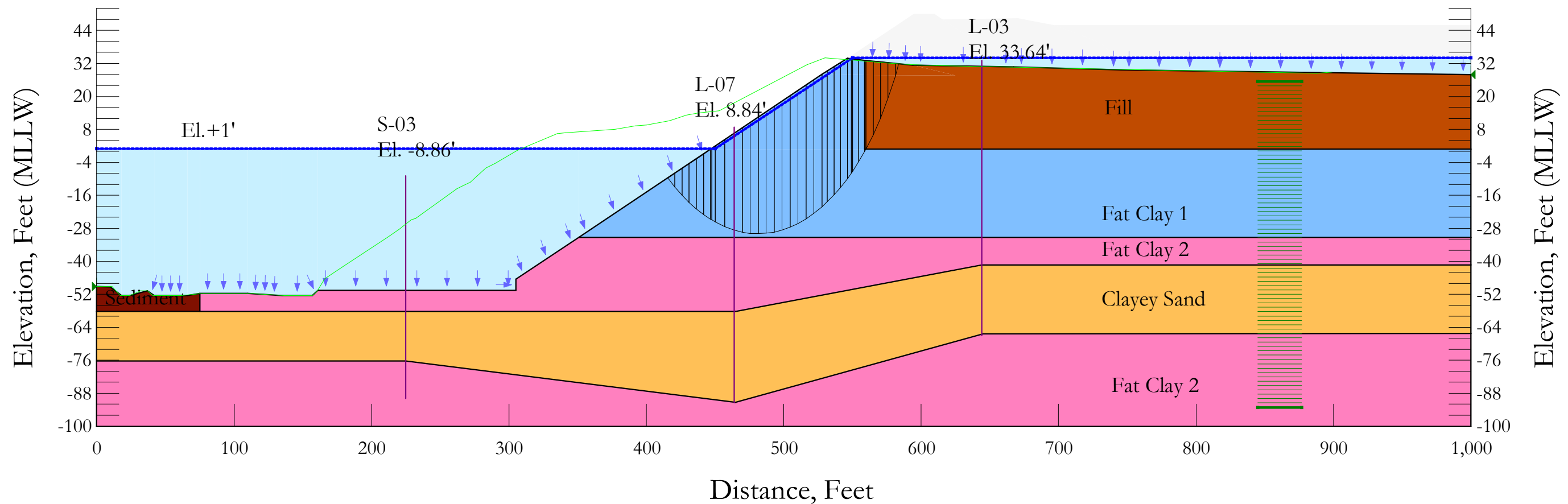
HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Fat Clay 1 (U)	125			1,000
Pink	Fat Clay 2 (U)	125			2,200
Brown	Fill (U)	110			300
Dark Brown	Sediment (U)	90			50



Short Term 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 154

Date: 2/16/2018

Time: 9:19:35 AM

Tool Version: 8.16.1.13452

File Name: 44+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\

Last Solved Date: 2/16/2018

Last Solved Time: 9:20:02 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Fill (U)

Model: Undrained (Phi=0)

Unit Weight: 110 pcf

Cohesion: 300 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Slip Surface Grid

Upper Left: [\(245.9759, 233.47631\) ft](#)

Lower Left: [\(245.9759, 63.16979\) ft](#)

Lower Right: [\(598.7619, 63.16979\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(845.056, 25.44217\) ft](#)

Upper Right Coordinate: [\(877.0413, 25.44217\) ft](#)

Lower Left Coordinate: [\(845.056, -93.25256\) ft](#)

Lower Right Coordinate: [\(877.0413, -93.25256\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -49.2\) ft](#)

Right Coordinate: [\(1,000, 27.94\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	550	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26

Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	705.5	44.34
Point 11	730.5	39.54
Point 12	742.5	33.2
Point 13	1,000	46
Point 14	999.9742	-11.27583
Point 15	1,000	-66.26
Point 16	0	-76.26
Point 17	0	-100
Point 18	1,000	-100
Point 19	1,000	-41.26
Point 20	644	-41.26
Point 21	0	-58.26
Point 22	1,000	-31.26
Point 23	644	-31.26
Point 24	464	-31.26
Point 25	135	-52.4
Point 26	1,000	0.74
Point 27	644	0.74
Point 28	464	0.74
Point 29	559	27.72993
Point 30	559	0.74
Point 31	559	33.14
Point 32	110	-51.6
Point 33	75	-51.6
Point 34	75	-58.26
Point 35	0	-49.2
Point 36	305	-50.5
Point 37	305	-46.5
Point 38	350.72	-31.26
Point 39	446.72	0.74
Point 40	546.2	33.9
Point 41	161	-50.5
Point 42	157	-52.4
Point 43	42	-52.4
Point 44	66	-52.4
Point 45	37	-50.8
Point 46	24	-52.4
Point 47	18	-52.5
Point 48	10	-49.29
Point 49	527.69	28
Point 50	594.5	50
Point 51	609.5	50
Point 52	745.7421	29.59999
Point 53	667.28	30.74
Point 54	615.5	48

Point 55	670.5	48.4
Point 56	696.5	46

Regions

	Points	Area (ft ²)	Material
Region 1	56,10,11,12,52,6,13	4,652.7	
Region 2	15,5,4,2,16,17,18	25,013	Fat Clay 2 (U)
Region 3	15,19,20,3,1,34,21,16,2,4,5	24,300	Clayey Sand
Region 4	19,22,23,24,38,37,36,41,42,25,32,33,34,1,3,20	12,506	Fat Clay 2 (U)
Region 5	38,24,23,22,26,27,30,28,39	19,241	Fat Clay 1 (U)
Region 6	29,49,39,28,30	1,952.9	Fat Clay 1 (U)
Region 7	29,7,8,9,31	219.6	Fill (U)
Region 8	29,49,40,31	129.49	Fat Clay 1 (U)
Region 9	34,33,44,43,45,46,47,48,35,21	500.79	Sediment (U)
Region 10	9,8,7,29,30,27,26,6,52,53	12,543	Fill (U)
Region 11	50,40,31,9,53,54,51	1,273	
Region 12	54,55,56,10,11,12,52,53	1,465.7	

Current Slip Surface

Slip Surface: 3,228
 F of S: 1.24
 Volume: 5,608.764 ft³
 Weight: 694,309.43 lbs
 Resisting Moment: 19,428,322 lbs-ft
 Activating Moment: 15,724,834 lbs-ft
 Resisting Force: 151,256.97 lbs
 Activating Force: 122,408.52 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (415.62871, -9.6237642) ft
 Entry: (583.65515, 31.91661) ft
 Radius: 115.82603 ft
 Center: (481.16657, 85.877326) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	418.21965	-11.30202	767.64602	1,488.8225	0	1,000
Slice 2	423.40153	-14.471727	965.43576	2,015.7695	0	1,000
Slice 3	428.58341	-17.28383	1,140.911	2,505.329	0	1,000
Slice 4	433.76529	-19.767003	1,295.861	2,953.2314	0	1,000
Slice 5	438.94718	-21.944055	1,431.709	3,355.8723	0	1,000
Slice 6	444.12906	-23.833267	1,549.5959	3,710.4835	0	1,000
Slice 7	447.10614	-24.826753	1,611.5894	3,896.5425	0	1,000
Slice 8	448.74614	-25.311159	1,641.8163	4,016.937	0	1,000
Slice 9	453.5	-26.538146	1,614.6202	4,358.9126	0	1,000
Slice 10	460.5	-28.034522	1,828.8125	4,797.1332	0	1,000
Slice	466.895	-29.029076	2,003.5316	5,120.8754	0	1,000

11						
Slice 12	472.685	-29.601269	2,143.2489	5,348.3649	0	1,000
Slice 13	478.475	-29.881212	2,266.5207	5,518.714	0	1,000
Slice 14	484.265	-29.87103	2,373.4666	5,635.6709	0	1,000
Slice 15	490.055	-29.570646	2,464.0823	5,703.4937	0	1,000
Slice 16	495.845	-28.977778	2,538.2393	5,726.631	0	1,000
Slice 17	501.635	-28.087849	2,595.6801	5,709.4216	0	1,000
Slice 18	507.425	-26.893807	2,636.0079	5,655.8222	0	1,000
Slice 19	513.215	-25.385834	2,658.6701	5,569.161	0	1,000
Slice 20	519.005	-23.550911	2,662.9343	5,451.9124	0	1,000
Slice 21	524.795	-21.372201	2,647.8528	5,305.4734	0	1,000
Slice 22	529.70151	-19.266004	2,620.4457	5,157.1072	0	1,000
Slice 23	534.12752	-17.095654	2,580.5057	4,995.8587	0	1,000
Slice 24	538.95651	-14.463233	2,522.0473	4,799.4159	0	1,000
Slice 25	543.7855	-11.520304	2,446.116	4,577.4806	0	1,000
Slice 26	547.68186	-8.9283062	2,372.6136	4,315.4583	0	1,000
Slice 27	549.58186	-7.5825481	2,586.1407	4,138.0288	0	1,000
Slice 28	552.25	-5.5266699	2,466.4642	3,874.3425	0	1,000
Slice 29	556.75	-1.8380796	2,236.2962	3,391.1434	0	1,000
Slice 30	559.34938	0.42036075	2,095.3695	2,645.9016	0	1,000
Slice 31	562.39915	3.3996246	1,909.4634	2,778.35	0	300
Slice 32	567.79993	9.1065539	1,553.351	2,205.2272	0	300
Slice 33	573.20071	15.695039	1,142.2295	1,523.0967	0	300
Slice 34	578.60149	23.450986	658.25849	674.01705	0	300
Slice 35	582.47852	29.791181	262.63034	-68.89532	0	300

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

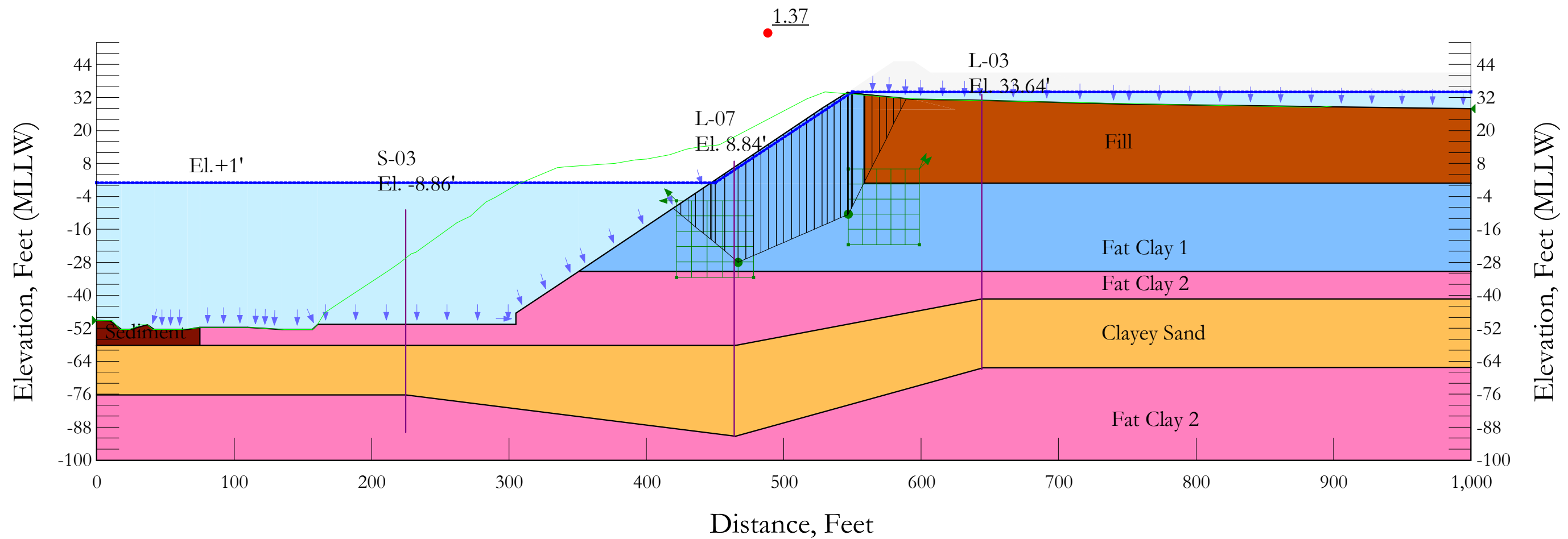
Station Analyzed: 44+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Fat Clay 1 (U)	125			1,000
Pink	Fat Clay 2 (U)	125			2,200
Brown	Fill (U)	110			300
Dark Brown	Sediment (U)	90			50



Short Term - Block 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 181

Date: 4/25/2018

Time: 4:08:34 PM

Tool Version: 8.16.1.13452

File Name: 44+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\

Last Solved Date: 4/25/2018

Last Solved Time: 4:09:52 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Fill (U)

Model: Undrained (Phi=0)

Unit Weight: 110 pcf

Cohesion: 300 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: [\(0, -49.2\) ft](#)

Right Coordinate: [\(1,000, 27.94\) ft](#)

Slip Surface Block

Left Grid

Upper Left: [\(422.0035, -5.60585\) ft](#)

Lower Left: [\(422.0035, -33.52792\) ft](#)

Lower Right: [\(478.0903, -33.52792\) ft](#)

X Increments: 5

Y Increments: 5

Starting Angle: [135 °](#)

Ending Angle: [180 °](#)

Angle Increments: 2

Right Grid

Upper Left: [\(546.98, 6.04062\) ft](#)

Lower Left: [\(546.98, -21.58966\) ft](#)

Lower Right: [\(598.6636, -21.58966\) ft](#)

X Increments: 5

Y Increments: 5

Starting Angle: [45 °](#)

Ending Angle: [65 °](#)

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	550	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26

Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74
Point 24	644	0.74
Point 25	464	0.74
Point 26	559	27.72993
Point 27	559	0.74
Point 28	559	33.14
Point 29	110	-51.6
Point 30	75	-51.6
Point 31	75	-58.26
Point 32	0	-49.2
Point 33	305	-50.5
Point 34	305	-46.5
Point 35	350.72	-31.26
Point 36	446.72	0.74
Point 37	546.2	33.9
Point 38	161	-50.5
Point 39	157	-52.4
Point 40	42	-52.4
Point 41	66	-52.4
Point 42	37	-50.8
Point 43	24	-52.4
Point 44	18	-52.5
Point 45	10	-49.29
Point 46	527.69	28
Point 47	579.92	45.14
Point 48	594.92	45.14
Point 49	745.7421	29.59999
Point 50	637.13	31.07
Point 51	606.92	41.14
Point 52	696.5	41.14

Regions

	Points	Area (ft ²)	Material
Region 1	52,49,6,10	3,429.3	
Region 2	12,5,4,2,13,14,15	25,013	Fat Clay 2 (U)
Region 3	12,16,17,3,1,31,18,13,2,4,5	24,300	Clayey Sand
Region 4	16,19,20,21,35,34,33,38,39,22,29,30,31,1,3,17	12,506	Fat Clay 2 (U)
Region 5	35,21,20,19,23,24,27,25,36	19,241	Fat Clay 1 (U)
Region 6	26,46,36,25,27	1,952.9	Fat Clay 1 (U)
Region 7	26,7,8,9,28	219.6	Fill (U)
Region 8	26,46,37,28	129.49	Fat Clay 1 (U)
Region 9	31,30,41,40,42,43,44,45,32,18	500.79	Sediment (U)
Region 10	9,8,7,26,27,24,23,6,49,50	12,541	Fill (U)
Region 11	47,37,28,9,50,51,48	712.18	
Region 12	51,52,49,50	1,041.5	

Current Slip Surface

Slip Surface: 3,385

F of S: 1.37

Volume: 4,994.2464 ft³

Weight: 617,119.63 lbs

Resisting Moment: 11,082,461 lbs-ft

Activating Moment: 8,120,684.7 lbs-ft

Resisting Force: 148,531.78 lbs

Activating Force: 108,852.02 lbs

F of S Rank (Analysis): 1 of 11,664 slip surfaces

F of S Rank (Query): 1 of 11,664 slip surfaces

Exit: (419.51651, -8.3278302) ft

Entry: (589.16096, 31.643411) ft

Radius: 82.232873 ft

Center: (497.27528, 41.636222) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	422.23686	-9.4546357	652.36927	1,111.9652	0	1,000
Slice 2	427.67756	-11.708247	792.99459	1,570.6873	0	1,000
Slice 3	433.11825	-13.961858	933.61991	2,037.1992	0	1,000
Slice 4	438.55895	-16.215469	1,074.2452	2,509.9923	0	1,000
Slice 5	443.99965	-18.469079	1,214.8706	2,987.1951	0	1,000
Slice 6	447.10614	-19.755828	1,295.1637	3,260.8542	0	1,000
Slice 7	448.74614	-20.435138	1,337.5526	3,434.466	0	1,000
Slice 8	453.5	-22.404253	1,381.9978	3,965.3663	0	1,000
Slice 9	460.5	-25.303748	1,675.1464	4,748.9005	0	1,000
Slice 10	465.43647	-27.348501	1,881.8777	5,299.6067	0	1,000
Slice 11	469.63735	-27.342844	1,959.5688	4,497.7674	0	1,000
Slice 12	475.16618	-26.141521	1,994.6369	4,541.301	0	1,000
Slice 13	480.695	-24.940198	2,029.7049	4,584.0107	0	1,000

Slice 14	486.22382	-23.738875	2,064.773	4,626.4408	0	1,000
Slice 15	491.75265	-22.537551	2,099.841	4,669.1274	0	1,000
Slice 16	497.28147	-21.336228	2,134.9091	4,712.5946	0	1,000
Slice 17	502.81029	-20.134905	2,169.9771	4,757.3504	0	1,000
Slice 18	508.33912	-18.933582	2,205.0452	4,803.8829	0	1,000
Slice 19	513.86794	-17.732259	2,240.1132	4,852.6565	0	1,000
Slice 20	519.39676	-16.530935	2,275.1813	4,904.1084	0	1,000
Slice 21	524.92559	-15.329612	2,310.2494	4,958.6444	0	1,000
Slice 22	529.70151	-14.291881	2,340.5419	5,004.115	0	1,000
Slice 23	534.12752	-13.330182	2,368.6151	5,043.2911	0	1,000
Slice 24	538.95651	-12.280921	2,399.2443	5,088.8378	0	1,000
Slice 25	543.7855	-11.23166	2,429.8735	5,137.5001	0	1,000
Slice 26	546.59	-10.622289	2,447.6617	5,149.2472	0	1,000
Slice 27	548.07186	-9.445686	2,408.9698	4,007.0887	0	1,000
Slice 28	549.58186	-7.935686	2,608.1765	3,860.7744	0	1,000
Slice 29	554.12877	-3.388774	2,333.0595	3,409.7943	0	1,000
Slice 30	558.62877	1.111226	2,052.2595	2,949.0396	0	1,000
Slice 31	561.615	4.097452	1,865.919	2,664.636	0	300
Slice 32	566.845	9.327452	1,539.567	2,196.4871	0	300
Slice 33	572.075	14.557452	1,213.215	1,708.8081	0	300
Slice 34	577.305	19.787452	886.863	1,197.0366	0	300
Slice 35	582.54608	25.028533	559.81955	655.68773	0	300
Slice 36	587.16656	29.649012	271.50162	152.30497	0	300

Project Name: HSC-ECIP Preliminary Slope Evaluation

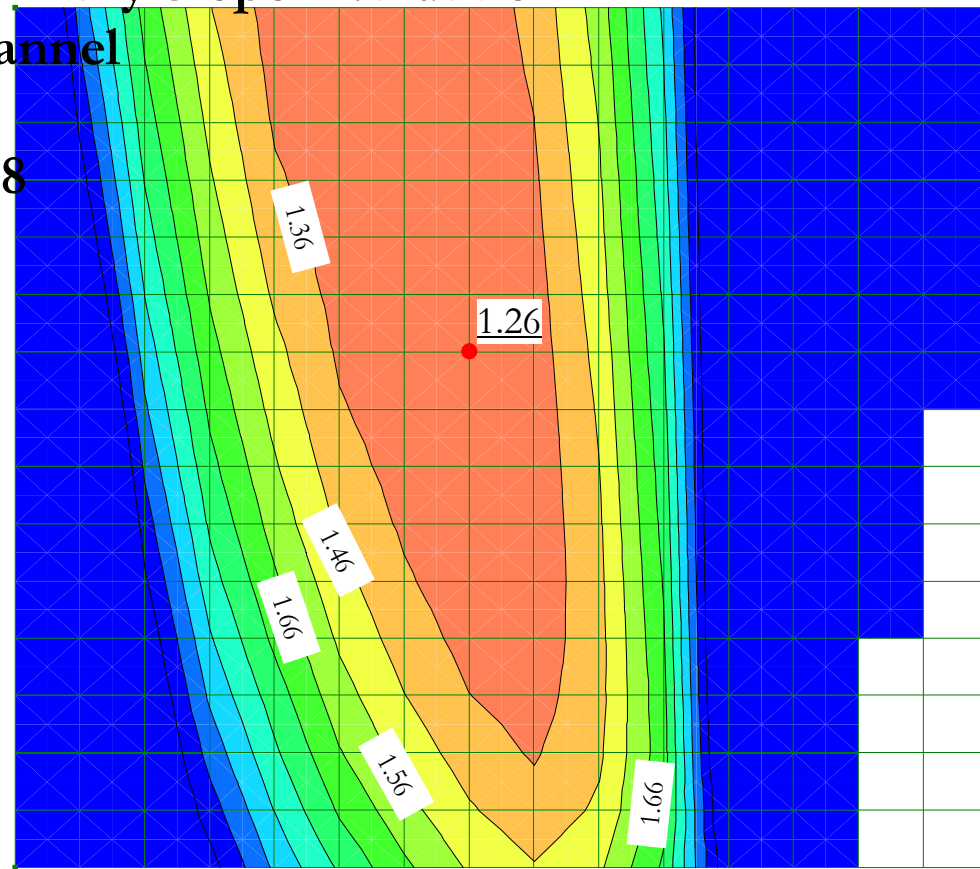
Location: Barbours Cut Ship Channel

Station Analyzed: 44+00

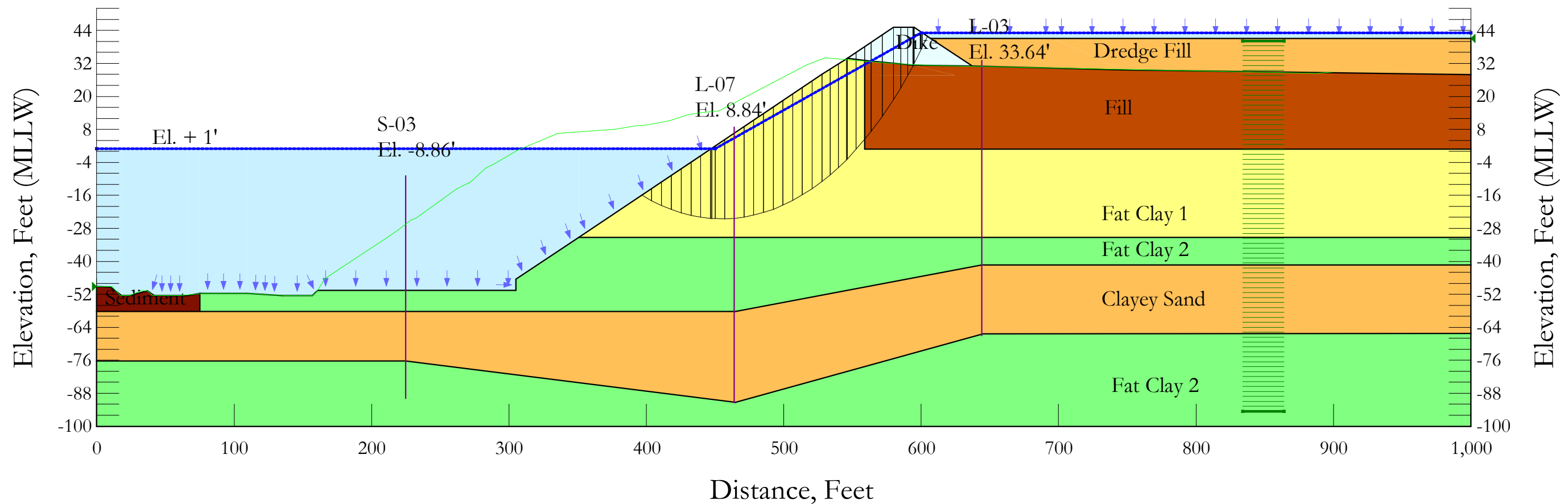
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Fat Clay 1	125	300	22
Light Green	Fat Clay 2	125	300	22
Orange	Clayey Sand	120	0	30
Light Orange	Dredge Fill	90	16	15
Light Blue	Dike	125	100	25
Brown	Fill	110	100	20
Dark Brown	Sediment	90	16	15



Long Term 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 183

Date: 4/25/2018

Time: 5:03:01 PM

Tool Version: 8.16.1.13452

File Name: 44+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:03:18 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf
Cohesion!: 16 psf
Phi!: 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dike

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion!: 100 psf
Phi!: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fill

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion!: 100 psf
Phi!: 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion!: 16 psf
Phi!: 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (267.004, 248.0868) ft
Lower Left: (267.004, 69.98645) ft
Lower Right: (670.0211, 69.98645) ft
Grid Horizontal Increment: 15
Grid Vertical Increment: 15
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (834.0689, 40.15019) ft
Upper Right Coordinate: (864.0265, 40.15019) ft
Lower Left Coordinate: (834.0689, -94.59981) ft
Lower Right Coordinate: (864.0265, -94.59981) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No

Slip Surface Limits

Left Coordinate: (0, -49.2) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26
Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74
Point 24	644	0.74
Point 25	464	0.74
Point 26	559	27.72993
Point 27	559	0.74
Point 28	559	33.14
Point 29	110	-51.6

Point 30	75	-51.6
Point 31	75	-58.26
Point 32	0	-49.2
Point 33	305	-50.5
Point 34	305	-46.5
Point 35	350.72	-31.26
Point 36	446.72	0.74
Point 37	546.2	33.9
Point 38	161	-50.5
Point 39	157	-52.4
Point 40	42	-52.4
Point 41	66	-52.4
Point 42	37	-50.8
Point 43	24	-52.4
Point 44	18	-52.5
Point 45	10	-49.29
Point 46	527.69	28
Point 47	579.92	45.14
Point 48	594.92	45.14
Point 49	745.7421	29.59999
Point 50	637.13	31.07
Point 51	606.92	41.14
Point 52	696.5	41.14

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	52,49,6,10	3,429.3
Region 2	Fat Clay 2	12,5,4,2,13,14,15	25,013
Region 3	Clayey Sand	12,16,17,3,1,31,18,13,2,4,5	24,300
Region 4	Fat Clay 2	16,19,20,21,35,34,33,38,39,22,29,30,31,1,3,17	12,506
Region 5	Fat Clay 1	35,21,20,19,23,24,27,25,36	19,241
Region 6	Fat Clay 1	26,46,36,25,27	1,952.9
Region 7	Fill	26,7,8,9,28	219.6
Region 8	Fat Clay 1	26,46,37,28	129.49
Region 9	Sediment	31,30,41,40,42,43,44,45,32,18	500.79
Region 10	Fill	9,8,7,26,27,24,23,6,49,50	12,541
Region 11	Dike	47,37,28,9,50,51,48	712.18
Region 12	Dredge Fill	51,52,49,50	1,041.5

Current Slip Surface

Slip Surface: 11,513
 F of S: 1.26
 Volume: 5,657.0009 ft³
 Weight: 698,965.33 lbs
 Resisting Moment: 43,021,295 lbs-ft
 Activating Moment: 34,218,470 lbs-ft
 Resisting Force: 200,886.28 lbs
 Activating Force: 159,993.98 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (396.78039, -15.906538) ft
 Entry: (604.57132, 41.922893) ft
 Radius: 201.37647 ft
 Center: (455.07865, 176.84666) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	400.3475	-16.914133	1,117.8419	1,378.7836	105.4273	300
Slice 2	407.48173	-18.789581	1,234.8699	1,848.7647	248.02959	300
Slice 3	414.61596	-20.389224	1,334.6876	2,278.8558	381.46873	300
Slice 4	421.75019	-21.719737	1,417.7116	2,662.7861	503.04273	300
Slice 5	428.88442	-22.786508	1,484.2781	2,995.156	610.4343	300
Slice 6	436.01865	-23.593755	1,534.6503	3,271.8939	701.89196	300
Slice 7	443.15288	-24.144608	1,569.0235	3,490.5728	776.35633	300
Slice 8	447.10614	-24.371561	1,583.1854	3,591.4362	811.386	300
Slice 9	448.74614	-24.42631	1,586.6017	3,656.4642	836.27873	300
Slice 10	453.5	-24.493201	1,531.2778	3,857.6348	939.90923	300
Slice 11	460.5	-24.42637	1,641.1478	4,096.9755	992.21881	300
Slice 12	467.53833	-24.112716	1,737.3656	4,282.9637	1,028.4884	300
Slice 13	474.615	-23.548387	1,819.7084	4,417.5726	1,049.6053	300
Slice 14	481.69167	-22.731614	1,887.4509	4,503.3015	1,056.8722	300
Slice 15	488.76833	-21.659278	1,940.4129	4,544.6169	1,052.1667	300
Slice 16	495.845	-20.327203	1,978.3527	4,546.303	1,037.5193	300
Slice 17	502.92167	-18.730075	2,000.9631	4,513.1046	1,014.9711	300
Slice 18	509.99833	-16.861328	2,007.8643	4,449.42	986.45255	300
Slice 19	517.075	-14.713001	1,998.5958	4,359.0527	953.6865	300
Slice 20	524.15167	-12.275551	1,972.6059	4,245.0222	918.11579	300
Slice 21	530.66826	-9.77694	1,933.9786	4,116.2664	881.70149	300
Slice 22	536.62478	-7.2514151	1,884.6946	3,976.3141	845.06912	300
Slice 23	542.58129	-4.4951015	1,822.0629	3,822.2704	808.13627	300
Slice 24	545.87978	-2.896237	1,783.1854	3,733.75	788.07927	300
Slice 25	549.47304	-0.99723414	1,731.7387	3,629.9516	766.92779	300
Slice 26	555.87304	2.5482794	1,630.669	3,437.8569	730.15129	300
Slice 27	561.29655	5.7825449	1,531.7346	3,007.6787	537.1997	100
Slice 28	567.67483	9.9624553	1,393.6213	2,840.6015	526.65773	100

Slice 29	575.83828	15.776585	1,189.9975	2,594.5424	511.21253	100
Slice 30	582.51961	20.962055	998.65116	2,275.2149	464.63117	100
Slice 31	587.71882	25.363563	828.56437	1,891.5094	386.88035	100
Slice 32	592.07656	29.271936	673.32614	1,548.9069	318.68532	100
Slice 33	594.07038	31.128873	598.32483	1,384.9289	286.30046	100
Slice 34	594.3341	31.380509	588.0561	1,362.4736	281.86491	100
Slice 35	594.64106	31.675501	575.98265	1,292.0102	333.88913	100
Slice 36	597.46	34.483996	459.35398	936.5105	222.50174	100
Slice 37	600.46	37.504266	351.66982	551.87435	93.356903	100
Slice 38	602.74566	39.953547	198.83465	250.74598	24.206653	100

Project Name: HSC-ECIP Preliminary Slope Evaluation

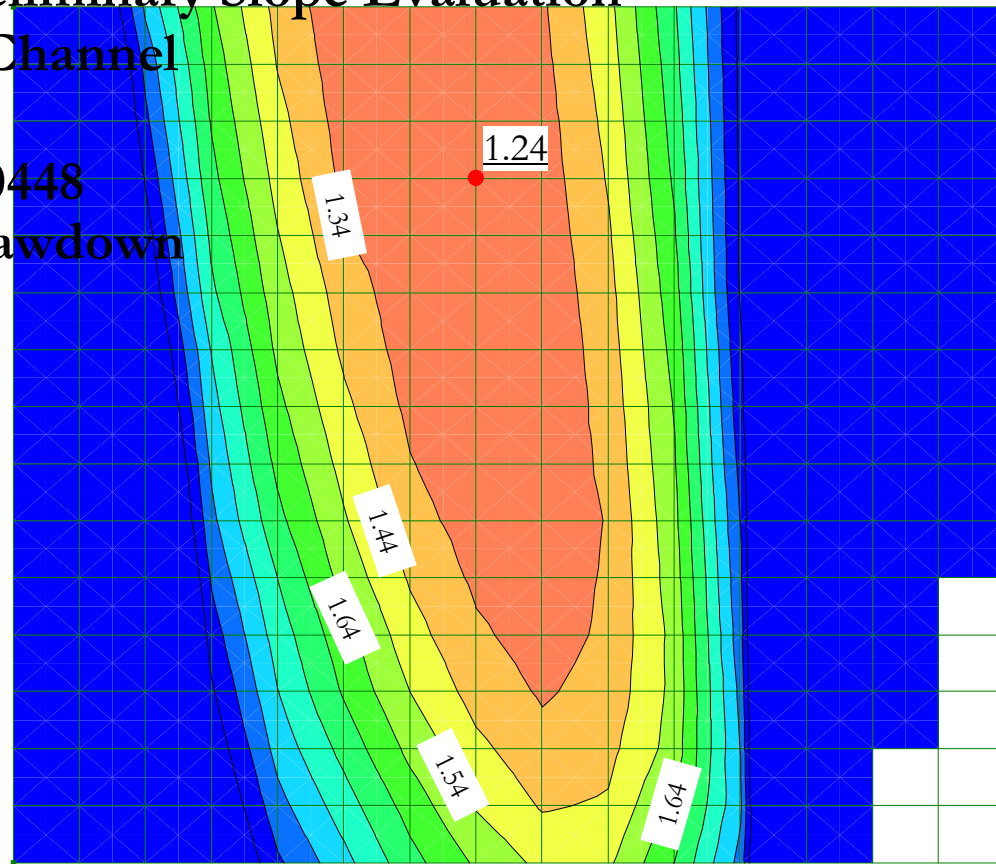
Location: Barbours Cut Ship Channel

Station Analyzed: 44+00

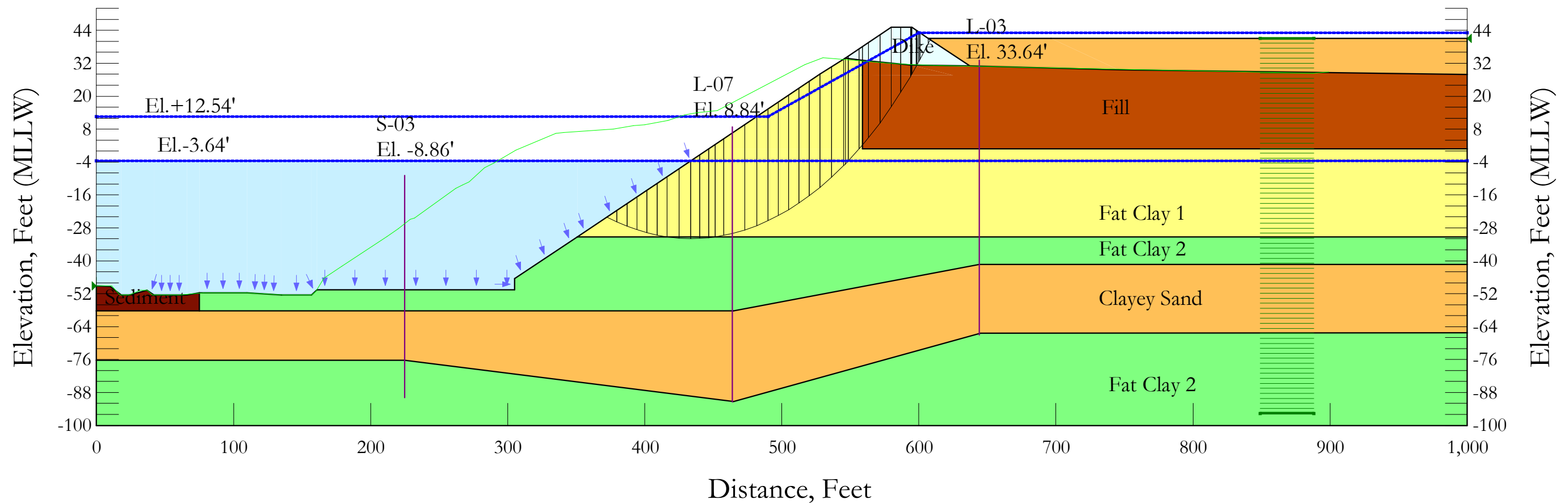
HVJ Project Number: HG1710448

Loading Condition: Rapid Drawdown

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Fat Clay 1	125	300	22	500	15	2
Light Green	Fat Clay 2	125	300	22	500	15	2
Orange	Clayey Sand	120	0	30	0	30	2
Light Orange	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Brown	Fill	110	100	20	150	15	2
Dark Brown	Sediment	90	16	15	50	0	2



RDD 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 183

Date: 4/25/2018

Time: 5:03:01 PM

Tool Version: 8.16.1.13452

File Name: 44+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:03:56 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

RDD 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fill

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 100 psf

Phi': 20 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (242.2658, 249.51717) ft

Lower Left: (242.2658, 72.20246) ft

Lower Right: (653.0031, 72.20246) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 15

Left Projection Angle: 0°

Right Projection Angle: 0°

Slip Surface Radius

Upper Left Coordinate: (848.9456, 41.02998) ft

Upper Right Coordinate: (888.1061, 41.02998) ft

Lower Left Coordinate: (848.9456, -95.69264) ft

Lower Right Coordinate: (888.1061, -95.69264) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135°

Right Projection: No

Right Projection Angle: 45°

Slip Surface Limits

Left Coordinate: (0, -49.2) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	490	12.54
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64
Coordinate 2	1,000	-3.64

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26
Point 3	465	-58.26

Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74
Point 24	644	0.74
Point 25	464	0.74
Point 26	559	27.72993
Point 27	559	0.74
Point 28	559	33.14
Point 29	110	-51.6
Point 30	75	-51.6
Point 31	75	-58.26
Point 32	0	-49.2
Point 33	305	-50.5
Point 34	305	-46.5
Point 35	350.72	-31.26
Point 36	446.72	0.74
Point 37	546.2	33.9
Point 38	161	-50.5
Point 39	157	-52.4
Point 40	42	-52.4
Point 41	66	-52.4
Point 42	37	-50.8
Point 43	24	-52.4
Point 44	18	-52.5
Point 45	10	-49.29
Point 46	527.69	28
Point 47	579.92	45.14
Point 48	594.92	45.14
Point 49	745.7421	29.59999
Point 50	637.13	31.07
Point 51	606.92	41.14
Point 52	696.5	41.14

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	52,49,6,10	3,429.3
Region 2	Fat Clay 2	12,5,4,2,13,14,15	25,013
Region 3	Clayey Sand	12,16,17,3,1,31,18,13,2,4,5	24,300
Region 4	Fat Clay 2	16,19,20,21,35,34,33,38,39,22,29,30,31,1,3,17	12,506
Region 5	Fat Clay 1	35,21,20,19,23,24,27,25,36	19,241
Region 6	Fat Clay 1	26,46,36,25,27	1,952.9
Region 7	Fill	26,7,8,9,28	219.6
Region 8	Fat Clay 1	26,46,37,28	129.49
Region 9	Sediment	31,30,41,40,42,43,44,45,32,18	500.79
Region 10	Fill	9,8,7,26,27,24,23,6,49,50	12,541
Region 11	Dike	47,37,28,9,50,51,48	712.18
Region 12	Dredge Fill	51,52,49,50	1,041.5

Current Slip Surface

Slip Surface: 15,165

F of S: 1.24

Volume: 6,884.4109 ft³

Weight: 850,832.03 lbs

Resisting Moment: 62,809,883 lbs-ft

Activating Moment: 50,793,186 lbs-ft

Resisting Force: 240,467.31 lbs

Activating Force: 194,593.44 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces

F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (372.34786, -24.050712) ft

Entry: (608.83923, 41.14) ft

Radius: 245.94298 ft

Center: (433.94321, 214.05423) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	376.01623	-24.939845	1,329.1103	1,569.6789	97.196022	300
Slice 2	383.35297	-26.60014	1,432.7127	2,008.9433	232.81227	300
Slice 3	390.6897	-28.026743	1,521.7328	2,414.3349	360.63465	300
Slice 4	398.02644	-29.22377	1,596.4272	2,781.3348	478.73373	300
Slice 5	405.36317	-30.194598	1,657.0069	3,105.9349	585.40489	300
Slice 6	412.69991	-30.941921	1,703.6398	3,384.9046	679.27505	300
Slice 7	420.6712	-31.492577	1,738.0008	3,632.1123	765.27074	300
Slice 8	429.27707	-31.806818	1,757.6095	3,835.7153	839.60925	300
Slice 9	436.865	-31.849451	1,760.2697	4,040.5563	921.29558	300
Slice 10	443.435	-31.683533	1,749.9165	4,263.1547	1,015.4141	300
Slice 11	449.11907	-31.408324	1,732.7434	4,427.4908	1,088.7486	300
Slice 12	454.63861	-30.996466	1,707.0435	4,538.6526	0	1,304.7827
Slice 13	460.87954	-30.389073	1,669.1422	4,651.4718	0	1,311.0474

Slice 14	468.44234	-29.415745	1,608.4065	4,746.1081	0	1,309.7321
Slice 15	477.32703	-27.990032	1,519.442	4,810.318	0	1,299.0686
Slice 16	485.88469	-26.304472	1,414.263	4,828.5156	0	1,314.0692
Slice 17	493.769	-24.469826	1,299.7811	4,809.7947	0	1,392.8188
Slice 18	501.307	-22.450973	1,173.8047	4,757.2761	0	1,377.1455
Slice 19	508.845	-20.172184	1,031.6083	4,678.8012	0	1,357.4794
Slice 20	516.383	-17.625778	872.71255	4,576.7543	0	1,334.6965
Slice 21	523.921	-14.802811	696.55941	4,452.8793	0	1,309.4946
Slice 22	532.02682	-11.434546	486.37969	4,286.881	0	1,276.9301
Slice 23	540.70045	-7.4579896	238.24255	4,076.7508	0	1,237.4343
Slice 24	545.61864	-5.0715843	89.330861	3,950.6205	0	1,215.0287
Slice 25	547.29304	-4.2076486	35.421273	3,905.2099	0	1,207.5387
Slice 26	552.37124	-1.45	-136.656	3,759.4109	0	1,184.6348
Slice 27	557.6782	1.5095	-321.3288	3,604.0552	0	1,161.1034
Slice 28	561.14376	3.57455	-450.18792	3,230.7557	0	710.29848
Slice 29	567.44563	7.5583835	-698.77913	3,079.7511	0	702.23238
Slice 30	575.76188	13.182366	-1,049.7156	2,854.5675	0	689.376
Slice 31	583.39868	18.780518	-1,399.0403	2,498.2271	0	632.47632
Slice 32	590.35603	24.310573	-1,744.1157	2,010.9622	0	531.08644
Slice 33	594.09693	27.403176	-1,937.0942	1,737.6996	0	475.12458
Slice 34	594.63958	27.870211	-1,966.2372	1,695.8604	0	466.62324
Slice 35	596.49759	29.50179	-2,068.0477	1,497.6136	0	418.60854
Slice 36	598.3436	31.132576	-2,169.8087	1,290.4549	0	367.70719
Slice 37	599.30601	32.004197	-2,224.1979	1,116.4013	0	419.75272
Slice 38	600.46	33.057776	-2,289.9412	987.18573	0	356.51305
Slice 39	603.92	36.35053	-2,495.4091	514.14244	0	260.0248
Slice 40	607.64126	39.939621	-2,719.3684	62.324032	0	98.415584
Slice 41	608.60088	40.899579	-2,779.2697	9.488487	0	14.891707

Project Name: HSC-ECIP Preliminary Slope Evaluation

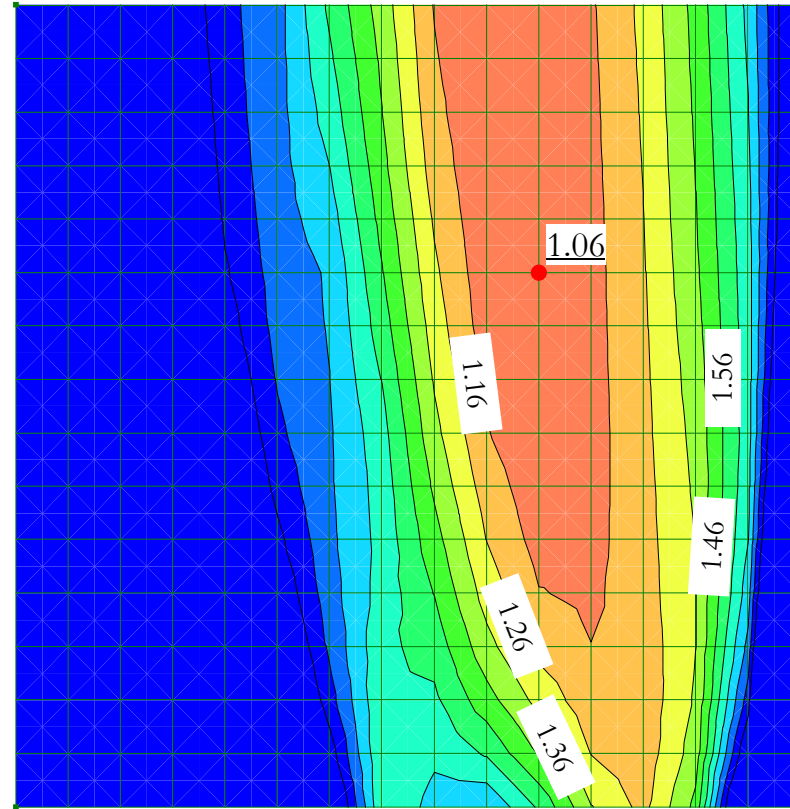
Location: Barbours Cut Ship Channel

Station Analyzed: 56+00

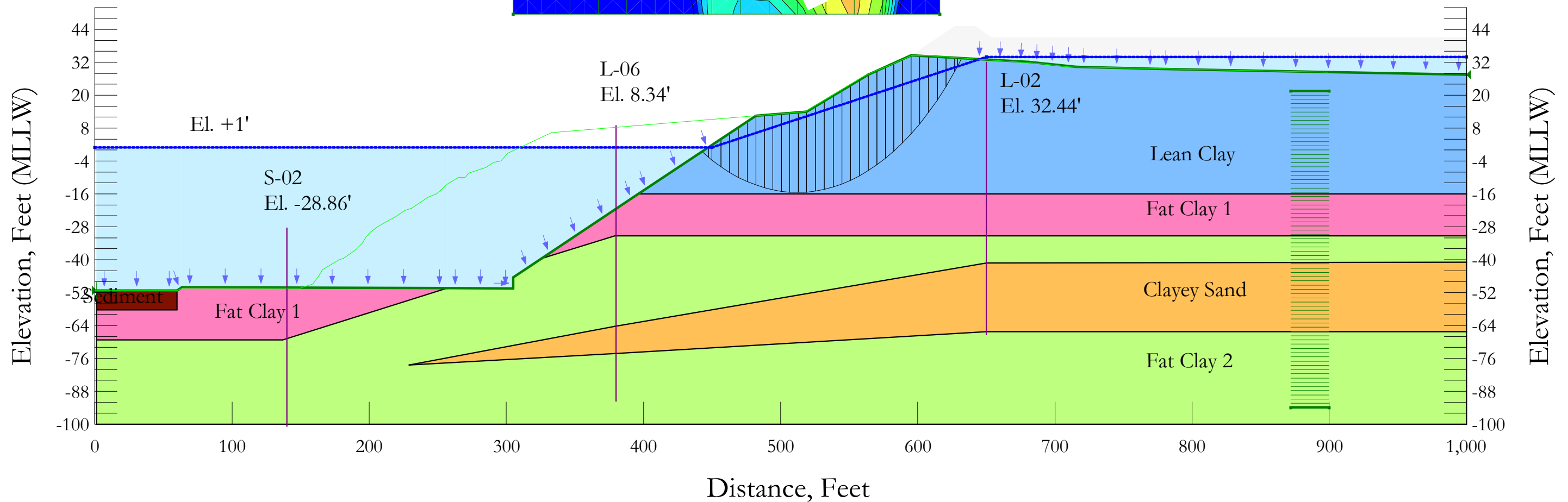
HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Lean Clay (U)	125			500
Pink	Fat Clay 1(U)	125			1,000
Light Green	Fat Clay 2(U)	125			2,200
Dark Red	Sediment (U)	90			50



Short Term 56+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 140

Date: 4/25/2018

Time: 4:56:47 PM

Tool Version: 8.16.1.13452

File Name: 56+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\

Last Solved Date: 4/25/2018

Last Solved Time: 4:57:22 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 56+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 0 psf

Phi: 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Slip Surface Grid

Upper Left: [\(305, 208.5\) ft](#)

Lower Left: [\(305, 49.5\) ft](#)

Lower Right: [\(616, 49.5\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(872, 21.5\) ft](#)

Upper Right Coordinate: [\(900, 21.5\) ft](#)

Lower Left Coordinate: [\(872, -94\) ft](#)

Lower Right Coordinate: [\(900, -94\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(1, -51.26\) ft](#)

Right Coordinate: [\(1,000, 27.54\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	650	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96

Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.04	32.1
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	519	13.94
Point 19	1,000	-16.06
Point 20	1,000	-31.26
Point 21	379	-31.26
Point 22	137	-69.26
Point 23	1	-69.26
Point 24	1	-100
Point 25	1,000	-100
Point 26	1,000	-66.26
Point 27	229	-78.46
Point 28	379	-64.26
Point 29	1,000	-40.86
Point 30	60	-51.26
Point 31	63.6	-50.06
Point 32	60	-58.26
Point 33	1	-58.26
Point 34	1	-51.26
Point 35	325.7	-39.6
Point 36	305	-50.5
Point 37	305	-46.5
Point 38	256.9893	-50.4
Point 39	196	-60
Point 40	396.32	-16.06
Point 41	482	12.5
Point 42	715.3	30.4

Regions

	Points	Area (ft ²)	Material
Region 1	10,11,12,42,14	982.22	
Region 2	11,13,9,12	2,972.5	
Region 3	15,16,17,10,14	593.84	
Region 4	8,18,41,40,19,9,12,42,14,15	24,082	Lean Clay (U)
Region 5	19,20,21,35,40	9,640.4	Fat Clay 1(U)
Region 6	20,21,35,37,36,38,39,22,23,24,25,26,7,5,27,28,6,29	44,368	Fat Clay 2(U)
Region 7	27,5,7,26,29,6,28	14,319	Clayey Sand
Region 8	30,34,33,32	413	Sediment (U)

Region 9	38,31,30,32,33,23,22,39	3,265.5	Fat Clay 1(U)
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Current Slip Surface

Slip Surface: 12,945

F of S: 1.06

Volume: 4,637.457 ft³

Weight: 579,682.12 lbs

Resisting Moment: 17,468,633 lbs-ft

Activating Moment: 16,428,747 lbs-ft

Resisting Force: 94,704.475 lbs

Activating Force: 89,138.983 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces

F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (442.65353, -0.61549053) ft

Entry: (632.06248, 33.466179) ft

Radius: 170.96 ft

Center: (512.33333, 155.5) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	445.07676	-1.6525626	165.5199	489.5236	0	500
Slice 2	448.75	-3.1904785	261.48586	783.94013	0	500
Slice 3	453.2	-4.8712513	388.73011	1,182.752	0	500
Slice 4	459.6	-7.0890524	587.60103	1,734.9069	0	500
Slice 5	466	-9.028088	769.53802	2,253.3921	0	500
Slice 6	472.4	-10.698133	935.13483	2,736.0269	0	500
Slice 7	478.8	-12.107241	1,084.8808	3,181.0033	0	500
Slice 8	485.08333	-13.245383	1,216.9971	3,465.1107	0	500
Slice 9	491.25	-14.126533	1,332.3329	3,589.6769	0	500
Slice 10	497.41667	-14.779872	1,433.83	3,678.318	0	500
Slice 11	503.58333	-15.208017	1,521.6474	3,731.8675	0	500
Slice 12	509.75	-15.412664	1,595.8882	3,751.4005	0	500
Slice 13	515.91667	-15.394617	1,656.6011	3,738.1598	0	500
Slice 14	522.21429	-15.143846	1,704.4895	3,796.9004	0	500
Slice 15	528.64286	-14.649624	1,738.9018	3,926.0864	0	500
Slice 16	535.07143	-13.910103	1,758.413	4,021.9173	0	500
Slice 17	541.5	-12.922046	1,762.8267	4,085.8366	0	500
Slice 18	547.92857	-11.681041	1,751.8748	4,119.1834	0	500
Slice 19	554.35714	-10.181395	1,725.2113	4,123.0861	0	500
Slice 20	560.78571	-8.4159968	1,682.4045	4,098.3599	0	500
Slice						

21	567.1	-6.4173381	1,624.2824	4,017.853	0	500
Slice 22	573.3	-4.1852415	1,550.8344	3,882.4783	0	500
Slice 23	579.5	-1.6769563	1,460.609	3,719.9608	0	500
Slice 24	585.7	1.1210073	1,352.7867	3,528.6954	0	500
Slice 25	591.9	4.2247589	1,226.389	3,306.2586	0	500
Slice 26	598.192	7.7096643	1,077.7598	2,947.7022	0	500
Slice 27	604.576	11.610334	904.79655	2,445.3035	0	500
Slice 28	610.96	15.911939	707.4781	1,890.54	0	500
Slice 29	617.344	20.652999	483.46438	1,272.9021	0	500
Slice 30	623.728	25.881962	229.81239	578.72935	0	500
Slice 31	627.95989	29.580077	47.582792	77.395114	0	500
Slice 32	630.53113	32.000572	-73.68118	-256.78897	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

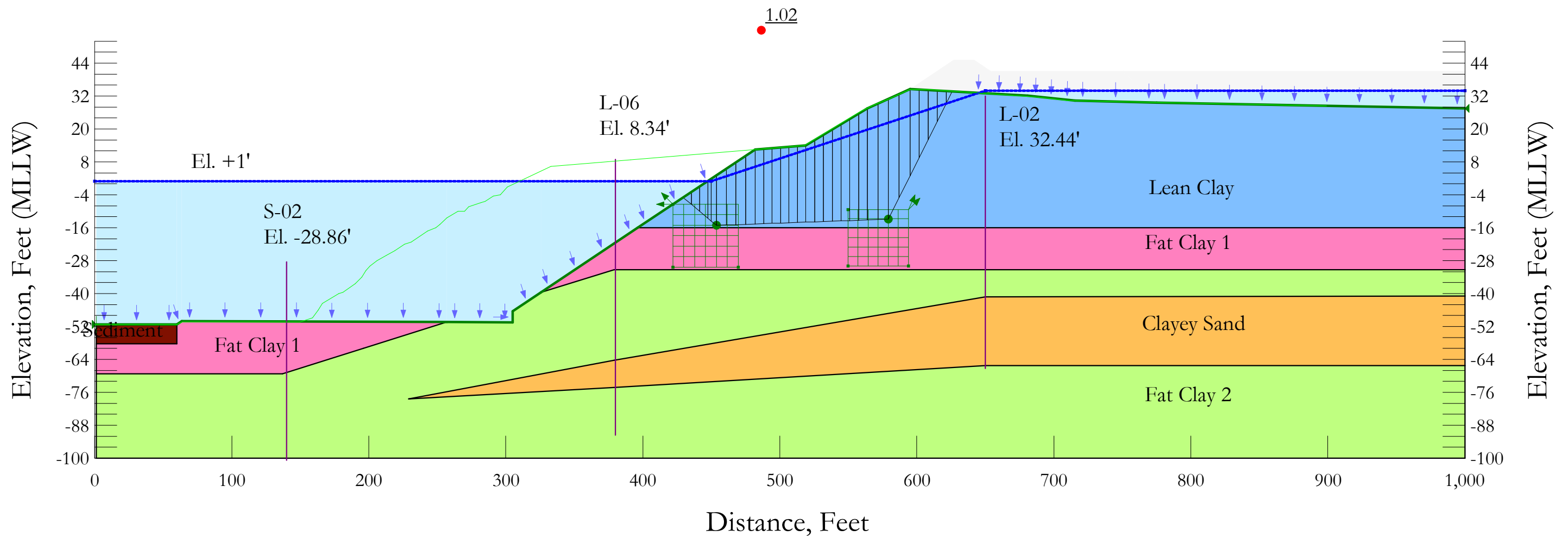
Station Analyzed: 56+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Blue	Lean Clay (U)	125			500
Pink	Fat Clay 1(U)	125			1,000
Light Green	Fat Clay 2(U)	125			2,200
Dark Red	Sediment (U)	90			50



Short Term - Block 56+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 140

Date: 4/25/2018

Time: 4:56:47 PM

Tool Version: 8.16.1.13452

File Name: 56+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\

Last Solved Date: 4/25/2018

Last Solved Time: 4:58:04 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block 56+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: [\(1, -51.26\) ft](#)

Right Coordinate: [\(1,000, 27.54\) ft](#)

Slip Surface Block

Left Grid

Upper Left: [\(421.9916, -7.48074\) ft](#)

Lower Left: [\(421.9916, -30.44074\) ft](#)

Lower Right: [\(469.7676, -30.44074\) ft](#)

X Increments: [6](#)

Y Increments: [6](#)

Starting Angle: [135 °](#)

Ending Angle: [180 °](#)

Angle Increments: [2](#)

Right Grid

Upper Left: [\(549.76, -9.45259\) ft](#)

Lower Left: [\(549.76, -29.98398\) ft](#)

Lower Right: [\(594.001, -29.98398\) ft](#)

X Increments: [6](#)

Y Increments: [6](#)

Starting Angle: [45 °](#)

Ending Angle: [65 °](#)

Angle Increments: [2](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	650	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96

Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.04	32.1
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	519	13.94
Point 19	1,000	-16.06
Point 20	1,000	-31.26
Point 21	379	-31.26
Point 22	137	-69.26
Point 23	1	-69.26
Point 24	1	-100
Point 25	1,000	-100
Point 26	1,000	-66.26
Point 27	229	-78.46
Point 28	379	-64.26
Point 29	1,000	-40.86
Point 30	60	-51.26
Point 31	63.6	-50.06
Point 32	60	-58.26
Point 33	1	-58.26
Point 34	1	-51.26
Point 35	325.7	-39.6
Point 36	305	-50.5
Point 37	305	-46.5
Point 38	256.9893	-50.4
Point 39	196	-60
Point 40	396.32	-16.06
Point 41	482	12.5
Point 42	715.3	30.4

Regions

	Points	Area (ft ²)	Material
Region 1	10,11,12,42,14	982.22	
Region 2	11,13,9,12	2,972.5	
Region 3	15,16,17,10,14	593.84	
Region 4	8,18,41,40,19,9,12,42,14,15	24,082	Lean Clay (U)
Region 5	19,20,21,35,40	9,640.4	Fat Clay 1(U)
Region 6	20,21,35,37,36,38,39,22,23,24,25,26,7,5,27,28,6,29	44,368	Fat Clay 2(U)
Region 7	27,5,7,26,29,6,28	14,319	Clayey Sand

Region 8	30,34,33,32	413	Sediment (U)
Region 9	38,31,30,32,33,23,22,39	3,265.5	Fat Clay 1(U)

Current Slip Surface

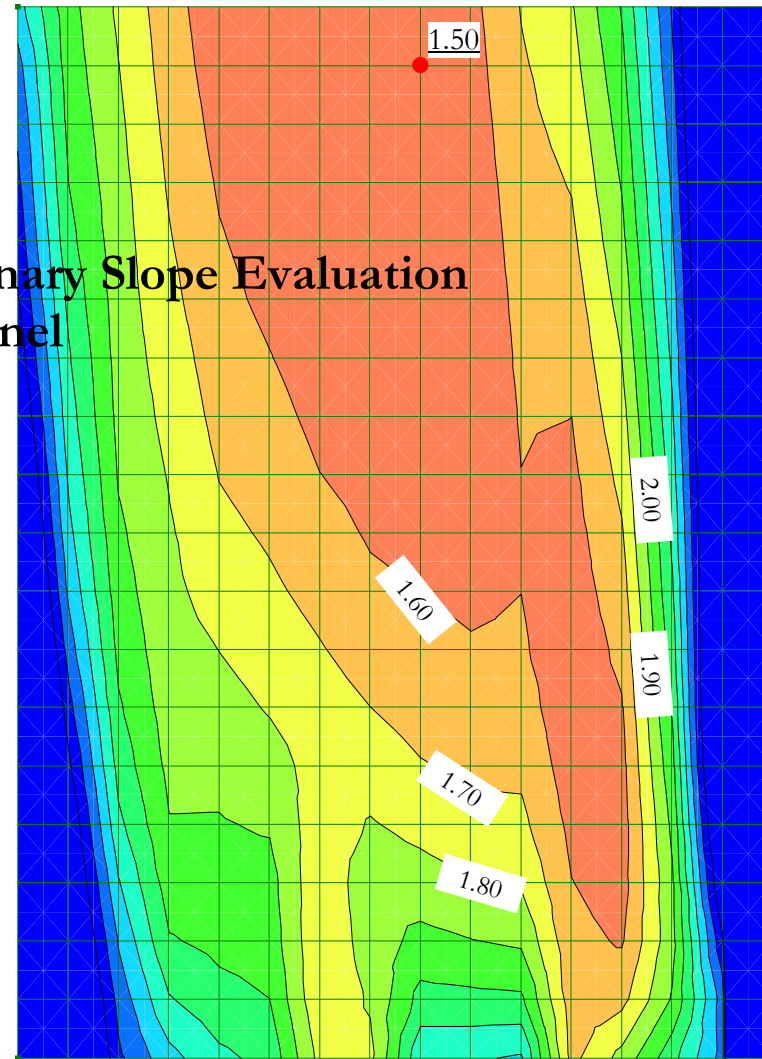
Slip Surface: 14,377
 F of S: 1.02
 Volume: 5,148.2759 ft³
 Weight: 643,534.49 lbs
 Resisting Moment: 7,285,963.9 lbs-ft
 Activating Moment: 7,142,300.3 lbs-ft
 Resisting Force: 98,169.322 lbs
 Activating Force: 95,802.445 lbs
 F of S Rank (Analysis): 1 of 21,609 slip surfaces
 F of S Rank (Query): 1 of 21,609 slip surfaces
 Exit: (429.43154, -5.0228197) ft
 Entry: (625.77018, 33.641696) ft
 Radius: 88.685023 ft
 Center: (521.89028, 43.307825) ft

Slip Slices

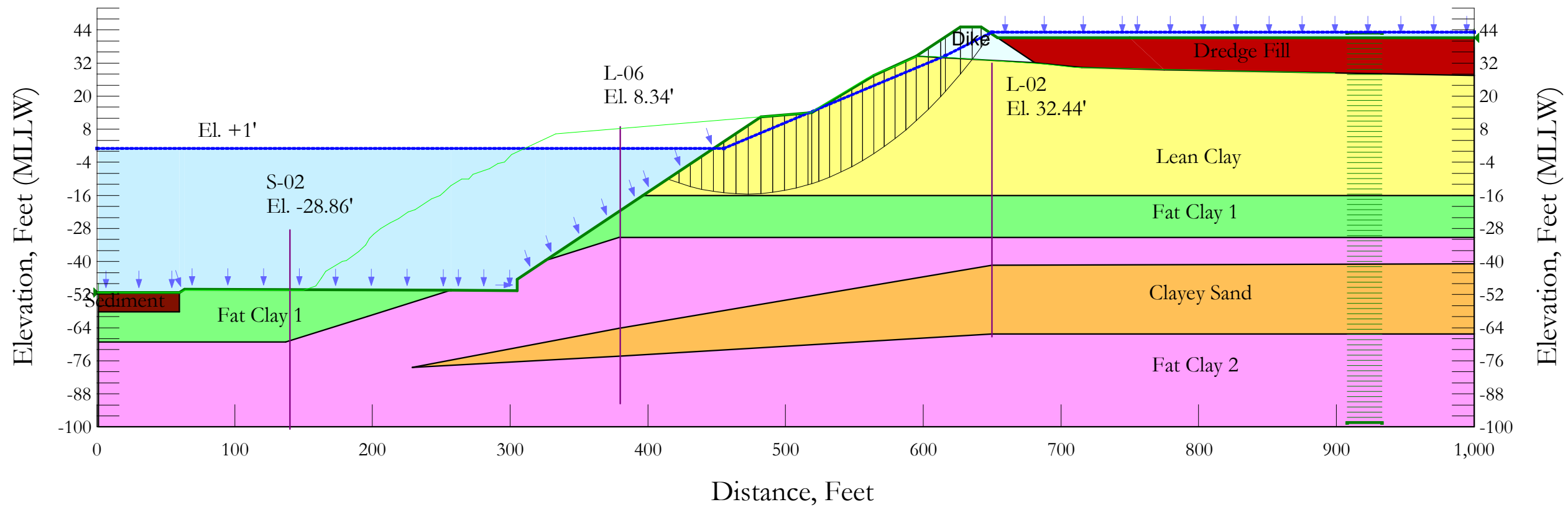
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	432.44295	-6.2701865	453.65964	811.39211	0	500
Slice 2	438.46577	-8.7649201	609.33101	1,280.8405	0	500
Slice 3	444.48859	-11.259654	765.00239	1,756.2658	0	500
Slice 4	448.75	-13.024787	875.14673	2,122.6941	0	500
Slice 5	451.92113	-14.338314	950.9998	2,446.2033	0	500
Slice 6	457.36198	-15.070657	1,050.0212	2,508.1646	0	500
Slice 7	464.40142	-14.943826	1,112.8737	2,794.3905	0	500
Slice 8	471.44085	-14.816994	1,175.7263	3,078.1388	0	500
Slice 9	478.48028	-14.690162	1,238.5788	3,359.2047	0	500
Slice 10	485.08333	-14.571193	1,297.535	3,507.0844	0	500
Slice 11	491.25	-14.460086	1,352.595	3,522.2097	0	500
Slice 12	497.41667	-14.348979	1,407.6549	3,535.1365	0	500
Slice 13	503.58333	-14.237872	1,462.7148	3,545.8349	0	500
Slice 14	509.75	-14.126765	1,517.7747	3,554.3069	0	500
Slice 15	515.91667	-14.015658	1,572.8346	3,560.587	0	500
Slice 16	522.21429	-13.902192	1,629.0638	3,670.2989	0	500
Slice 17	528.64286	-13.786366	1,686.4622	3,883.4315	0	500
Slice 18	535.07143	-13.67054	1,743.8605	4,094.5476	0	500
Slice 19	541.5	-13.554715	1,801.2589	4,303.8695	0	500
Slice 20	547.92857	-13.438889	1,858.6573	4,511.6517	0	500

Slice 21	554.35714	-13.323063	1,916.0557	4,718.1771	0	500
Slice 22	560.78571	-13.207238	1,973.4541	4,923.754	0	500
Slice 23	567.8135	-13.080616	2,036.2026	5,110.829	0	500
Slice 24	575.4405	-12.943197	2,104.3013	5,279.7088	0	500
Slice 25	583.1905	-8.9379883	1,938.6793	4,125.3611	0	500
Slice 26	591.0635	-1.0649883	1,539.3366	3,512.9391	0	500
Slice 27	598.30142	6.1729321	1,172.2071	2,837.6177	0	500
Slice 28	604.90426	12.775773	837.2908	2,091.1494	0	500
Slice 29	611.5071	19.378614	502.37448	1,313.9703	0	500
Slice 30	618.10994	25.981455	167.45816	501.14333	0	500
Slice 31	623.59077	31.462286	-110.54639	-202.58862	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Lean Clay	125	100	25
Light Green	Fat Clay 1	125	300	22
Orange	Clayey Sand	120	0	30
Dark Red	Dredge Fill	90	16	15
Light Blue	Dike	125	100	25
Pink	Fat Clay 2	125	300	22
Dark Brown	Sediment	90	16	15



Long Term 56+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 144

Date: 4/25/2018

Time: 5:01:20 PM

Tool Version: 8.16.1.13452

File Name: 56+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:01:36 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term 56+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf
Cohesion!: 16 psf
Phi!: 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dike

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion!: 100 psf
Phi!: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion!: 300 psf
Phi!: 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion!: 16 psf
Phi!: 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (289.8782, 296.40863) ft
Lower Left: (289.8782, 59.18752) ft
Lower Right: (630.7282, 59.18752) ft
Grid Horizontal Increment: 15
Grid Vertical Increment: 18
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (907.9586, 42.95493) ft
Upper Right Coordinate: (933.1186, 42.95493) ft
Lower Left Coordinate: (907.9586, -98.52178) ft
Lower Right Coordinate: (933.1186, -98.52178) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No

Slip Surface Limits

Left Coordinate: (1, -51.26) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	455	1
Coordinate 3	616	34.74
Coordinate 4	650	43.14
Coordinate 5	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96
Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.04	32.1
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	519	13.94
Point 19	1,000	-16.06
Point 20	1,000	-31.26
Point 21	379	-31.26
Point 22	137	-69.26
Point 23	1	-69.26
Point 24	1	-100
Point 25	1,000	-100
Point 26	1,000	-66.26
Point 27	229	-78.46
Point 28	379	-64.26

Point 29	1,000	-40.86
Point 30	60	-51.26
Point 31	63.6	-50.06
Point 32	60	-58.26
Point 33	1	-58.26
Point 34	1	-51.26
Point 35	325.7	-39.6
Point 36	305	-50.5
Point 37	305	-46.5
Point 38	256.9893	-50.4
Point 39	196	-60
Point 40	396.32	-16.06
Point 41	482	12.5
Point 42	715.3	30.4

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	10,11,12,42,14	982.22
Region 2	Dredge Fill	11,13,9,12	2,972.5
Region 3	Dike	15,16,17,10,14	593.84
Region 4	Lean Clay	8,18,41,40,19,9,12,42,14,15	24,082
Region 5	Fat Clay 1	19,20,21,35,40	9,640.4
Region 6	Fat Clay 2	20,21,35,37,36,38,39,22,23,24,25,26,7,5,27,28,6,29	44,368
Region 7	Clayey Sand	27,5,7,26,29,6,28	14,319
Region 8	Sediment	30,34,33,32	413
Region 9	Fat Clay 1	38,31,30,32,33,23,22,39	3,265.5

Current Slip Surface

Slip Surface: 21,312
 F of S: 1.50
 Volume: 4,956.9764 ft³
 Weight: 619,622.05 lbs
 Resisting Moment: 56,595,303 lbs-ft
 Activating Moment: 37,836,868 lbs-ft
 Resisting Force: 181,247.34 lbs
 Activating Force: 121,208.62 lbs
 F of S Rank (Analysis): 1 of 23,104 slip surfaces
 F of S Rank (Query): 1 of 23,104 slip surfaces
 Exit: (414.49624, -10.001253) ft
 Entry: (648.97832, 42.787228) ft
 Radius: 298.75179 ft
 Center: (471.66487, 283.22968) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	418.62171	-10.745629	732.92722	900.01464	77.914144	100
Slice 2	426.87265	-12.115675	818.41809	1,283.3373	216.79541	100
Slice 3	435.12359	-13.249812	889.18827	1,633.0687	346.87712	100
Slice 4	443.37453	-14.150742	945.4063	1,946.0321	466.59947	100

Slice 5	451.25	-14.800078	985.92489	2,296.003	610.89944	100
Slice 6	459.5	-15.24036	1,027.1351	2,722.1617	790.40387	100
Slice 7	468.5	-15.471447	1,153.6888	3,136.6164	924.65431	100
Slice 8	477.5	-15.431207	1,264.024	3,499.8947	1,042.6036	100
Slice 9	486.27913	-15.13369	1,356.2137	3,640.0879	1,064.988	100
Slice 10	494.83738	-14.591147	1,430.9902	3,565.4195	995.30073	100
Slice 11	503.39564	-13.801076	1,490.9708	3,452.6386	914.74071	100
Slice 12	511.9539	-12.761495	1,536.037	3,305.3897	825.06272	100
Slice 13	517.61651	-11.963677	1,627.7614	3,207.3634	736.58051	100
Slice 14	521.54797	-11.316802	1,638.8075	3,202.8061	729.3045	100
Slice 15	528.08634	-10.117788	1,580.0965	3,237.5815	772.89796	100
Slice 16	536.06715	-8.4692711	1,581.5301	3,273.2174	788.84674	100
Slice 17	544.04797	-6.5916483	1,569.269	3,281.66	798.50104	100
Slice 18	552.02878	-4.4804308	1,543.0448	3,264.6866	802.81476	100
Slice 19	560.00959	-2.130429	1,502.5473	3,223.7596	802.61447	100
Slice 20	567.875	0.42322873	1,448.4306	3,127.3577	782.89656	100
Slice 21	575.625	3.1799738	1,380.7288	2,977.9843	744.81246	100
Slice 22	583.375	6.1809094	1,298.4305	2,809.1977	704.4823	100
Slice 23	591.125	9.4340728	1,201.0553	2,620.2118	661.76354	100
Slice 24	599.38061	13.19665	1,079.5637	2,445.0124	636.71917	100
Slice 25	608.14184	17.518532	930.97344	2,276.7713	627.55587	100
Slice 26	614.26123	20.713025	816.67898	2,142.6481	618.30952	100
Slice 27	621.46	24.822597	662.57745	1,948.007	599.40564	100
Slice 28	631.18214	30.679766	459.37425	1,508.8681	489.387	100
Slice 29	638.68214	35.555273	281.61617	985.90925	328.41726	100
Slice 30	645.3627	40.199255	105.56804	365.845	121.36914	100
Slice 31	648.89186	42.72352	8.9047675	-26.398425	-16.462149	100

Project Name: HSC-ECIP Preliminary Slope Evaluation

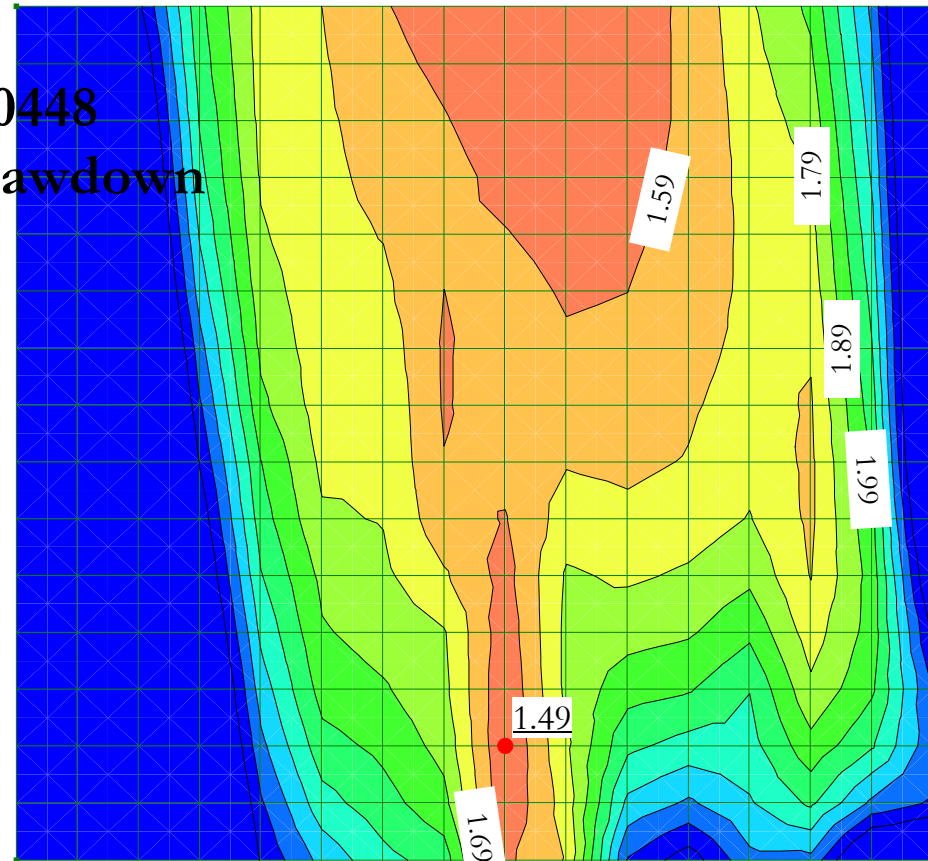
Location: Barbours Cut Ship Channel

Station Analyzed: 56+00

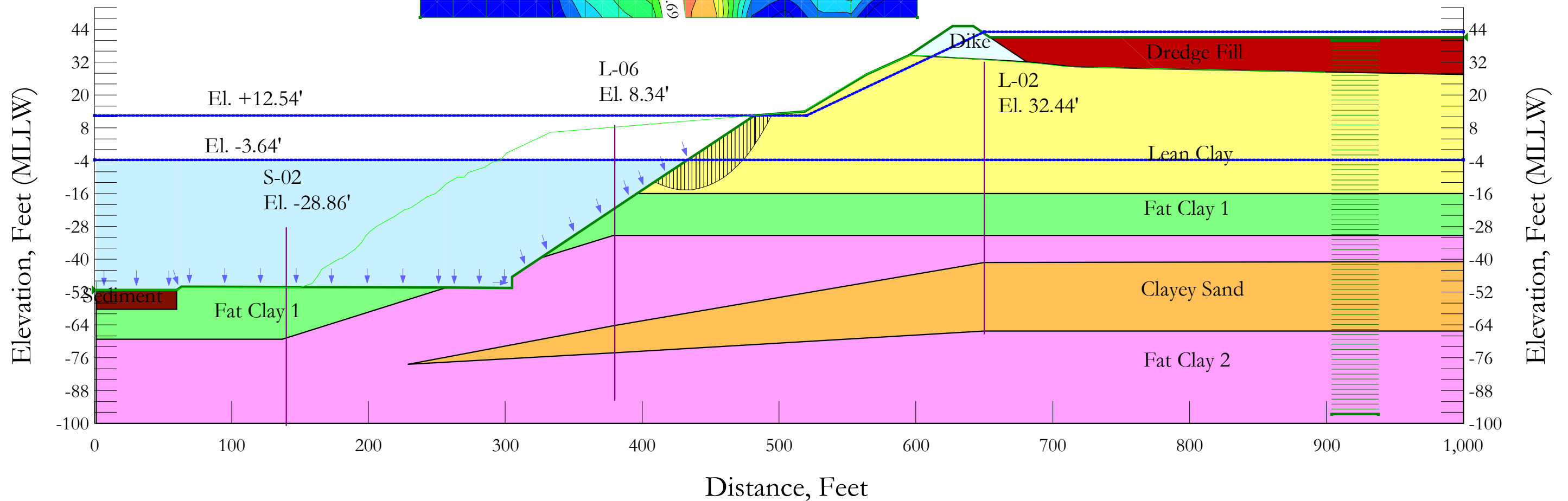
HVJ Project Number: HG1710448

Loading Condition: Rapid Drawdown

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Lean Clay	125	100	25	150	20	2
Light Green	Fat Clay 1	125	300	22	500	15	2
Orange	Clayey Sand	120	0	30	0	30	2
Red	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Pink	Fat Clay 2	125	300	22	500	15	2
Brown	Sediment	90	16	15	50	0	2



RDD 56+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 140

Date: 4/25/2018

Time: 4:56:47 PM

Tool Version: 8.16.1.13452

File Name: 56+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\

Last Solved Date: 4/25/2018

Last Solved Time: 4:57:50 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

RDD 56+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 20 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (237.892, 217.61929) ft

Lower Left: (237.892, 48.37518) ft

Lower Right: (601.1356, 48.37518) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 15

Left Projection Angle: 0°

Right Projection Angle: 0°

Slip Surface Radius

Upper Left Coordinate: (903.9399, 39.9822) ft

Upper Right Coordinate: (937.9492, 39.9822) ft

Lower Left Coordinate: (903.9399, -96.76581) ft

Lower Right Coordinate: (937.9492, -96.76581) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135°

Right Projection: No

Right Projection Angle: 45°

Slip Surface Limits

Left Coordinate: (1, -51.26) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	520	12.54
Coordinate 3	650	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64
Coordinate 2	1,000	-3.64

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96
Point 3	380	4.34

Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.04	32.1
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	519	13.94
Point 19	1,000	-16.06
Point 20	1,000	-31.26
Point 21	379	-31.26
Point 22	137	-69.26
Point 23	1	-69.26
Point 24	1	-100
Point 25	1,000	-100
Point 26	1,000	-66.26
Point 27	229	-78.46
Point 28	379	-64.26
Point 29	1,000	-40.86
Point 30	60	-51.26
Point 31	63.6	-50.06
Point 32	60	-58.26
Point 33	1	-58.26
Point 34	1	-51.26
Point 35	325.7	-39.6
Point 36	305	-50.5
Point 37	305	-46.5
Point 38	256.9893	-50.4
Point 39	196	-60
Point 40	396.32	-16.06
Point 41	482	12.5
Point 42	715.3	30.4

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	10,11,12,42,14	982.22
Region 2	Dredge Fill	11,13,9,12	2,972.5
Region 3	Dike	15,16,17,10,14	593.84
Region 4	Lean Clay	8,18,41,40,19,9,12,42,14,15	24,082
Region 5	Fat Clay 1	19,20,21,35,40	9,640.4
Region 6	Fat Clay 2	20,21,35,37,36,38,39,22,23,24,25,26,7,5,27,28,6,29	44,368
Region 7	Clayey Sand	27,5,7,26,29,6,28	14,319
Region 8	Sediment	30,34,33,32	413

Current Slip Surface

Slip Surface: 3,071
 F of S: 1.49
 Volume: 885.10023 ft³
 Weight: 110,637.53 lbs
 Resisting Moment: 3,426,643.3 lbs-ft
 Activating Moment: 2,301,362.1 lbs-ft
 Resisting Force: 37,096.953 lbs
 Activating Force: 24,932.599 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (409.26012, -11.746628) ft
 Entry: (494.70517, 12.994472) ft
 Radius: 85.658065 ft
 Center: (431.62192, 70.941061) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	410.61122	-12.088526	527.18801	611.06897	39.114334	100
Slice 2	413.31343	-12.72608	566.97137	775.41161	97.19728	100
Slice 3	416.01564	-13.272121	601.04432	926.17034	151.60875	100
Slice 4	418.71785	-13.728421	629.51747	1,061.7665	201.56102	100
Slice 5	421.42006	-14.096427	652.48104	1,180.8374	246.37661	100
Slice 6	424.12227	-14.377282	670.00642	1,282.3299	285.53111	100
Slice 7	426.82448	-14.571847	682.14724	1,365.5681	318.6844	100
Slice 8	429.52669	-14.680709	688.94025	1,430.2908	345.69746	100
Slice 9	432.2289	-14.704196	690.40585	1,476.6545	366.63376	100
Slice 10	435.01473	-14.637741	686.25902	1,539.2838	397.77196	100
Slice 11	437.88418	-14.475675	676.14611	1,617.0601	438.75538	100
Slice 12	440.75363	-14.216639	659.9823	1,675.6086	473.59432	100
Slice 13	443.62308	-13.859745	637.71208	1,712.7625	0	561.42361
Slice 14	446.49253	-13.403748	609.25785	1,735.3491	0	566.37471
Slice 15	449.36198	-12.847027	574.51851	1,742.9702	0	568.11469
Slice 16	452.23143	-12.187558	533.36763	1,736.9862	0	566.92191
Slice 17	455.10088	-11.422869	485.651	1,718.6939	0	563.05289
Slice 18	457.97033	-10.549993	431.18354	1,689.2559	0	556.7304
Slice 19	460.83978	-9.5654061	369.74534	1,649.6415	0	548.13245
Slice 20	463.70923	-8.464947	301.07669	1,600.5769	0	537.38225
Slice						

21	466.57868	-7.2437144	224.87178	1,542.5025	0	524.53905
Slice 22	469.44813	-5.8959392	140.7706	1,475.5353	0	509.5898
Slice 23	472.31758	-4.414818	48.348643	1,399.4294	0	492.44154
Slice 24	475.12692	-2.8293408	-50.585134	1,315.5944	0	473.3866
Slice 25	477.87615	-1.1365521	-156.21515	1,223.327	0	452.25411
Slice 26	480.62538	0.70463722	-271.10536	1,119.6347	0	428.37263
Slice 27	482.51389	2.0432857	-354.63703	1,026.6814	0	406.90241
Slice 28	484.43489	3.5251925	-447.10801	876.06163	0	373.82287
Slice 29	487.24911	5.8296605	-590.90682	640.58224	0	323.92606
Slice 30	490.06334	8.3455399	-747.89769	375.59495	175.1428	100
Slice 31	492.87756	11.099635	-919.75321	133.35926	0	136.15554
Slice 32	494.49492	12.767236	-1,023.8115	-33.478673	-15.611361	100

Project Name: HSC-ECIP Preliminary Slope Evaluation

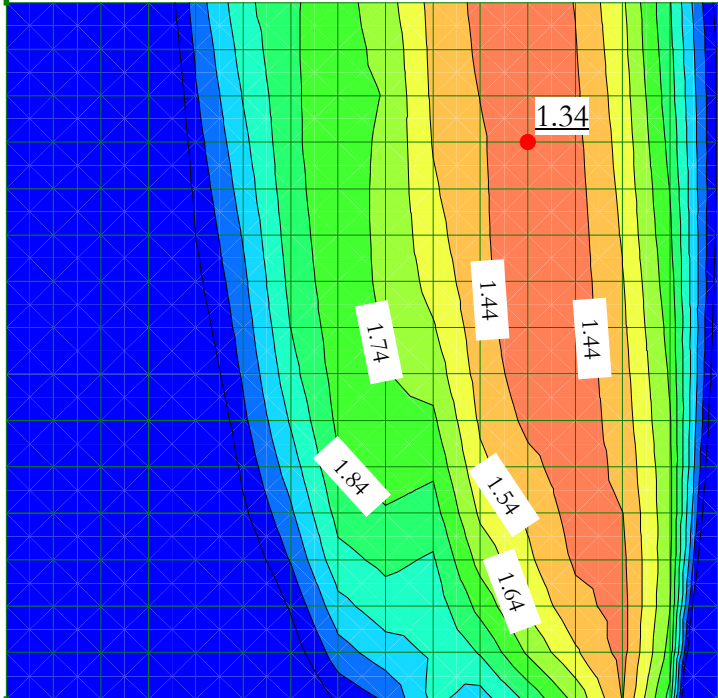
Location: Barbours Cut Ship Channel

Station Analyzed: 64+00

HVJ Project Number: HG1710448

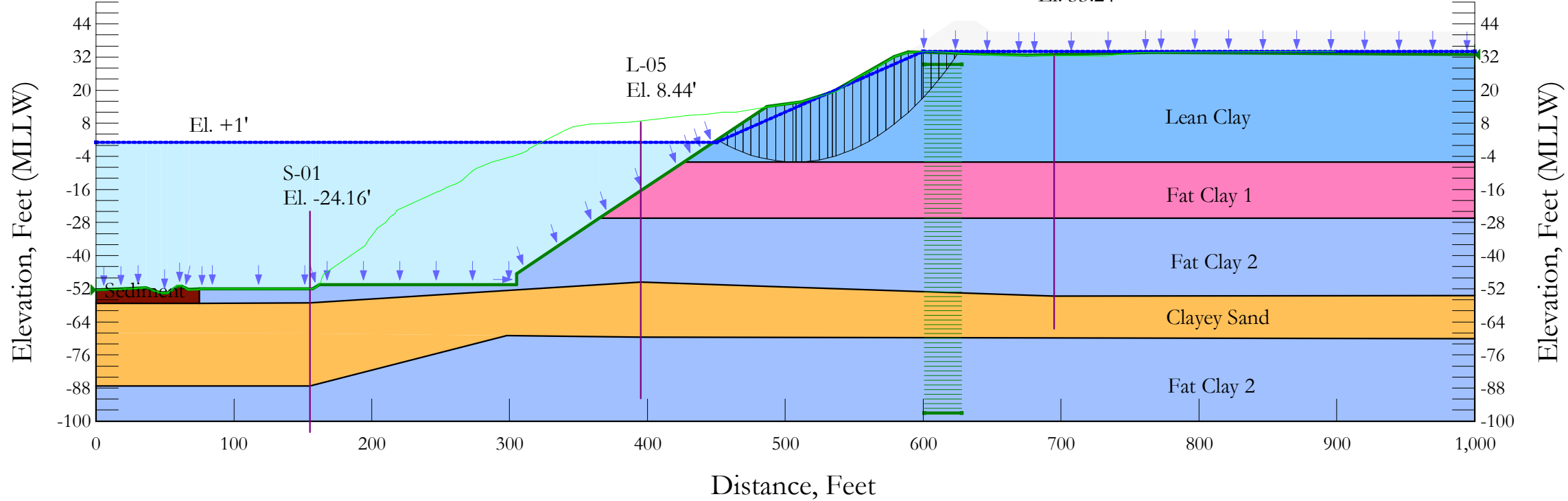
Loading Condition: Short Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Lean Clay (U)	125			500
Pink	Fat Clay1 (U)	125			1,000
Blue	Fat Clay 2 (U)	125			2,200
Dark Blue	Sediment (U)	90			50

L-01
El. 33.24'



Short Term 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 153

Date: 4/25/2018

Time: 5:15:34 PM

Tool Version: 8.16.1.13452

File Name: 64+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:16:06 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Slip Surface Grid

Upper Left: [\(246.9755, 226.94565\) ft](#)

Lower Left: [\(246.9755, 53.57301\) ft](#)

Lower Right: [\(601.0543, 53.57301\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(600.8933, 29.30808\) ft](#)

Upper Right Coordinate: [\(627.8293, 29.30808\) ft](#)

Lower Left Coordinate: [\(600.8933, -97.01541\) ft](#)

Lower Right Coordinate: [\(627.8293, -97.01541\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -52.4\) ft](#)

Right Coordinate: [\(1,000, 33\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16

Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	674.92	32.7
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52
Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5

Point 55	36	-51.6
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Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,6,1	15,337
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2 (U)	22,24,25,21,7,23,3	26,362
Region 4		17,26,27,29,28	595.28
Region 5		29,30,31,28	676.69
Region 6		30,32,16,31	1,992.6
Region 7	Lean Clay (U)	33,16,31,28,17,47,34,46,45,44	19,642
Region 8	Fat Clay1 (U)	43,35,33,44	12,327
Region 9	Fat Clay 2 (U)	36,49,38,37,39,1,6,13,18,35,43,42,41	18,953
Region 10	Sediment (U)	37,50,51,52,53,54,55,40,19,39	383

Current Slip Surface

Slip Surface: 15,450
 F of S: 1.34
 Volume: 3,178.481 ft³
 Weight: 397,310.12 lbs
 Resisting Moment: 18,258,394 lbs-ft
 Activating Moment: 13,588,826 lbs-ft
 Resisting Force: 87,403.059 lbs
 Activating Force: 65,057.881 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (450.57456, 2.024852) ft
 Entry: (625.38067, 33.414953) ft
 Radius: 198.33362 ft
 Center: (506.63329, 192.27112) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	451.45601	1.7695465	-26.737534	178.3438	0	500
Slice 2	455.18434	0.74947682	82.795912	462.86256	0	500
Slice 3	460.87809	-0.69034171	243.04827	885.47344	0	500
Slice 4	466.57185	-1.9526056	392.7327	1,287.7718	0	500
Slice 5	472.26561	-3.0407607	532.0543	1,668.1182	0	500
Slice 6	477.95936	-3.957706	661.18563	2,025.0344	0	500
Slice 7	483.65312	-4.7058348	780.26912	2,357.2785	0	500
Slice 8	489.68967	-5.3114925	895.36143	2,573.4009	0	500
Slice 9	496.06901	-5.7551834	1,005.3022	2,669.8636	0	500
Slice 10	502.44835	-5.9926727	1,102.97	2,734.4815	0	500
Slice 11	506.63329	-6.06	1,161.7758	2,762.9701	0	500
Slice 12	509.81428	-6.0249375	1,201.3415	2,772.2037	0	500
Slice						

13	515.12913	-5.855695	1,260.8624	2,809.6178	0	500
Slice 14	521.3874	-5.4880616	1,320.9283	2,860.6238	0	500
Slice 15	527.64566	-4.9211745	1,369.1349	2,884.029	0	500
Slice 16	532.3874	-4.3765455	1,466.5106	2,892.0295	0	500
Slice 17	535.35	-3.9677971	1,481.6753	2,905.1373	0	500
Slice 18	539.72143	-3.2589496	1,428.3234	2,941.0913	0	500
Slice 19	545.76429	-2.1395015	1,440.8213	2,981.7604	0	500
Slice 20	551.80714	-0.82449824	1,441.6798	2,999.8243	0	500
Slice 21	557.85	0.69009135	1,430.6592	2,996.0154	0	500
Slice 22	563.89286	2.409049	1,407.4747	2,970.821	0	500
Slice 23	569.93571	4.3379893	1,371.7922	2,924.4169	0	500
Slice 24	575.97857	6.4834606	1,323.2219	2,856.6017	0	500
Slice 25	581.5	8.6304104	1,267.736	2,742.5537	0	500
Slice 26	586.5	10.749573	1,207.0761	2,584.4625	0	500
Slice 27	591.51672	13.041458	1,136.355	2,351.1594	0	500
Slice 28	596.55016	15.513641	1,055.1215	2,040.1841	0	500
Slice 29	599.53344	17.041254	1,051.8209	1,854.751	0	500
Slice 30	602.825	18.855602	945.01045	1,635.2782	0	500
Slice 31	608.475	22.1134	741.72387	1,227.3145	0	500
Slice 32	614.125	25.626425	522.51106	781.02969	0	500
Slice 33	619.775	29.411229	286.33933	290.36793	0	500
Slice 34	623.99034	32.39438	100.19068	-104.62006	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

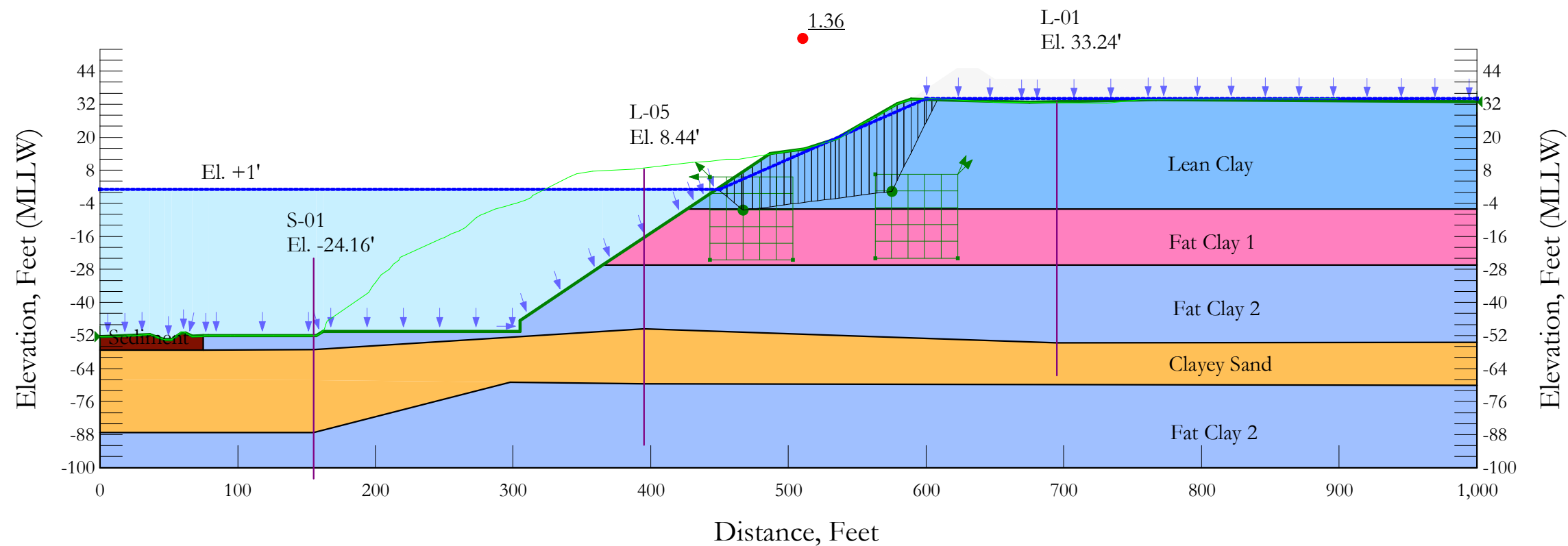
Station Analyzed: 64+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Lean Clay (U)	125			500
Pink	Fat Clay1 (U)	125			1,000
Blue	Fat Clay 2 (U)	125			2,200
Dark Red	Sediment (U)	90			50



Short Term - Block 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 153

Date: 4/25/2018

Time: 5:15:34 PM

Tool Version: 8.16.1.13452

File Name: 64+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:17:02 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: [\(0, -52.4\) ft](#)

Right Coordinate: [\(1,000, 33\) ft](#)

Slip Surface Block

Left Grid

Upper Left: [\(443.0048, 5.52893\) ft](#)

Lower Left: [\(443.0048, -24.49958\) ft](#)

Lower Right: [\(503.0619, -24.49958\) ft](#)

X Increments: 5

Y Increments: 5

Starting Angle: [135 °](#)

Ending Angle: [180 °](#)

Angle Increments: 2

Right Grid

Upper Left: [\(563.0034, 6.45178\) ft](#)

Lower Left: [\(563.0034, -23.99346\) ft](#)

Lower Right: [\(623.0497, -23.99346\) ft](#)

X Increments: 5

Y Increments: 5

Starting Angle: [45 °](#)

Ending Angle: [65 °](#)

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16

Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	674.92	32.7
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52
Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5

Point 55	36	-51.6
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Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,6,1	15,337
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2 (U)	22,24,25,21,7,23,3	26,362
Region 4		17,26,27,29,28	595.28
Region 5		29,30,31,28	676.69
Region 6		30,32,16,31	1,992.6
Region 7	Lean Clay (U)	33,16,31,28,17,47,34,46,45,44	19,642
Region 8	Fat Clay1 (U)	43,35,33,44	12,327
Region 9	Fat Clay 2 (U)	36,49,38,37,39,1,6,13,18,35,43,42,41	18,953
Region 10	Sediment (U)	37,50,51,52,53,54,55,40,19,39	383

Current Slip Surface

Slip Surface: 6,664
 F of S: 1.36
 Volume: 3,009.8699 ft³
 Weight: 376,233.73 lbs
 Resisting Moment: 4,815,729.2 lbs-ft
 Activating Moment: 3,554,545.9 lbs-ft
 Resisting Force: 83,842.488 lbs
 Activating Force: 61,693.652 lbs
 F of S Rank (Analysis): 1 of 11,664 slip surfaces
 F of S Rank (Query): 1 of 11,664 slip surfaces
 Exit: (448.31084, 1.2702793) ft
 Entry: (608.31123, 33.6613) ft
 Radius: 71.745141 ft
 Center: (523.39302, 41.759055) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	448.63709	1.1351396	-8.4327138	184.31568	0	500
Slice 2	449.48167	0.78530271	13.397111	266.00913	0	500
Slice 3	452.66795	-0.53449548	126.26682	577.26398	0	500
Slice 4	458.00385	-2.7446973	327.68595	1,106.8916	0	500
Slice 5	463.33975	-4.9548991	529.10508	1,647.457	0	500
Slice 6	466.51767	-6.271237	649.065	2,154.4807	0	1,000
Slice 7	470.35996	-6.271237	699.37691	1,914.949	0	1,000
Slice 8	476.89421	-5.8570287	760.28458	2,139.7922	0	500
Slice 9	483.29807	-5.451086	819.97681	2,357.1462	0	500
Slice 10	489.05	-5.0864693	873.59222	2,465.6258	0	500
Slice 11	494.15	-4.7631787	921.13082	2,466.1591	0	500
Slice 12	499.25	-4.439888	968.66941	2,465.3136	0	500
Slice						

13	504.35	-4.1165973	1,016.208	2,463.0757	0	500
Slice 14	509.45	-3.7933066	1,063.7466	2,459.4507	0	500
Slice 15	514.34685	-3.4828937	1,109.3916	2,483.1374	0	500
Slice 16	519.04055	-3.1853585	1,153.1429	2,534.2892	0	500
Slice 17	523.73425	-2.8878234	1,196.8943	2,584.361	0	500
Slice 18	528.42795	-2.5902882	1,240.6456	2,633.4446	0	500
Slice 19	532.3874	-2.3392973	1,339.3864	2,679.8895	0	500
Slice 20	535.35	-2.1514971	1,368.3382	2,730.5462	0	500
Slice 21	539.43662	-1.892445	1,343.2607	2,827.6517	0	500
Slice 22	544.90986	-1.5454947	1,394.2783	2,964.9528	0	500
Slice 23	550.38309	-1.1985444	1,445.2959	3,101.8222	0	500
Slice 24	555.85633	-0.85159407	1,496.3136	3,238.5492	0	500
Slice 25	561.32957	-0.50464376	1,547.3312	3,375.4267	0	500
Slice 26	566.8028	-0.15769346	1,598.3489	3,512.7469	0	500
Slice 27	572.27604	0.18925685	1,649.3665	3,650.796	0	500
Slice 28	577.00633	2.356402	1,582.3192	2,934.9881	0	500
Slice 29	581.5	6.850072	1,373.7004	2,589.029	0	500
Slice 30	586.5	11.850072	1,141.5753	2,165.1598	0	500
Slice 31	591.51672	16.866793	908.67385	1,668.3412	0	500
Slice 32	596.55016	21.900235	674.99617	1,091.2719	0	500
Slice 33	599.53344	24.883514	562.46382	744.20154	0	500
Slice 34	602.07781	27.427879	410.10035	441.16353	0	500
Slice 35	606.23342	31.583493	150.79005	-79.87284	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation

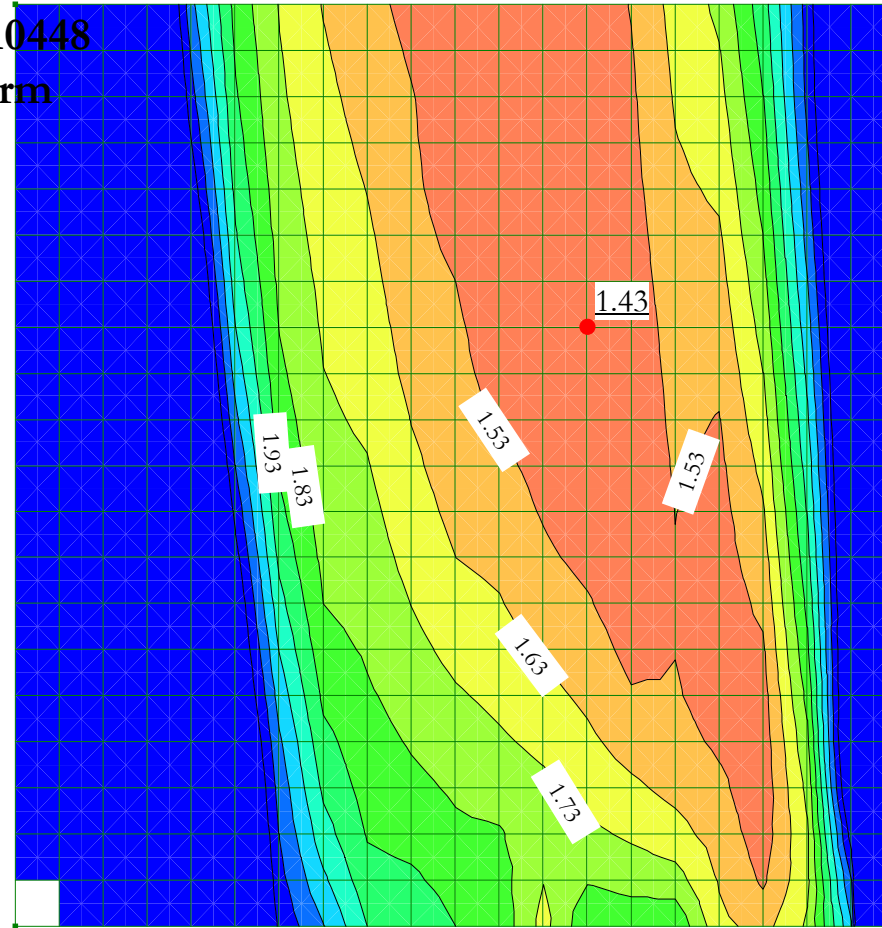
Location: Barbours Cut Ship Channel

Station Analyzed: 64+00

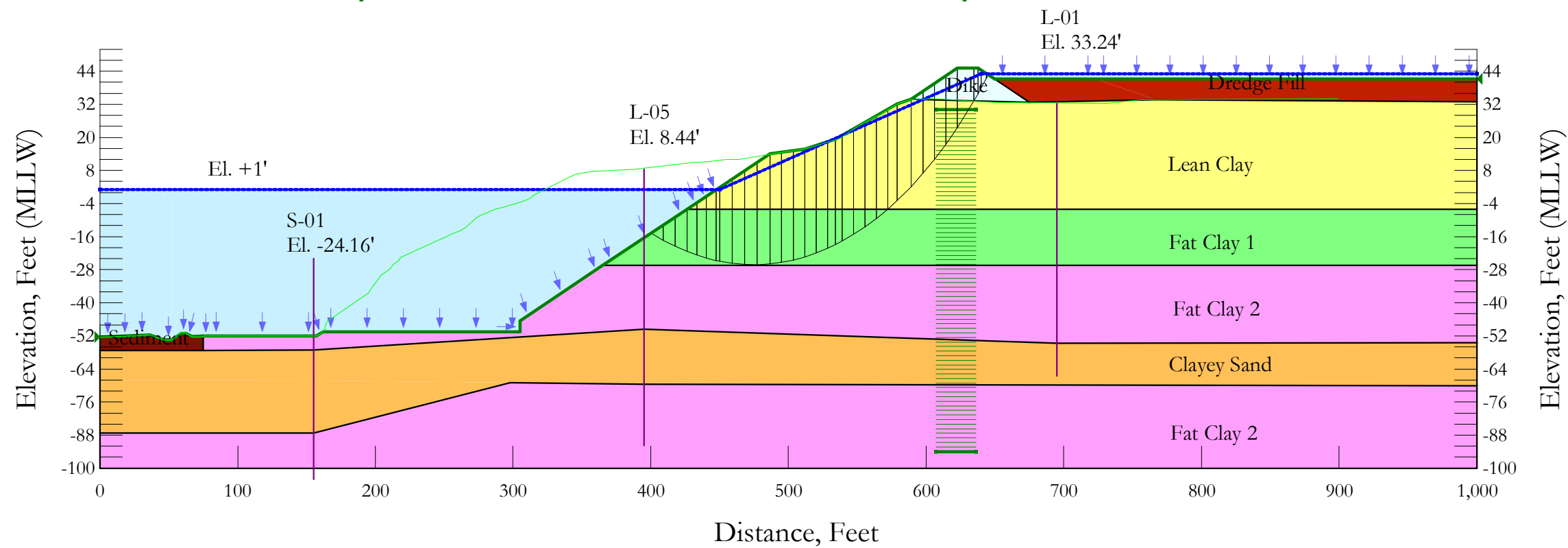
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Lean Clay	125	100	25
Light Green	Fat Clay 1	125	400	18
Orange	Clayey Sand	120	0	30
Dark Red	Dredge Fill	90	16	15
Light Blue	Dike	125	100	25
Pink	Fat Clay 2	125	300	22
Dark Brown	Sediment	90	16	15



Long Term 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 153

Date: 4/25/2018

Time: 5:15:34 PM

Tool Version: 8.16.1.13452

File Name: 64+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:15:58 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 400 psf

Phi': 18 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dike

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 300 psf
Phi': 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (189.9206, 299.45421) ft
Lower Left: (189.9206, 70.01303) ft
Lower Right: (627.8489, 70.01303) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (607, 30) ft
Upper Right Coordinate: (636, 30) ft
Lower Left Coordinate: (607, -94) ft
Lower Right Coordinate: (636, -94) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No

Slip Surface Limits

Left Coordinate: (0, -52.4) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	640	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16
Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	674.92	32.7
Point 29	649.6	41.14

Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52
Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5
Point 55	36	-51.6

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,6,1	15,337
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2	22,24,25,21,7,23,3	26,362
Region 4	Dike	17,26,27,29,28	595.28
Region 5	Dredge Fill	29,30,31,28	676.69
Region 6	Dredge Fill	30,32,16,31	1,992.6
Region 7	Lean Clay	33,16,31,28,17,47,34,46,45,44	19,642
Region 8	Fat Clay 1	43,35,33,44	12,327
Region 9	Fat Clay 2	36,49,38,37,39,1,6,13,18,35,43,42,41	18,953
Region 10	Sediment	37,50,51,52,53,54,55,40,19,39	383

Current Slip Surface

Slip Surface: 21,771
 F of S: 1.43
 Volume: 7,014.9405 ft³
 Weight: 876,867.57 lbs
 Resisting Moment: 61,178,049 lbs-ft
 Activating Moment: 42,656,933 lbs-ft
 Resisting Force: 236,242.44 lbs
 Activating Force: 164,880.69 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (400.34888, -14.717041) ft

Entry: (645.03075, 42.663083) ft

Radius: 245.36313 ft

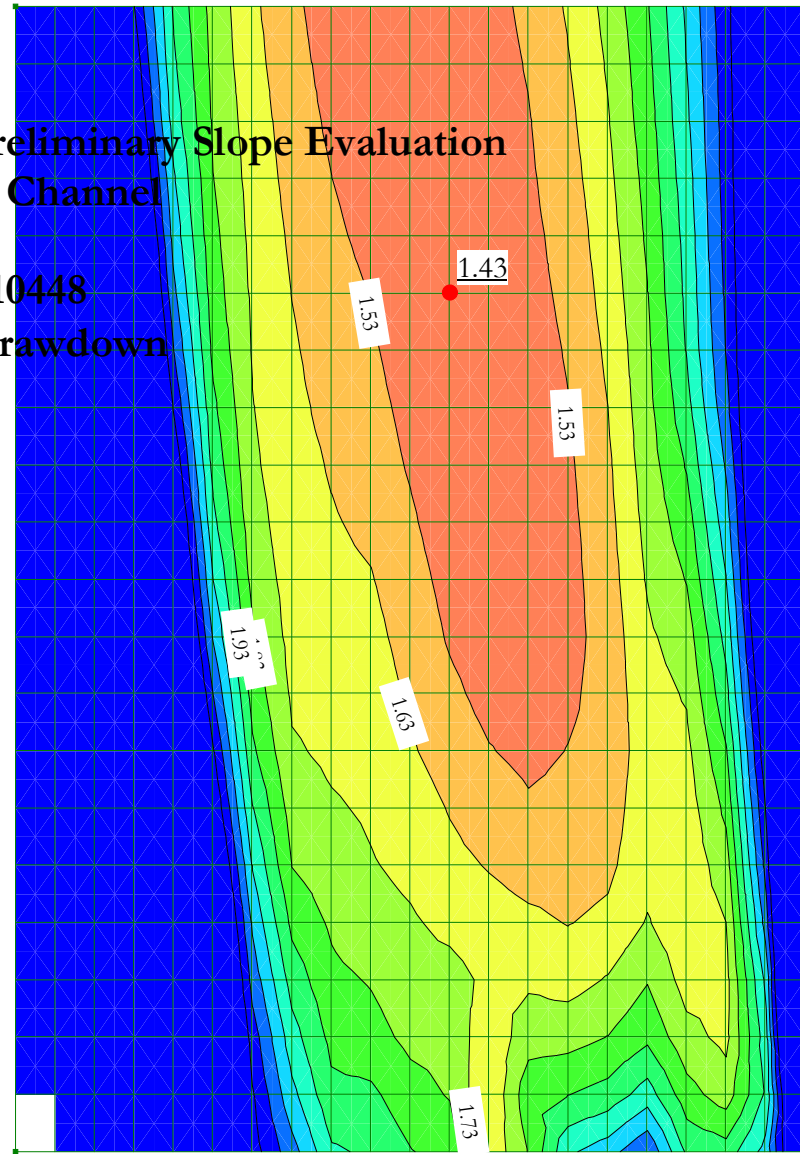
Center: (474.57399, 219.1498) ft

Slip Slices

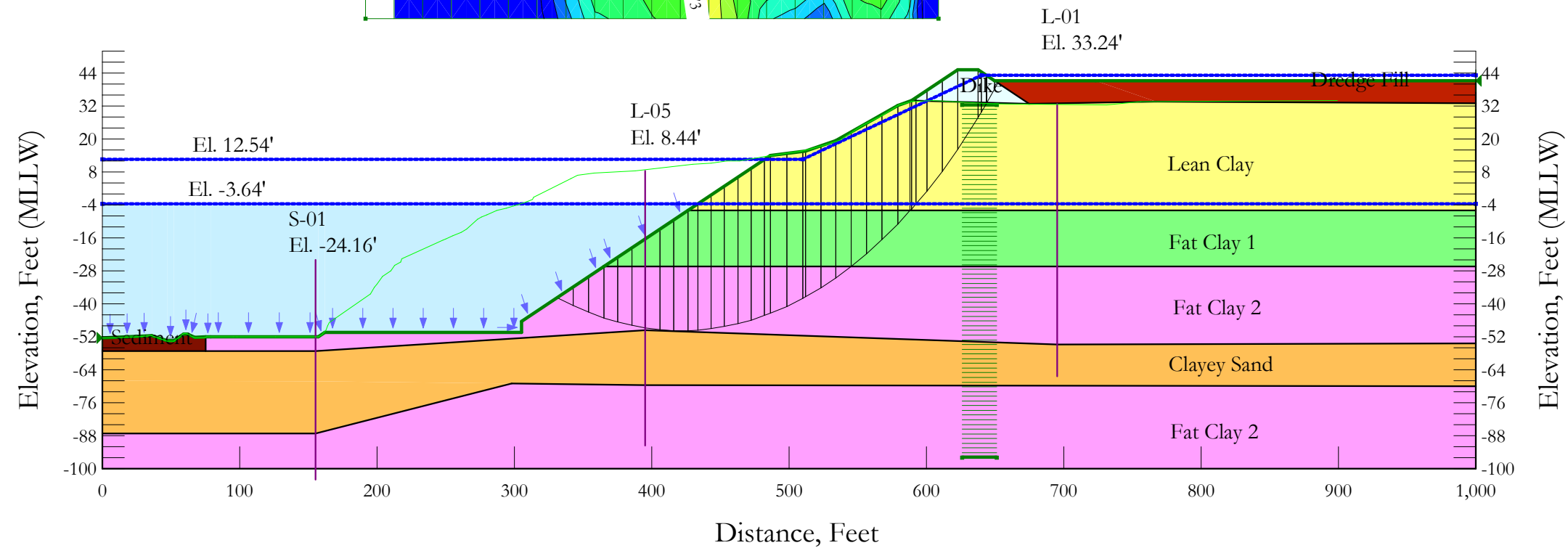
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	404.6774	-16.003642	1,061.0273	1,362.6291	97.996362	400
Slice 2	413.33444	-18.406094	1,210.9403	1,914.0244	228.44586	400
Slice 3	421.99148	-20.471793	1,339.8399	2,418.0343	350.32661	400
Slice 4	429.85	-22.076115	1,439.9496	2,831.7564	452.22544	400
Slice 5	436.91	-23.279012	1,515.0104	3,161.8015	535.07488	400
Slice 6	443.97	-24.271244	1,576.9256	3,451.9926	609.2462	400
Slice 7	448.75	-24.847348	1,612.8745	3,657.7837	664.43126	400
Slice 8	454.5625	-25.353066	1,627.5163	3,974.9105	762.71462	400
Slice 9	463.6875	-25.929155	1,782.1449	4,417.166	856.17025	400
Slice 10	472.8125	-26.164584	1,916.513	4,790.0818	933.67911	400
Slice 11	481.9375	-26.060336	2,030.679	5,094.2368	995.41028	400
Slice 12	490.75	-25.642485	2,122.0714	5,180.7659	993.8301	400
Slice 13	499.25	-24.931979	2,191.9363	5,064.1066	933.22471	400
Slice 14	507.75	-23.922249	2,244.005	4,905.6567	864.82306	400
Slice 15	516.06634	-22.644391	2,277.7043	4,763.6462	807.73149	400
Slice 16	524.19901	-21.106698	2,293.5273	4,641.2293	762.81463	400
Slice 17	531.13267	-19.587504	2,407.5091	4,525.457	688.16298	400
Slice 18	536.5457	-18.243655	2,398.5674	4,449.2749	666.31527	400
Slice 19	543.19971	-16.382083	2,263.168	4,373.6265	685.72952	400
Slice 20	551.41632	-13.83005	2,219.771	4,271.1381	666.52957	400
Slice 21	559.63292	-10.956395	2,157.2457	4,141.3015	644.65879	400
Slice 22	567.84953	-7.7488787	2,074.8641	3,984.6461	620.5258	400
Slice 23	575.47892	-4.471176	1,980.5624	3,822.6982	859.00205	100
Slice 24	584	-0.3901863	1,850.2477	3,545.5287	790.5225	100
Slice 25	593.46882	4.5781674	1,679.6591	3,235.5131	725.50665	100
Slice 26	602.04803	9.5542577	1,496.8757	2,989.9955	696.25319	100
Slice 27	610.26882	14.783371	1,294.316	2,713.0228	661.55384	100
Slice						

28	618.48961	20.490289	1,063.3391	2,389.7834	618.53112	100
Slice 29	628.67352	28.373886	728.80065	1,704.8977	455.16155	100
Slice 30	636.17352	34.528382	461.69657	1,066.3934	281.97478	100
Slice 31	638.8	36.858063	357.7856	783.83472	198.66997	100
Slice 32	641.8	39.615739	219.91389	394.1685	81.256261	100
Slice 33	644.31538	41.977711	72.52683	65.699997	-3.1834044	100

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Lean Clay	125	100	25	150	20	2
Light Green	Fat Clay 1	125	400	18	500	14	2
Orange	Clayey Sand	120	0	30	0	30	2
Dark Red	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Pink	Fat Clay 2	125	300	22	500	15	2
Dark Brown	Sediment	90	16	15	50	0	2



RDD 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 153

Date: 4/25/2018

Time: 5:15:34 PM

Tool Version: 8.16.1.13452

File Name: 64+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\

Last Solved Date: 4/25/2018

Last Solved Time: 5:16:56 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

RDD 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 20 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 400 psf

Phi': 18 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (191.7483, 366.48988) ft

Lower Left: (191.7483, 63.70715) ft

Lower Right: (608.9357, 63.70715) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0°

Right Projection Angle: 0°

Slip Surface Radius

Upper Left Coordinate: (625.9097, 32.48158) ft

Upper Right Coordinate: (651.0697, 32.48158) ft

Lower Left Coordinate: (625.9097, -96.0427) ft

Lower Right Coordinate: (651.0697, -96.0427) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135°

Right Projection: No

Right Projection Angle: 45°

Slip Surface Limits

Left Coordinate: (0, -52.4) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	510	12.54
Coordinate 3	640	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64
Coordinate 2	1,000	-3.64

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16
Point 3	155	-87.16

Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	674.92	32.7
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52
Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5
Point 55	36	-51.6

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,6,1	15,337
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2	22,24,25,21,7,23,3	26,362
Region 4	Dike	17,26,27,29,28	595.28
Region 5	Dredge Fill	29,30,31,28	676.69
Region 6	Dredge Fill	30,32,16,31	1,992.6
Region 7	Lean Clay	33,16,31,28,17,47,34,46,45,44	19,642
Region 8	Fat Clay 1	43,35,33,44	12,327
Region 9	Fat Clay 2	36,49,38,37,39,1,6,13,18,35,43,42,41	18,953
Region 10	Sediment	37,50,51,52,53,54,55,40,19,39	383

Current Slip Surface

Slip Surface: 24,825

F of S: 1.43

Volume: 12,105.902 ft³

Weight: 1,513,192.6 lbs

Resisting Moment: 1.4352383e+008 lbs-ft

Activating Moment: 1.002606e+008 lbs-ft

Resisting Force: 398,835.9 lbs

Activating Force: 278,747.91 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (331.36502, -37.711661) ft

Entry: (652.84647, 41.14) ft

Radius: 340.56816 ft

Center: (421.20137, 290.7942) ft

Slip Slices

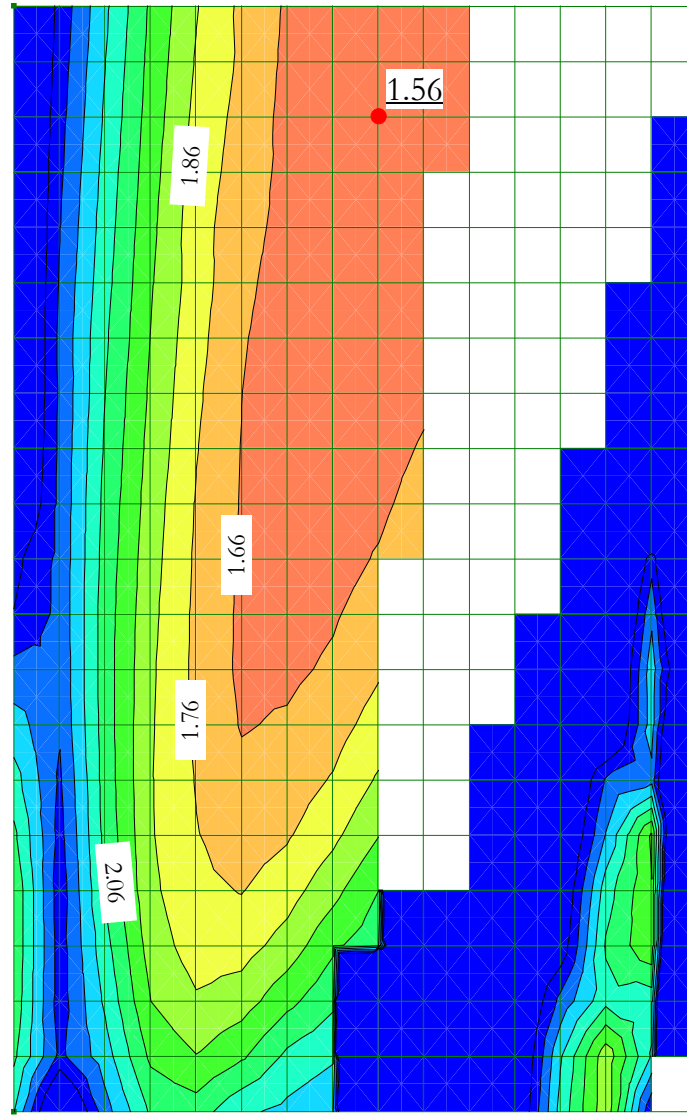
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	336.99085	-39.147533	2,215.6701	2,539.6255	130.88647	300
Slice 2	348.24251	-41.81744	2,382.2722	3,213.3728	335.78644	300
Slice 3	359.49417	-44.088119	2,523.9626	3,826.517	526.26614	300
Slice 4	370.22	-45.897001	2,636.8368	4,350.1398	692.21936	300
Slice 5	380.42	-47.284434	2,723.4127	4,786.6618	833.60674	300
Slice 6	390.62	-48.359496	2,790.4965	5,161.523	957.95689	300
Slice 7	400.82	-49.125154	2,838.2736	5,473.0792	1,064.5306	300
Slice 8	411.02	-49.583498	2,866.8743	5,720.9134	1,153.1067	300
Slice 9	421.22	-49.73577	2,876.3761	5,905.8249	1,223.9768	300
Slice 10	429.95	-49.642207	2,870.5377	6,018.2775	1,271.7694	300
Slice 11	438.434	-49.302971	2,849.3694	6,192.7186	1,350.8007	300
Slice 12	448.142	-48.671798	2,809.9842	6,430.3411	0	1,655.0854
Slice 13	457.85	-47.76113	2,753.1585	6,621.3692	0	1,671.7941
Slice 14	467.558	-46.568702	2,678.751	6,766.4323	0	1,679.2753
Slice						

15	477.266	-45.091511	2,586.5743	6,868.6423	0	1,678.7929
Slice 16	484.31	-43.868324	2,510.2474	6,921.7724	0	1,691.7703
Slice 17	492.375	-42.199633	2,406.1211	6,760.8733	0	1,675.2334
Slice 18	504.125	-39.468803	2,235.7173	6,395.5662	0	1,610.2568
Slice 19	511	-37.720339	2,126.6132	6,167.6812	0	1,624.6788
Slice 20	517.5	-35.825403	2,008.3692	5,993.8418	0	1,572.6198
Slice 21	528.5	-32.377721	1,793.2338	5,702.2762	0	1,490.3244
Slice 22	539.52088	-28.505813	1,551.6267	5,454.3696	0	1,432.4712
Slice 23	550.70147	-24.13269	1,278.7439	5,254.8185	0	1,325.7649
Slice 24	562.02088	-19.234661	973.10687	5,007.0693	0	1,292.7891
Slice 25	573.34029	-13.837376	636.31624	4,719.5709	0	1,255.9667
Slice 26	583.56363	-8.5354043	305.47323	4,370.1546	0	1,201.8788
Slice 27	588.56363	-5.8137782	135.64376	4,166.2364	0	1,127.7973
Slice 28	590.67985	-4.6037782	60.139757	4,100.0921	0	1,116.5787
Slice 29	596.2932	-1.2819726	-147.14091	3,933.3959	0	1,094.0431
Slice 30	605.82002	4.6852829	-519.49765	3,620.565	0	1,050.2986
Slice 31	617.00667	12.226055	-990.04183	3,202.4498	0	989.07676
Slice 32	630.1	21.986068	-1,599.0666	2,371.1739	0	778.04909
Slice 33	638.8	28.811236	-2,024.9571	1,626.3664	0	554.25567
Slice 34	641.8	31.33836	-2,182.6497	1,269.2662	0	427.76001
Slice 35	643.76133	33.008069	-2,286.8395	1,023.9684	0	362.31812
Slice 36	646.76133	35.656945	-2,452.1294	612.42392	0	298.50304
Slice 37	650.79312	39.25556	-2,676.6829	146.12631	0	117.75411
Slice 38	652.41636	40.742292	-2,769.455	25.148754	0	16.436286

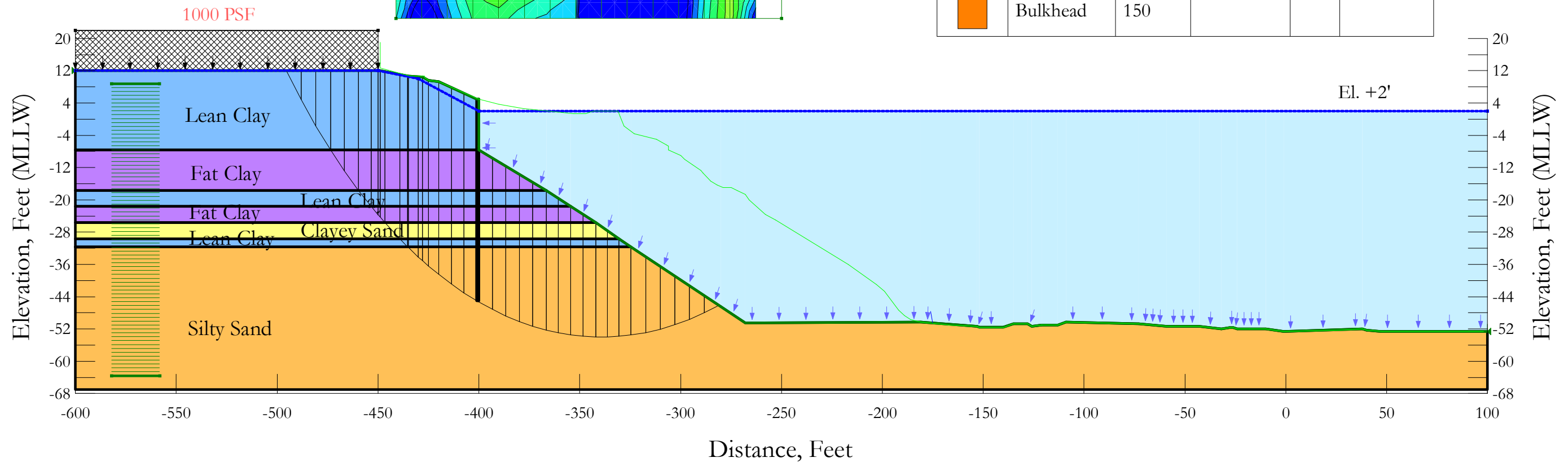
APPENDIX B

SLOPE STABILITY ANALYSIS: PROPOSED AT BAYPORT SHIP CHANNEL

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 40+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Clayey Sand	120	0	28	
Orange	Silty sand	120	0	31	
Light Blue	Lean Clay (Undrained)	123			532
Purple	Fat Clay (Undrained)	115			1,200
Dark Orange	Bulkhead	150			



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 174

Date: 4/26/2018

Time: 8:58:21 PM

Tool Version: 8.16.1.13452

File Name: 040+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\040+00\

Last Solved Date: 4/26/2018

Last Solved Time: 8:58:56 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 4 ft

Search Method: [Linear Search](#)

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (Undrained)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: 123 pcf

Cohesion: 532 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: [High Strength](#)

Unit Weight: 150 pcf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-441, 179.58357) ft

Lower Left: (-441, 25.00513) ft

Lower Right: (-250, 25.00513) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-581.95887, 8.73276) ft

Upper Right Coordinate: (-558.24914, 8.73276) ft

Lower Left Coordinate: (-581.95887, -63.64172) ft

Lower Right Coordinate: (-558.0587, -63.64172) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 12) ft

Right Coordinate: (100, -52.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12
Coordinate 2	-450	12
Coordinate 3	-430	10
Coordinate 4	-400	2
Coordinate 5	100	2

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-600	22
	-450	22

Points

	X (ft)	Y (ft)
Point 1	-600	-7.64333
Point 2	-600	-17.64333
Point 3	-600	-21.64333
Point 4	-600	-25.64333
Point 5	-600	-29.64333
Point 6	-600	-31.64333

Point 7	-175	-48.31
Point 8	-181	-50.31
Point 9	-268	-50.5
Point 10	-280	-46.5
Point 11	-400	-31.64333
Point 12	-400	-29.64333
Point 13	-400	-25.64333
Point 14	-400	-21.64333
Point 15	-400	-17.64333
Point 16	-400	-7.64333
Point 17	-350	8.85667
Point 18	-400	-6.64
Point 19	-400	5
Point 20	-401	5
Point 21	-401	-6.66667
Point 22	-401	-7.64333
Point 23	-401	-17.64333
Point 24	-401	-21.64333
Point 25	-401	-25.64333
Point 26	-401	-29.64333
Point 27	-401	-31.64333
Point 28	-400	-45
Point 29	-401	-45
Point 30	-449	12
Point 31	-435	10.66667
Point 32	-428	10.5
Point 33	-425	9.66667
Point 34	-420	9.33333
Point 35	-324.58	-31.64
Point 36	-330.58	-29.64
Point 37	-342	-25.64
Point 38	-354.58	-21.64
Point 39	-366.58	-17.64
Point 40	-600	12
Point 41	-153	-51.31
Point 42	-152	-51.6
Point 43	-140	-51.53857
Point 44	-135	-50.66667
Point 45	-128	-50.66667
Point 46	-126	-51.33333
Point 47	-121	-51
Point 48	-113	-51
Point 49	-109	-50.33333
Point 50	-73	-50.66667
Point 51	-59	-51.33333
Point 52	-43	-51.33333
Point 53	-32	-52
Point 54	-28	-51.66667
Point 55	-26	-51.66667
Point 56	-24	-52
Point 57	-10	-52
Point 58	-1	-52.66667
Point 59	38	-52
Point 60	40	-52.33333
Point 61	47	-52.66667
Point 62	100	-52.66667
Point 63	100	-67
Point 64	-600	-67

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (Undrained)	40,1,22,21,20,34,33,32,31,30	3,779.7
Region 2	Fat Clay (Undrained)	23,2,1,22	1,990
Region 3	Lean Clay (Undrained)	24,3,2,23	796
Region 4	Fat Clay (Undrained)	25,4,3,24	796
Region 5	Clayey Sand	26,5,4,25	796
Region 6	Lean Clay (Undrained)	27,6,5,26	398
Region 7	Bulkhead	19,20,21,22,23,24,25,26,27,29,28,11,12,13,14,15,16,18	50
Region 8	Fat Clay (Undrained)	39,15,16	167.1
Region 9	Lean Clay (Undrained)	15,39,38,14	157.7
Region 10	Fat Clay (Undrained)	14,38,37,13	206.86
Region 11	Clayey Sand	12,36,37,13	254.86
Region 12	Lean Clay (Undrained)	12,11,35,36	144.85
Region 13	Silty sand	6,27,29,28,11,35,10,9,8,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64	16,952

Current Slip Surface

Slip Surface: 22,562

F of S: 1.56

Volume: 6,081.2287 ft³

Weight: 731,458.23 lbs

Resisting Moment: 49,721,689 lbs-ft

Activating Moment: 31,850,021 lbs-ft

Resisting Force: 212,151.55 lbs

Activating Force: 136,069.06 lbs

F of S Rank (Analysis): 1 of 25,536 slip surfaces

F of S Rank (Query): 1 of 25,536 slip surfaces

Exit: (-281.10581, -46.131396) ft

Entry: (-495.44397, 12) ft

Radius: 218.11752 ft

Center: (-339.13333, 164.12573) ft

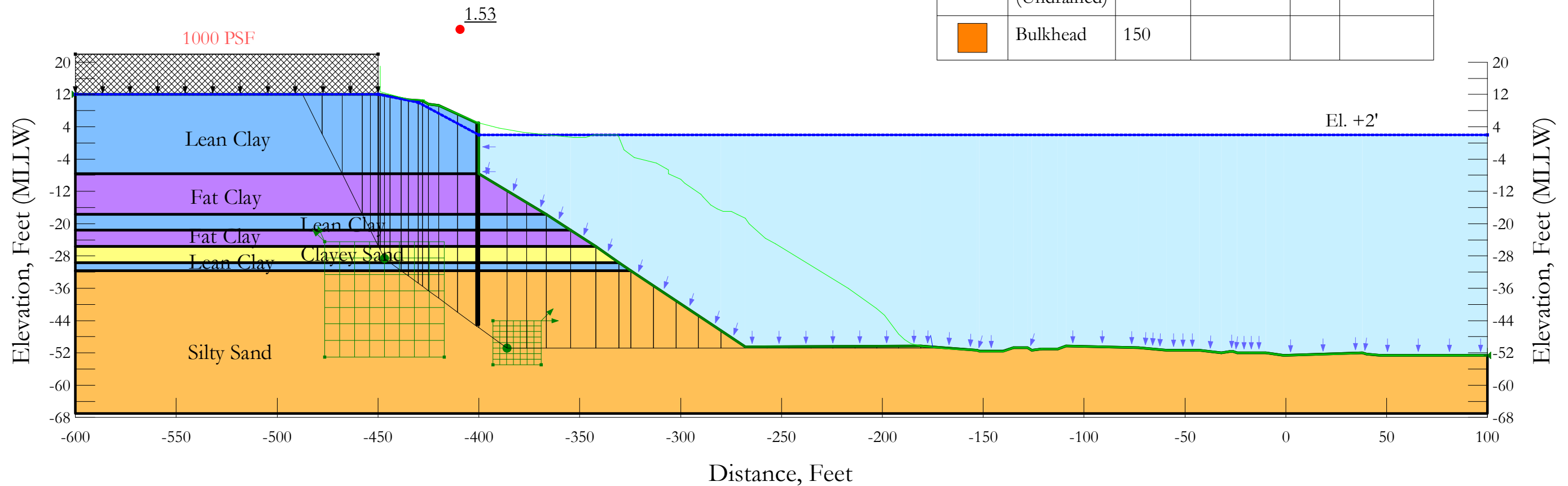
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-491.79671	8.4239166	223.1476	1,092.0389	0	532
Slice 2	-484.50219	1.5858783	649.8412	1,911.3492	0	532
Slice 3	-477.20768	-4.6597034	1,039.5655	2,631.3934	0	532
Slice 4	-470.09422	-10.246594	1,388.1875	2,964.108	0	1,200
Slice 5	-463.16181	-15.246594	1,700.1875	3,522.9293	0	1,200
Slice 6	-456.56582	-19.64333	1,974.5438	4,243.376	0	532
Slice 7	-451.71802	-22.678758	2,163.9545	4,375.4143	0	1,200
Slice 8	-449.5	-24.007507	2,221.5331	3,586.3595	0	1,200
Slice 9	-447.83226	-24.972079	2,270.8228	3,685.0651	0	1,200
Slice 10	-442.97088	-27.64333	2,405.8239	4,035.0878	866.29497	0
Slice 11	-437.29304	-30.64333	2,556.0915	4,406.4169	0	532

Slice 12	-435.15442	-31.71904	2,609.3383	4,396.6766	1,073.9412	0
Slice 13	-432.5	-32.978976	2,670.7803	4,536.6107	1,121.104	0
Slice 14	-429	-34.615383	2,583.6347	4,706.8232	1,275.7403	0
Slice 15	-426.5	-35.723307	2,609.3412	4,795.0497	1,313.3062	0
Slice 16	-422.5	-37.413178	2,645.6474	4,944.1853	1,381.1009	0
Slice 17	-416.83333	-39.654731	2,688.201	5,140.8601	1,473.7063	0
Slice 18	-410.5	-41.958769	2,724.0378	5,300.5685	1,548.1358	0
Slice 19	-404.16667	-44.04466	2,747.1661	5,445.3382	1,621.2253	0
Slice 20	-400.5	-45.180536	2,756.3764	7,378.0815	2,777.0006	0
Slice 21	-396.658	-46.240999	3,010.2384	4,823.1897	1,089.331	0
Slice 22	-389.974	-47.956018	3,117.2555	5,005.2603	1,134.4277	0
Slice 23	-383.29	-49.448132	3,210.3634	5,165.8101	1,174.9509	0
Slice 24	-376.606	-50.72199	3,289.8522	5,302.5785	1,209.368	0
Slice 25	-369.922	-51.781459	3,355.963	5,412.9873	1,235.9849	0
Slice 26	-363.58	-52.596438	3,406.8177	5,485.5642	1,249.0369	0
Slice 27	-357.58	-53.189497	3,443.8246	5,506.2558	1,239.2337	0
Slice 28	-351.435	-53.621827	3,470.802	5,504.897	1,222.2076	0
Slice 29	-345.145	-53.886227	3,487.3006	5,485.5407	1,200.6638	0
Slice 30	-339.145	-53.973103	3,492.7216	5,432.7398	1,165.6805	0
Slice 31	-333.435	-53.898637	3,488.075	5,332.016	1,107.9516	0
Slice 32	-327.58	-53.664874	3,473.4882	5,191.3941	1,032.222	0
Slice 33	-320.95715	-53.202735	3,444.6507	4,999.3309	934.1461	0
Slice 34	-313.71145	-52.474534	3,399.2109	4,744.8405	808.53581	0
Slice 35	-306.46576	-51.500463	3,338.4289	4,439.4004	661.53042	0
Slice 36	-299.22006	-50.277168	3,262.0953	4,084.6372	494.23306	0
Slice 37	-291.97436	-48.800348	3,169.9417	3,682.9922	308.27184	0
Slice 38	-284.72866	-47.064677	3,061.6358	3,237.5283	105.68687	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 40+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Clayey Sand	120	0	28	
Orange	Silty sand	120	0	31	
Blue	Lean Clay (Undrained)	123			532
Purple	Fat Clay (Undrained)	115			1,200
Dark Orange	Bulkhead	150			



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 174

Date: 4/26/2018

Time: 8:58:21 PM

Tool Version: 8.16.1.13452

File Name: 040+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\040+00\

Last Solved Date: 4/26/2018

Last Solved Time: 8:59:22 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 4 ft

Search Method: [Linear Search](#)

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (Undrained)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: 123 pcf

Cohesion: 532 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: [High Strength](#)

Unit Weight: 150 pcf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-600, 12) ft

Right Coordinate: (100, -52.66667) ft

Slip Surface Block

Left Grid

Upper Left: (-476.5184, -24.49092) ft
Lower Left: (-476.5184, -53.01372) ft
Lower Right: (-417.23972, -53.01372) ft
X Increments: 8
Y Increments: 7
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2

Right Grid

Upper Left: (-392.98134, -43.99251) ft
Lower Left: (-392.98134, -54.97868) ft
Lower Right: (-369.06866, -54.97868) ft
X Increments: 7
Y Increments: 8
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12
Coordinate 2	-450	12
Coordinate 3	-430	10
Coordinate 4	-400	2
Coordinate 5	100	2

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-600	22
	-450	22

Points

	X (ft)	Y (ft)
Point 1	-600	-7.64333
Point 2	-600	-17.64333
Point 3	-600	-21.64333
Point 4	-600	-25.64333
Point 5	-600	-29.64333
Point 6	-600	-31.64333

Point 7	-175	-48.31
Point 8	-181	-50.31
Point 9	-268	-50.5
Point 10	-280	-46.5
Point 11	-400	-31.64333
Point 12	-400	-29.64333
Point 13	-400	-25.64333
Point 14	-400	-21.64333
Point 15	-400	-17.64333
Point 16	-400	-7.64333
Point 17	-350	8.85667
Point 18	-400	-6.64
Point 19	-400	5
Point 20	-401	5
Point 21	-401	-6.66667
Point 22	-401	-7.64333
Point 23	-401	-17.64333
Point 24	-401	-21.64333
Point 25	-401	-25.64333
Point 26	-401	-29.64333
Point 27	-401	-31.64333
Point 28	-400	-45
Point 29	-401	-45
Point 30	-449	12
Point 31	-435	10.66667
Point 32	-428	10.5
Point 33	-425	9.66667
Point 34	-420	9.33333
Point 35	-324.58	-31.64
Point 36	-330.58	-29.64
Point 37	-342	-25.64
Point 38	-354.58	-21.64
Point 39	-366.58	-17.64
Point 40	-600	12
Point 41	-153	-51.31
Point 42	-152	-51.6
Point 43	-140	-51.53857
Point 44	-135	-50.66667
Point 45	-128	-50.66667
Point 46	-126	-51.33333
Point 47	-121	-51
Point 48	-113	-51
Point 49	-109	-50.33333
Point 50	-73	-50.66667
Point 51	-59	-51.33333
Point 52	-43	-51.33333
Point 53	-32	-52
Point 54	-28	-51.66667
Point 55	-26	-51.66667
Point 56	-24	-52
Point 57	-10	-52
Point 58	-1	-52.66667
Point 59	38	-52
Point 60	40	-52.33333
Point 61	47	-52.66667
Point 62	100	-52.66667
Point 63	100	-67
Point 64	-600	-67

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (Undrained)	40,1,22,21,20,34,33,32,31,30	3,779.7
Region 2	Fat Clay (Undrained)	23,2,1,22	1,990
Region 3	Lean Clay (Undrained)	24,3,2,23	796
Region 4	Fat Clay (Undrained)	25,4,3,24	796
Region 5	Clayey Sand	26,5,4,25	796
Region 6	Lean Clay (Undrained)	27,6,5,26	398
Region 7	Bulkhead	19,20,21,22,23,24,25,26,27,29,28,11,12,13,14,15,16,18	50
Region 8	Fat Clay (Undrained)	39,15,16	167.1
Region 9	Lean Clay (Undrained)	15,39,38,14	157.7
Region 10	Fat Clay (Undrained)	14,38,37,13	206.86
Region 11	Clayey Sand	12,36,37,13	254.86
Region 12	Lean Clay (Undrained)	12,11,35,36	144.85
Region 13	Silty sand	6,27,29,28,11,35,10,9,8,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64	16,952

Current Slip Surface

Slip Surface: 38,095

F of S: 1.53

Volume: 5,934.5707 ft³

Weight: 713,606.56 lbs

Resisting Moment: 21,293,595 lbs-ft

Activating Moment: 13,944,097 lbs-ft

Resisting Force: 203,736.15 lbs

Activating Force: 133,262.11 lbs

F of S Rank (Analysis): 1 of 46,656 slip surfaces

F of S Rank (Query): 1 of 46,656 slip surfaces

Exit: (-165.63175, -50.858866) ft

Entry: (-487.44467, 12) ft

Radius: 140.26332 ft

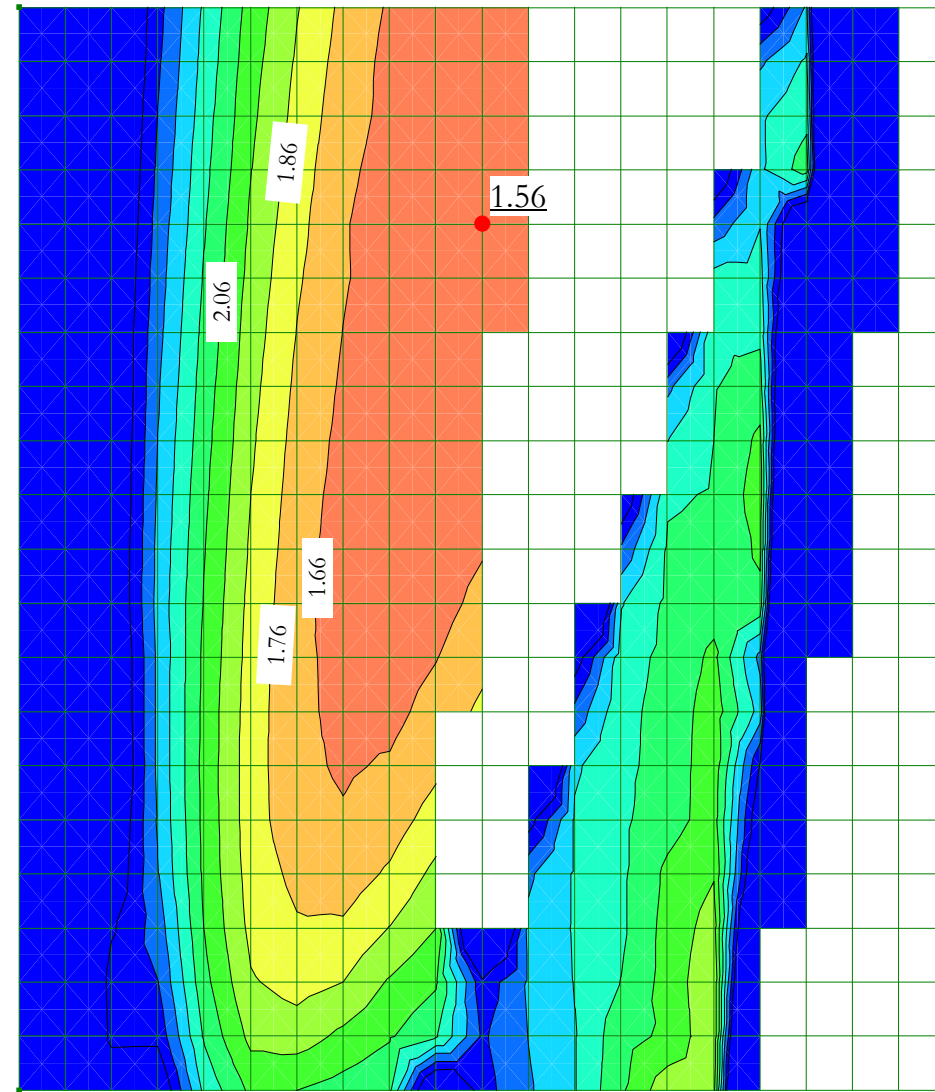
Center: (-317.32966, 27.714717) ft

Slip Slices

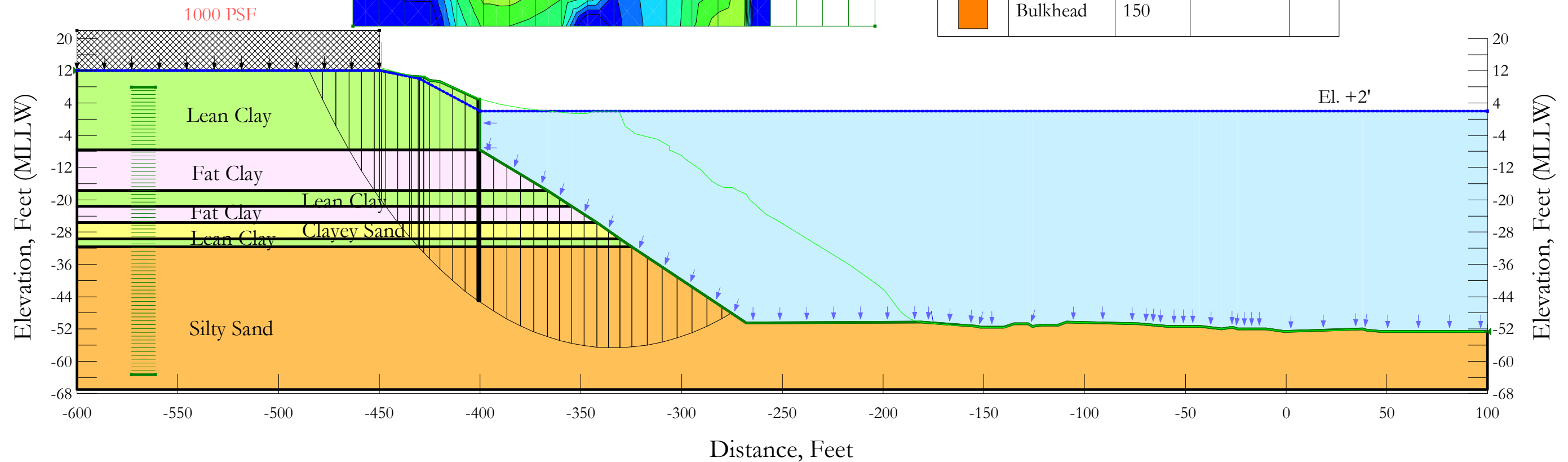
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-482.53383	7.0891675	306.43595	1,239.5722	0	532
Slice 2	-472.71217	-2.7324975	919.30784	2,374.3323	0	532
Slice 3	-462.80134	-12.64333	1,537.7438	3,032.0512	0	1,200
Slice 4	-455.80134	-19.64333	1,974.5438	4,140.7939	0	532
Slice 5	-451.90067	-23.543998	2,217.9455	4,146.9395	0	1,200
Slice 6	-449.90067	-25.543998	2,318.9363	3,405.1584	0	1,200
Slice 7	-449.40067	-26.043998	2,346.7383	3,723.223	731.88991	0
Slice 8	-447.93953	-27.505136	2,427.9833	3,847.5786	754.81219	0
Slice 9	-445.41113	-29.104468	2,511.1725	4,420.3108	1,015.1068	0
Slice 10	-441.21905	-30.64333	2,580.3472	4,630.0066	0	532
Slice 11	-436.74746	-32.284802	2,654.1344	4,642.0111	1,194.4368	0

Slice 12	-432.5	-33.843995	2,724.2231	4,780.3195	1,235.4274	0
Slice 13	-429	-35.128805	2,613.5453	4,890.2753	1,367.9974	0
Slice 14	-426.5	-36.046527	2,628.1711	4,936.8707	1,387.2067	0
Slice 15	-422.5	-37.514881	2,651.5723	5,024.9271	1,426.0554	0
Slice 16	-415.25	-40.176274	2,693.9871	5,165.1909	1,484.849	0
Slice 17	-405.75	-43.663616	2,749.565	5,294.7557	1,529.3049	0
Slice 18	-400.5	-45.590831	2,780.2791	7,071.895	2,578.663	0
Slice 19	-393.07457	-48.316621	3,139.7571	4,792.8386	993.2716	0
Slice 20	-381.25686	-50.858866	3,298.3933	5,497.1656	1,321.1557	0
Slice 21	-371.47229	-50.858866	3,298.3933	5,385.4928	1,254.0559	0
Slice 22	-360.58	-50.858866	3,298.3933	5,236.5943	1,164.5887	0
Slice 23	-348.29	-50.858866	3,298.3933	5,044.8581	1,049.3819	0
Slice 24	-336.29	-50.858866	3,298.3933	4,865.6546	941.70558	0
Slice 25	-327.58	-50.858866	3,298.3933	4,698.2405	841.11303	0
Slice 26	-319.0075	-50.858866	3,298.3933	4,539.3215	745.62487	0
Slice 27	-307.8625	-50.858866	3,298.3933	4,329.3202	619.44335	0
Slice 28	-296.7175	-50.858866	3,298.3933	4,110.4665	487.94278	0
Slice 29	-285.5725	-50.858866	3,298.3933	3,883.1452	351.35437	0
Slice 30	-274	-50.858866	3,298.3933	3,638.7588	204.51223	0
Slice 31	-262.5625	-50.858866	3,298.3933	3,322.6099	14.550821	0
Slice 32	-251.6875	-50.858866	3,298.3933	3,324.3625	15.603877	0
Slice 33	-240.8125	-50.858866	3,298.3933	3,326.0373	16.61018	0
Slice 34	-229.9375	-50.858866	3,298.3933	3,327.6284	17.566206	0
Slice 35	-219.0625	-50.858866	3,298.3933	3,329.1324	18.469932	0
Slice 36	-208.1875	-50.858866	3,298.3933	3,330.5485	19.320801	0
Slice 37	-197.3125	-50.858866	3,298.3933	3,331.878	20.11964	0
Slice 38	-186.4375	-50.858866	3,298.3933	3,333.1244	20.86854	0
Slice 39	-173.31587	-50.858866	3,298.3933	3,317.7485	11.629766	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 40+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Clayey Sand	120	0	28
Light Green	Lean Clay	123	200	23
Pink	Fat Clay	115	200	18
Orange	Silty sand	120	0	31
Dark Orange	Bulkhead	150		



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 174

Date: 4/26/2018

Time: 8:58:21 PM

Tool Version: 8.16.1.13452

File Name: 040+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\040+00\

Last Solved Date: 4/26/2018

Last Solved Time: 8:58:42 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 4 ft

Search Method: [Linear Search](#)

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

- Lambda 1: -1
- Lambda 2: -0.8
- Lambda 3: -0.6
- Lambda 4: -0.4
- Lambda 5: -0.2
- Lambda 6: 0
- Lambda 7: 0.2
- Lambda 8: 0.4
- Lambda 9: 0.6
- Lambda 10: 0.8
- Lambda 11: 1

Materials

Clayey Sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay

Model: [Mohr-Coulomb](#)

Unit Weight: 123 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay

Model: [Mohr-Coulomb](#)

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: [High Strength](#)

Unit Weight: 150 pcf

Pore Water Pressure

Slip Surface Grid

Upper Left: (-463.14431, 174.53862) ft

Lower Left: (-463.14431, 23.01022) ft

Lower Right: (-203.97755, 23.01022) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-573, 7.95197) ft

Upper Right Coordinate: (-561, 7.95197) ft

Lower Left Coordinate: (-573, -63.31921) ft

Lower Right Coordinate: (-561, -63.31921) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 12) ft

Right Coordinate: (100, -52.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12
Coordinate 2	-450	12
Coordinate 3	-430	10
Coordinate 4	-400	2
Coordinate 5	100	2

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-600	22
	-450	22

Points

	X (ft)	Y (ft)
Point 1	-600	-7.64333
Point 2	-600	-17.64333
Point 3	-600	-21.64333
Point 4	-600	-25.64333
Point 5	-600	-29.64333
Point 6	-600	-31.64333
Point 7	-175	-48.31
Point 8	-181	-50.31
Point 9	-268	-50.5
Point 10	-280	-46.5
Point 11	-400	-31.64333
Point 12	-400	-29.64333
Point 13	-400	-25.64333
Point 14	-400	-21.64333
Point 15	-400	-17.64333
Point 16	-400	-7.64333
Point 17	-350	8.85667
Point 18	-400	-6.64
Point 19	-400	5
Point 20	-401	5
Point 21	-401	-6.66667
Point 22	-401	-7.64333
Point 23	-401	-17.64333
Point 24	-401	-21.64333
Point 25	-401	-25.64333
Point 26	-401	-29.64333
Point 27	-401	-31.64333
Point 28	-400	-45
Point 29	-401	-45
Point 30	-449	12
Point 31	-435	10.66667
Point 32	-428	10.5
Point 33	-425	9.66667
Point 34	-420	9.33333
Point 35	-324.58	-31.64
Point 36	-330.58	-29.64
Point 37	-342	-25.64
Point 38	-354.58	-21.64
Point 39	-366.58	-17.64
Point 40	-600	12
Point 41	-153	-51.31
Point 42	-152	-51.6
Point 43	-140	-51.53857
Point 44	-135	-50.66667
Point 45	-128	-50.66667
Point 46	-126	-51.33333
Point 47	-121	-51
Point 48	-113	-51
Point 49	-109	-50.33333
Point 50	-73	-50.66667
Point 51	-59	-51.33333
Point 52	-43	-51.33333
Point 53	-32	-52
Point 54	-28	-51.66667
Point 55	-26	-51.66667
Point 56	-24	-52

Point 57	-10	-52
Point 58	-1	-52.66667
Point 59	38	-52
Point 60	40	-52.33333
Point 61	47	-52.66667
Point 62	100	-52.66667
Point 63	100	-67
Point 64	-600	-67

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	40,1,22,21,20,34,33,32,31,30	3,779.7
Region 2	Fat Clay	23,2,1,22	1,990
Region 3	Lean Clay	24,3,2,23	796
Region 4	Fat Clay	25,4,3,24	796
Region 5	Clayey Sand	26,5,4,25	796
Region 6	Lean Clay	27,6,5,26	398
Region 7	Bulkhead	19,20,21,22,23,24,25,26,27,29,28,11,12,13,14,15,16,18	50
Region 8	Fat Clay	39,15,16	167.1
Region 9	Lean Clay	15,39,38,14	157.7
Region 10	Fat Clay	14,38,37,13	206.86
Region 11	Clayey Sand	12,36,37,13	254.86
Region 12	Lean Clay	12,11,35,36	144.85
Region 13	Silty sand	6,27,29,28,11,35,10,9,8,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64	16,952

Current Slip Surface

Slip Surface: 26,365
 F of S: 1.56
 Volume: 5,979.2908 ft³
 Weight: 719,065.54 lbs
 Resisting Moment: 44,735,835 lbs-ft
 Activating Moment: 28,608,962 lbs-ft
 Resisting Force: 205,402.19 lbs
 Activating Force: 131,526.63 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-275.35148, -48.049507) ft
 Entry: (-484.80685, 12) ft
 Radius: 200.90017 ft
 Center: (-333.56093, 144.23294) ft

Slip Slices

				Base Normal Stress	Frictional Strength	

	X (ft)	Y (ft)	PWP (psf)	(psf)	(psf)	Cohesive Strength (psf)
Slice 1	-481.51728	8.4163902	223.61725	1,044.8265	348.58262	200
Slice 2	-474.93813	1.5727886	650.65799	1,788.9094	483.15907	200
Slice 3	-468.35898	-4.6652666	1,039.9126	2,459.1687	602.43846	200
Slice 4	-461.93803	-10.245608	1,388.1259	3,105.4996	558.00853	200
Slice 5	-455.67529	-15.245608	1,700.1259	3,608.246	619.98581	200
Slice 6	-451.27196	-18.563033	1,907.1333	3,883.3477	838.85325	200
Slice 7	-449.5	-19.83606	1,963.812	3,207.0373	527.71782	200
Slice 8	-447.95044	-20.916357	2,020.9816	3,312.6428	548.27767	200
Slice 9	-443.85676	-23.64333	2,164.1683	3,595.4969	465.06686	200
Slice 10	-437.90633	-27.410147	2,360.1274	3,901.5268	819.57659	0
Slice 11	-434.59925	-29.410147	2,463.2599	4,088.6098	864.21387	0
Slice 12	-432.42974	-30.64333	2,526.0449	4,216.984	717.76107	200
Slice 13	-430.33048	-31.824979	2,586.0801	4,323.562	1,043.9844	0
Slice 14	-429	-32.546505	2,463.1076	4,381.6376	1,152.7691	0
Slice 15	-426.5	-33.869127	2,501.3217	4,486.3528	1,192.727	0
Slice 16	-422.5	-35.886319	2,556.6968	4,660.5203	1,264.1047	0
Slice 17	-416.83333	-38.563334	2,624.6191	4,891.7859	1,362.2513	0
Slice 18	-410.5	-41.318959	2,686.7642	5,090.9866	1,444.6026	0
Slice 19	-404.16667	-43.820957	2,734.1338	5,274.9654	1,526.6856	0
Slice 20	-400.5	-45.186592	2,756.7293	7,170.2203	2,651.8929	0
Slice 21	-396.658	-46.469047	3,024.4685	4,727.9194	1,023.5366	0
Slice 22	-389.974	-48.552744	3,154.4912	4,951.86	1,079.9681	0
Slice 23	-383.29	-50.384636	3,268.8013	5,155.4321	1,133.6022	0
Slice 24	-376.606	-51.971787	3,367.8395	5,336.6376	1,182.9732	0
Slice 25	-369.922	-53.320103	3,451.9744	5,492.9454	1,226.3391	0
Slice 26	-363.58	-54.388633	3,518.6507	5,610.8655	1,257.1295	0
Slice 27	-357.58	-55.203349	3,569.489	5,675.303	1,265.3007	0
Slice 28	-351.435	-55.845613	3,609.5662	5,718.5274	1,267.1917	0
Slice 29	-345.145	-56.30824	3,638.4342	5,744.4933	1,265.4479	0
Slice 30	-339.145	-56.569302	3,654.7244	5,734.9308	1,249.9141	0
Slice 31	-333.435	-56.646906	3,659.567	5,673.2464	1,209.9406	0
Slice 32	-327.58	-56.555755	3,653.8791	5,569.6485	1,151.1104	0
Slice 33	-320.865	-56.231113	3,633.6214	5,413.3799	1,069.3868	0
Slice 34	-313.435	-55.621721	3,595.5954	5,188.3498	957.02342	0

Slice 35	-306.005	-54.733098	3,540.1453	4,902.4099	818.53113	0
Slice 36	-298.575	-53.561477	3,467.0361	4,556.4913	654.61073	0
Slice 37	-291.145	-52.101782	3,375.9512	4,152.781	466.76642	0
Slice 38	-283.715	-50.347521	3,266.4853	3,694.5273	257.19356	0
Slice 39	-277.67574	-48.722676	3,165.095	3,287.4544	73.520953	0

Project Name: HSC-ECIP Preliminary Slope Evaluation

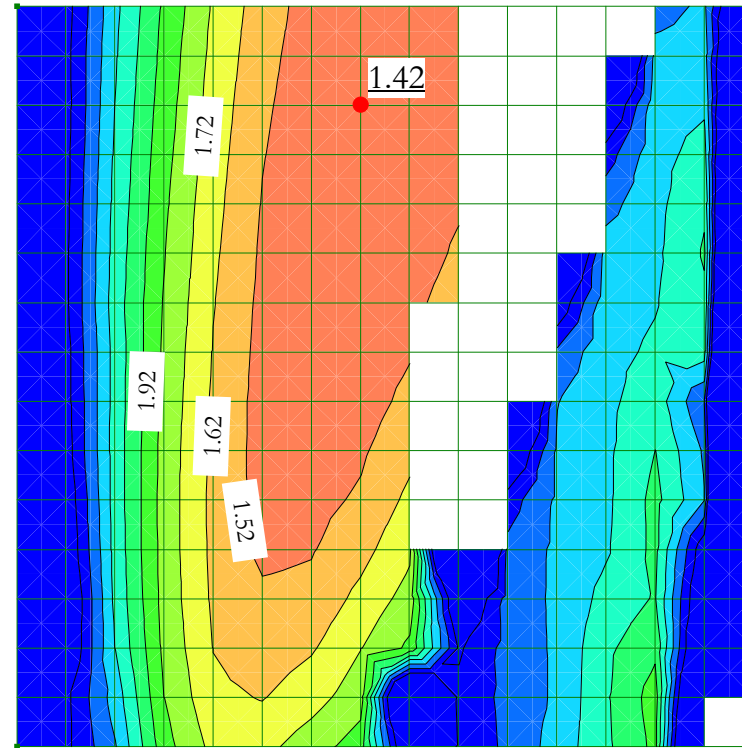
Location: Bayport Ship Channel

Station Analyzed: 40+00

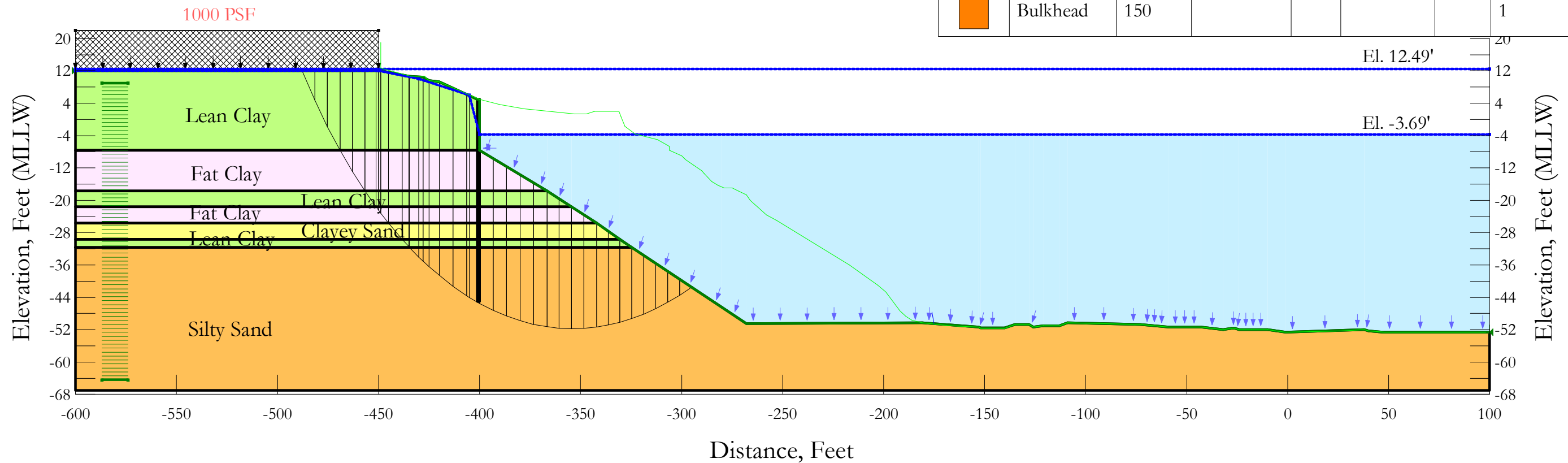
HVJ Project Number: HG1710448

Loading Condition: Rapid Drawdown

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Clayey Sand	120	0	28	0.1	27.9	1
Light Green	Lean Clay	123	200	23	300	19	1
Pink	Fat Clay	115	200	18	300	14	1
Light Orange	Silty sand	120	0	31	0.1	30.9	1
Dark Orange	Bulkhead	150					1



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 174

Date: 4/26/2018

Time: 8:58:21 PM

Tool Version: 8.16.1.13452

File Name: 040+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\040+00\

Last Solved Date: 4/26/2018

Last Solved Time: 8:58:52 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 4 ft

Search Method: [Linear Search](#)

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

- Lambda 1: -1
- Lambda 2: -0.8
- Lambda 3: -0.6
- Lambda 4: -0.4
- Lambda 5: -0.2
- Lambda 6: 0
- Lambda 7: 0.2
- Lambda 8: 0.4
- Lambda 9: 0.6
- Lambda 10: 0.8
- Lambda 11: 1

Materials

Clayey Sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 27.9 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Lean Clay

Model: [Mohr-Coulomb](#)

Unit Weight: 123 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Fat Clay

Model: [Mohr-Coulomb](#)

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Silty sand

Model: [Mohr-Coulomb](#)

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 30.9 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Bulkhead

Model: High Strength

Unit Weight: 150 pcf

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Slip Surface Grid

Upper Left: (-450, 134.5) ft

Lower Left: (-450, 31) ft

Lower Right: (-244, 31) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 15

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-587, 9) ft

Upper Right Coordinate: (-574, 9) ft

Lower Left Coordinate: (-587, -64.5) ft

Lower Right Coordinate: (-574, -64.5) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 12) ft

Right Coordinate: (100, -52.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12
Coordinate 2	-450	12
Coordinate 3	-430	10
Coordinate 4	-405	6
Coordinate 5	-400	-3.69
Coordinate 6	100	-3.69

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12.49
Coordinate 2	100	12.49

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-600	22
	-450	22

Points

	X (ft)	Y (ft)
Point 1	-600	-7.64333
Point 2	-600	-17.64333
Point 3	-600	-21.64333
Point 4	-600	-25.64333
Point 5	-600	-29.64333
Point 6	-600	-31.64333
Point 7	-175	-48.31
Point 8	-181	-50.31
Point 9	-268	-50.5
Point 10	-280	-46.5
Point 11	-400	-31.64333
Point 12	-400	-29.64333
Point 13	-400	-25.64333
Point 14	-400	-21.64333
Point 15	-400	-17.64333
Point 16	-400	-7.64333
Point 17	-350	8.85667
Point 18	-400	-6.64
Point 19	-400	5
Point 20	-401	5
Point 21	-401	-6.66667
Point 22	-401	-7.64333
Point 23	-401	-17.64333
Point 24	-401	-21.64333
Point 25	-401	-25.64333
Point 26	-401	-29.64333
Point 27	-401	-31.64333
Point 28	-400	-45
Point 29	-401	-45
Point 30	-449	12
Point 31	-435	10.66667
Point 32	-428	10.5
Point 33	-425	9.66667
Point 34	-420	9.33333
Point 35	-324.58	-31.64

Point 36	-330.58	-29.64
Point 37	-342	-25.64
Point 38	-354.58	-21.64
Point 39	-366.58	-17.64
Point 40	-600	12
Point 41	-153	-51.31
Point 42	-152	-51.6
Point 43	-140	-51.53857
Point 44	-135	-50.66667
Point 45	-128	-50.66667
Point 46	-126	-51.33333
Point 47	-121	-51
Point 48	-113	-51
Point 49	-109	-50.33333
Point 50	-73	-50.66667
Point 51	-59	-51.33333
Point 52	-43	-51.33333
Point 53	-32	-52
Point 54	-28	-51.66667
Point 55	-26	-51.66667
Point 56	-24	-52
Point 57	-10	-52
Point 58	-1	-52.66667
Point 59	38	-52
Point 60	40	-52.33333
Point 61	47	-52.66667
Point 62	100	-52.66667
Point 63	100	-67
Point 64	-600	-67

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	40,1,22,21,20,34,33,32,31,30	3,779.7
Region 2	Fat Clay	23,2,1,22	1,990
Region 3	Lean Clay	24,3,2,23	796
Region 4	Fat Clay	25,4,3,24	796
Region 5	Clayey Sand	26,5,4,25	796
Region 6	Lean Clay	27,6,5,26	398
Region 7	Bulkhead	19,20,21,22,23,24,25,26,27,29,28,11,12,13,14,15,16,18	50
Region 8	Fat Clay	39,15,16	167.1
Region 9	Lean Clay	15,39,38,14	157.7
Region 10	Fat Clay	14,38,37,13	206.86
Region 11	Clayey Sand	12,36,37,13	254.86
Region 12	Lean Clay	12,11,35,36	144.85

Region 13	Silty sand	6,27,29,28,11,35,10,9,8,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64	16,952
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Current Slip Surface

Slip Surface: 16,403
 F of S: 1.42
 Volume: 5,556.4256 ft³
 Weight: 668,309.17 lbs
 Resisting Moment: 36,138,982 lbs-ft
 Activating Moment: 25,401,374 lbs-ft
 Resisting Force: 193,287.62 lbs
 Activating Force: 136,013.74 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (-295.14032, -41.453225) ft
 Entry: (-487.75752, 12) ft
 Radius: 172.46 ft
 Center: (-353.86667, 120.7) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-484.64195	8.3727387	226.3411	997.46107	327.32101	200
Slice 2	-478.4108	1.4904799	655.79405	1,733.9996	457.67106	200
Slice 3	-472.17964	-4.7039238	1,042.3248	2,387.3785	570.94142	200
Slice 4	-466.00813	-10.260134	1,389.0324	3,022.2102	530.65163	200
Slice 5	-459.89626	-15.260134	1,701.0324	3,515.6425	589.60257	200
Slice 6	-454.03827	-19.64333	1,974.5438	3,901.2794	817.85075	200
Slice 7	-450.61811	-22.062226	2,125.4829	4,227.9072	683.11907	200
Slice 8	-449.5	-22.814306	2,147.8146	3,474.8375	431.17587	200
Slice 9	-447.05702	-24.39541	2,230.4053	3,616.8372	450.47902	200
Slice 10	-441.73764	-27.64333	2,398.2046	3,883.756	789.88171	0
Slice 11	-436.68063	-30.563442	2,547.3721	4,155.1745	682.47163	200
Slice 12	-434.84979	-31.563442	2,597.843	4,256.7594	704.16822	200
Slice 13	-432.34979	-32.844411	2,661.5386	4,382.4509	1,034.0284	0
Slice 14	-429	-34.529506	2,699.5487	4,573.1772	1,125.7896	0
Slice 15	-426.5	-35.710087	2,747.0412	4,675.6802	1,158.8432	0
Slice 16	-422.5	-37.49131	2,816.476	4,846.8424	1,219.9672	0
Slice 17	-416.57217	-39.914229	2,906.1861	5,082.1593	1,307.4566	0
Slice 18	-409.71651	-42.426086	2,992.2751	5,290.7822	1,381.0824	0
Slice 19	-405.64434	-43.802487	3,114.1082	5,415.0296	1,382.5331	0
Slice 20	-403	-44.599769	613.04854	5,452.9574	0	1,917.8575
Slice 21	-400.5	-45.334677	559.12126	6,978.6901	3,857.2661	0
Slice 22	-396.658	-46.331289	2,660.8164	4,488.1937	1,097.999	0
Slice 23	-389.974	-47.903176	2,758.9022	4,691.7219	1,161.3552	0

Slice 24	-383.29	-49.197661	2,839.678	4,868.0865	1,218.7908	0
Slice 25	-376.606	-50.221057	2,903.5379	5,012.6938	1,267.3087	0
Slice 26	-369.922	-50.97822	2,950.7849	5,120.3427	1,303.6018	0
Slice 27	-363.58	-51.460025	2,980.8495	5,176.8651	1,319.4993	0
Slice 28	-357.58	-51.693905	2,995.4437	5,169.0381	1,306.0273	0
Slice 29	-351.435	-51.714169	2,996.7081	5,123.9829	1,278.1956	0
Slice 30	-345.145	-51.510533	2,984.0013	5,043.0572	1,237.2056	0
Slice 31	-339.145	-51.106616	2,958.7968	4,913.2608	1,174.3604	0
Slice 32	-333.435	-50.521294	2,922.2727	4,723.1311	1,082.0649	0
Slice 33	-327.58	-49.717865	2,872.1388	4,475.9024	963.6384	0
Slice 34	-321.63603	-48.694974	2,808.3104	4,183.5158	826.30679	0
Slice 35	-315.7481	-47.467518	2,731.7171	3,849.9378	671.8948	0
Slice 36	-309.86016	-46.023149	2,641.5885	3,471.7904	498.83565	0
Slice 37	-303.97223	-44.356165	2,537.5687	3,052.2063	309.22545	0
Slice 38	-298.08429	-42.459733	2,419.2313	2,594.785	105.48331	0

Project Name: HSC-ECIP Preliminary Slope Evaluation

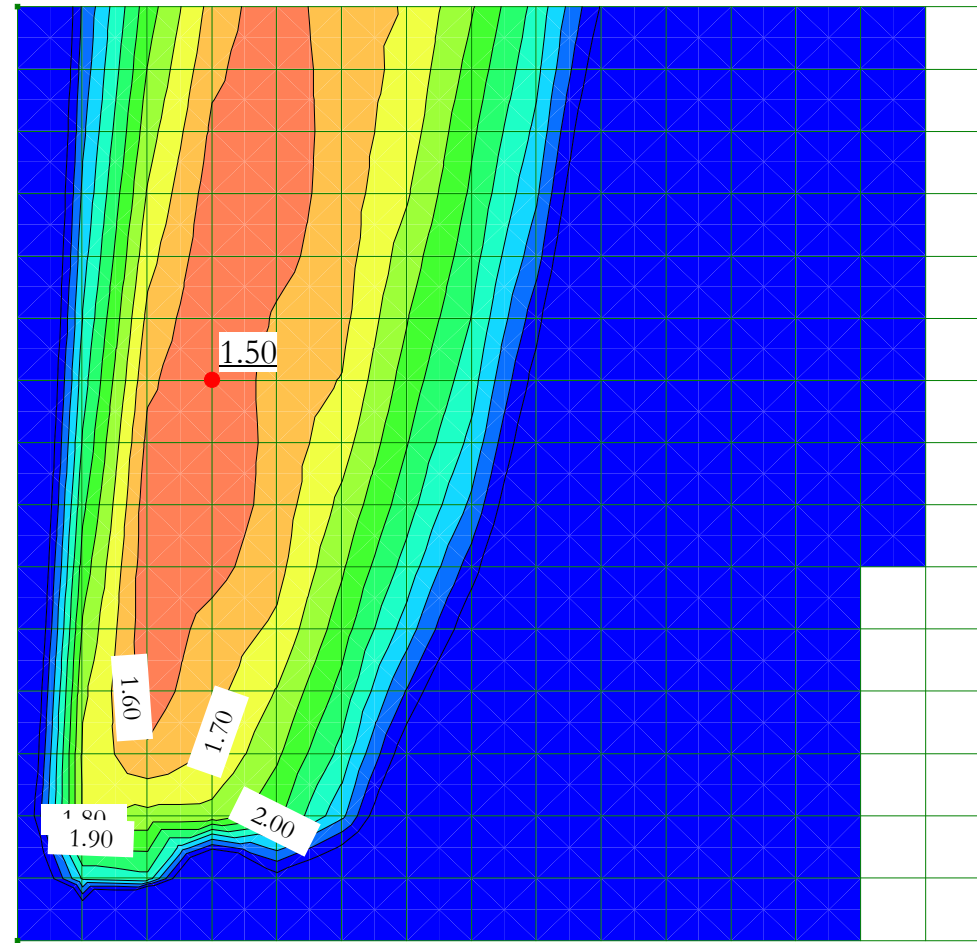
Location: Bayport Ship Channel

Station Analyzed: 66+00

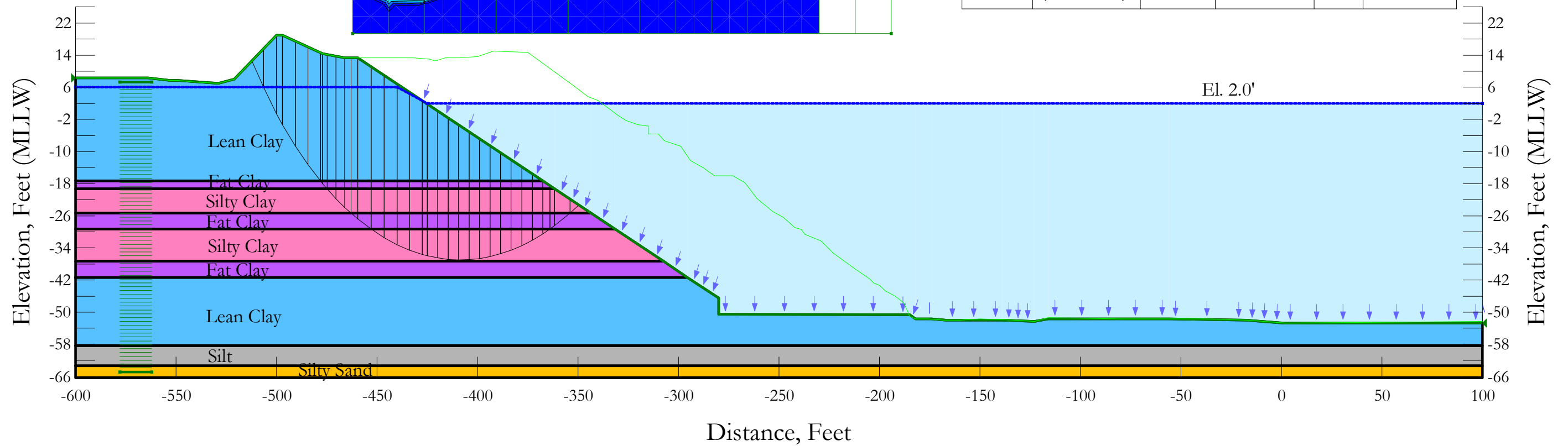
HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Silty Sand	120	0	34	
Grey	Silt	110	0	30	
Purple	Fat Clay (Undrained)	115			1,200
Light Blue	Lean Clay (Undrained)	125			1,000
Pink	Silty Clay (undrained)	115			500



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 81

Date: 4/26/2018

Time: 9:25:51 PM

Tool Version: 8.16.1.13452

File Name: 066+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\066+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:26:36 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Lean Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure
Piezometric Line: 1

Silty Clay (undrained)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 500 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-462, 147.96504) ft
Lower Left: (-462, 19.36474) ft
Lower Right: (-194.20183, 19.36474) ft
Grid Horizontal Increment: 15
Grid Vertical Increment: 15
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-578.00828, 7.2798) ft
Upper Right Coordinate: (-562.03796, 7.2798) ft
Lower Left Coordinate: (-578.00828, -64.86904) ft
Lower Right Coordinate: (-562.03796, -64.86904) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 8.33333) ft
Right Coordinate: (100, -52.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	6
Coordinate 2	-440	6
Coordinate 3	-425	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
--	--------	--------

Point 1	-600	-17.31
Point 2	-600	-19.31
Point 3	-600	-25.31
Point 4	-600	-29.31
Point 5	-600	-37.31
Point 6	-600	-41.31
Point 7	-600	-58.31
Point 8	100	-58.31
Point 9	-600	-63.31
Point 10	100	-63.31
Point 11	-600	-66.31
Point 12	100	-66.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-295.57	-41.31
Point 16	-307.57	-37.31
Point 17	-331.57	-29.31
Point 18	-343.57	-25.31
Point 19	-361.57	-19.31
Point 20	-367.57	-17.31
Point 21	-459.5	13.33333
Point 22	-600	8.33333
Point 23	-564	8.33333
Point 24	-553	7.66667
Point 25	-549	7.66667
Point 26	-529	7
Point 27	-521	8
Point 28	-500	19
Point 29	-497	19
Point 30	-477	14.33333
Point 31	-466	13.33333
Point 32	-185	-50.66667
Point 33	-182	-51.66667
Point 34	-174	-51.66667
Point 35	-167	-52
Point 36	-139	-52
Point 37	-123	-52.33333
Point 38	-116	-51.66667
Point 39	-56	-51.66667
Point 40	-18	-52
Point 41	1	-52.66667
Point 42	100	-52.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay (Undrained)	19,2,1,20	470.86
Region 2	Silty Clay (undrained)	18,3,2,19	1,484.6
Region 3	Fat Clay (Undrained)	17,4,3,18	1,049.7
Region 4	Silty Clay (undrained)	16,5,4,17	2,243.4
Region 5	Fat Clay (Undrained)	15,6,5,16	1,193.7

Region 6	Silt	7,9,10,8	3,500
Region 7	Silty Sand	9,11,12,10	2,100
Region 8	Lean Clay (Undrained)	22,23,24,25,26,27,28,29,30,31,21,20,1	5,378.6
Region 9	Lean Clay (Undrained)	6,15,14,13,32,33,34,35,36,37,38,39,40,41,42,8,7	7,889.6

Current Slip Surface

Slip Surface: 11,219
 F of S: 1.50
 Volume: 4,458.1467 ft³
 Weight: 539,602.93 lbs
 Resisting Moment: 17,417,264 lbs-ft
 Activating Moment: 11,579,854 lbs-ft
 Resisting Force: 114,713.07 lbs
 Activating Force: 76,502.029 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (-349.59448, -23.301841) ft
 Entry: (-512.24547, 12.585706) ft
 Radius: 133.49641 ft
 Center: (-408.44037, 96.52492) ft

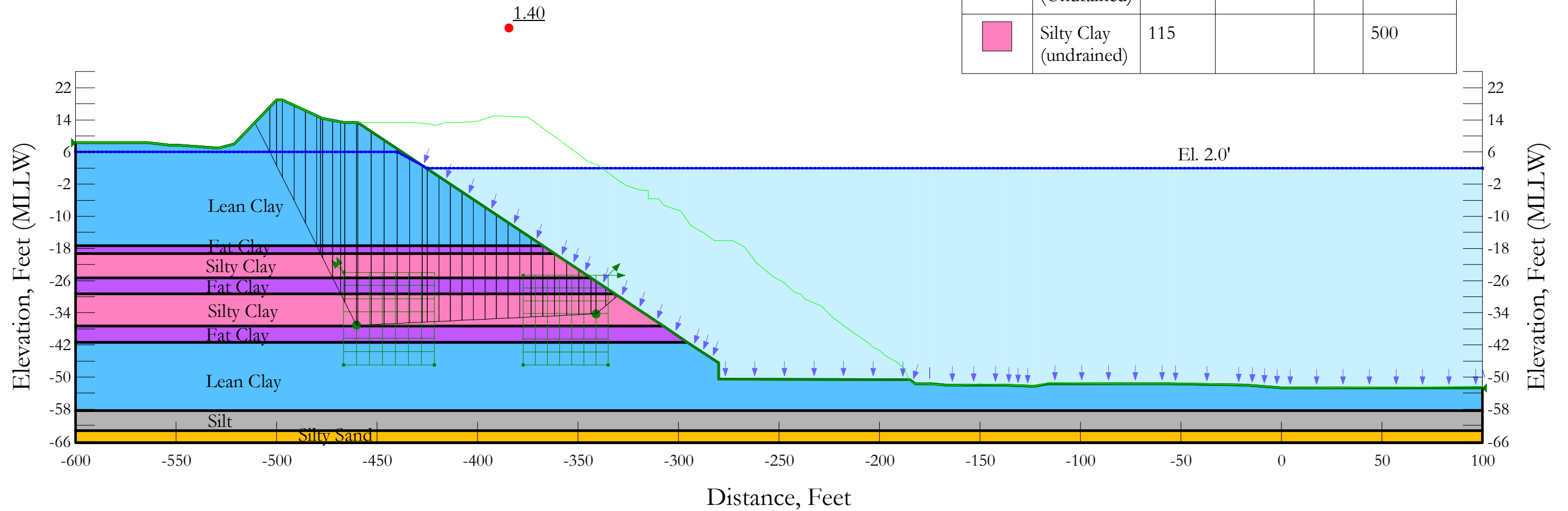
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-509.40036	9.2928532	-205.47404	-164.86342	0	1,000
Slice 2	-503.27762	2.6874548	206.70282	1,150.9177	0	1,000
Slice 3	-498.5	-1.996262	498.96675	1,995.1214	0	1,000
Slice 4	-493.86248	-5.9820236	747.67827	2,435.7414	0	1,000
Slice 5	-487.58744	-10.90806	1,055.0629	2,907.8578	0	1,000
Slice 6	-481.3124	-15.264753	1,326.9206	3,305.1451	0	1,000
Slice 7	-477.58744	-17.665718	1,476.7408	3,441.6693	0	1,200
Slice 8	-475.89985	-18.665718	1,539.1408	3,539.7127	0	1,200
Slice 9	-472.59978	-20.515955	1,654.5956	3,964.2525	0	500
Slice 10	-468.19993	-22.823448	1,798.5831	4,187.754	0	500
Slice 11	-464.50362	-24.617493	1,910.5315	4,378.0851	0	500
Slice 12	-461.25362	-26.065477	2,000.8858	4,386.4057	0	1,200
Slice 13	-456.25731	-28.065477	2,125.6858	4,527.8009	0	1,200
Slice 14	-449.76096	-30.369487	2,269.456	4,705.3907	0	500
Slice 15	-443.25365	-32.308177	2,390.4302	4,699.5055	0	500
Slice 16	-436.87501	-33.868839	2,274.1018	4,658.6769	0	500
Slice 17	-430.62502	-35.07709	2,247.396	4,583.9053	0	500
Slice 18	-426.25002	-35.772157	2,377.7829	4,519.7882	0	500
Slice 19	-422.38955	-36.214757	2,384.6008	4,499.0686	0	500

Slice 20	-417.16864	-36.660157	2,412.3938	4,481.099	0	500
Slice 21	-411.94773	-36.899854	2,427.3509	4,437.504	0	500
Slice 22	-406.72682	-36.934959	2,429.5414	4,367.3825	0	500
Slice 23	-401.50591	-36.765633	2,418.9755	4,269.8398	0	500
Slice 24	-396.285	-36.391094	2,395.6042	4,144.0325	0	500
Slice 25	-391.06409	-35.809596	2,359.3188	3,989.2084	0	500
Slice 26	-385.84318	-35.018391	2,309.9476	3,804.739	0	500
Slice 27	-380.62227	-34.01366	2,247.2524	3,590.1445	0	500
Slice 28	-375.40136	-32.790416	2,170.922	3,345.1069	0	500
Slice 29	-370.18045	-31.342377	2,080.5643	3,069.472	0	500
Slice 30	-365.71806	-29.935644	1,992.7842	2,817.609	0	500
Slice 31	-362.71806	-28.89146	1,927.6271	2,819.9288	0	1,200
Slice 32	-357.72175	-26.89146	1,802.8271	2,509.6531	0	1,200
Slice 33	-351.73399	-24.30592	1,641.4894	1,898.0266	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 66+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Silty Sand	120	0	34	
Grey	Silt	110	0	30	
Purple	Fat Clay (Undrained)	115			1,200
Light Blue	Lean Clay (Undrained)	125			1,000
Pink	Silty Clay (undrained)	115			500



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 81

Date: 4/26/2018

Time: 9:25:51 PM

Tool Version: 8.16.1.13452

File Name: 066+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\066+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:27:04 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Lean Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf
Pore Water Pressure
Piezometric Line: 1

Silty Clay (undrained)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 500 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-600, 8.33333) ft
Right Coordinate: (100, -52.66667) ft

Slip Surface Block

Left Grid
Upper Left: (-466.71366, -24.00079) ft
Lower Left: (-466.71366, -46.97058) ft
Lower Right: (-421.38292, -46.97058) ft
X Increments: 7
Y Increments: 7
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2

Right Grid
Upper Left: (-377.21577, -24.70938) ft
Lower Left: (-377.21577, -46.98267) ft
Lower Right: (-335.01768, -46.98267) ft
X Increments: 7
Y Increments: 7
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	6
Coordinate 2	-440	6
Coordinate 3	-425	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)

Point 1	-600	-17.31
Point 2	-600	-19.31
Point 3	-600	-25.31
Point 4	-600	-29.31
Point 5	-600	-37.31
Point 6	-600	-41.31
Point 7	-600	-58.31
Point 8	100	-58.31
Point 9	-600	-63.31
Point 10	100	-63.31
Point 11	-600	-66.31
Point 12	100	-66.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-295.57	-41.31
Point 16	-307.57	-37.31
Point 17	-331.57	-29.31
Point 18	-343.57	-25.31
Point 19	-361.57	-19.31
Point 20	-367.57	-17.31
Point 21	-459.5	13.33333
Point 22	-600	8.33333
Point 23	-564	8.33333
Point 24	-553	7.66667
Point 25	-549	7.66667
Point 26	-529	7
Point 27	-521	8
Point 28	-500	19
Point 29	-497	19
Point 30	-477	14.33333
Point 31	-466	13.33333
Point 32	-185	-50.66667
Point 33	-182	-51.66667
Point 34	-174	-51.66667
Point 35	-167	-52
Point 36	-139	-52
Point 37	-123	-52.33333
Point 38	-116	-51.66667
Point 39	-56	-51.66667
Point 40	-18	-52
Point 41	1	-52.66667
Point 42	100	-52.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay (Undrained)	19,2,1,20	470.86
Region 2	Silty Clay (undrained)	18,3,2,19	1,484.6
Region 3	Fat Clay (Undrained)	17,4,3,18	1,049.7
Region 4	Silty Clay (undrained)	16,5,4,17	2,243.4
Region 5	Fat Clay (Undrained)	15,6,5,16	1,193.7

Region 6	Silt	7,9,10,8	3,500
Region 7	Silty Sand	9,11,12,10	2,100
Region 8	Lean Clay (Undrained)	22,23,24,25,26,27,28,29,30,31,21,20,1	5,378.6
Region 9	Lean Clay (Undrained)	6,15,14,13,32,33,34,35,36,37,38,39,40,41,42,8,7	7,889.6

Current Slip Surface

Slip Surface: 14,900
 F of S: 1.40
 Volume: 4,941.5412 ft³
 Weight: 594,554.17 lbs
 Resisting Moment: 8,934,513.6 lbs-ft
 Activating Moment: 6,425,613.1 lbs-ft
 Resisting Force: 109,809.14 lbs
 Activating Force: 78,843.971 lbs
 F of S Rank (Analysis): 1 of 36,864 slip surfaces
 F of S Rank (Query): 1 of 36,864 slip surfaces
 Exit: (-330.20554, -29.76482) ft
 Entry: (-510.73902, 13.374798) ft
 Radius: 86.000356 ft
 Center: (-412.74092, 24.159702) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-507.05162	9.687399	-230.09369	-9.0103256	0	1,000
Slice 2	-501.68211	4.3178879	104.9638	1,009.253	0	1,000
Slice 3	-498.5	1.1357757	303.5276	1,504.9256	0	1,000
Slice 4	-494.1757	-3.1885202	573.36366	1,941.905	0	1,000
Slice 5	-488.52711	-8.8371121	925.8358	2,447.5494	0	1,000
Slice 6	-482.87852	-14.485704	1,278.3079	2,944.0147	0	1,000
Slice 7	-479.05422	-18.31	1,516.944	3,134.7322	0	1,200
Slice 8	-477.52711	-19.837112	1,612.2358	3,712.5762	0	500
Slice 9	-474.52711	-22.837112	1,799.4358	3,978.8408	0	500
Slice 10	-470.05422	-27.31	2,078.544	3,936.6546	0	1,200
Slice 11	-467.02711	-30.337112	2,267.4358	4,666.5901	0	500
Slice 12	-463.11892	-34.245304	2,511.307	5,052.3823	0	500
Slice 13	-459.86892	-37.117497	2,690.5318	6,057.811	0	500
Slice 14	-456.25	-37.030318	2,685.0918	5,922.4057	0	500
Slice 15	-449.75	-36.873734	2,675.321	5,651.2787	0	500
Slice 16	-443.25	-36.717151	2,665.5502	5,379.5644	0	500
Slice 17	-436.87501	-36.563578	2,431.0899	5,112.2772	0	500
Slice 18	-430.62502	-36.413017	2,325.2235	4,849.2605	0	500
Slice 19	-426.25002	-36.307624	2,411.196	4,669.8807	0	500

Slice 20	-422.1285	-36.208338	2,384.2003	4,562.0506	0	500
Slice 21	-416.3855	-36.06999	2,375.5674	4,440.6596	0	500
Slice 22	-410.6425	-35.931642	2,366.9345	4,317.8347	0	500
Slice 23	-404.8995	-35.793295	2,358.3016	4,193.3089	0	500
Slice 24	-399.1565	-35.654947	2,349.6687	4,066.8451	0	500
Slice 25	-393.4135	-35.516599	2,341.0358	3,938.2411	0	500
Slice 26	-387.6705	-35.378251	2,332.4029	3,807.3336	0	500
Slice 27	-381.9275	-35.239904	2,323.77	3,674.0021	0	500
Slice 28	-376.1845	-35.101556	2,315.1371	3,538.1719	0	500
Slice 29	-370.4415	-34.963208	2,306.5042	3,399.8158	0	500
Slice 30	-364.57	-34.821765	2,297.6781	3,265.777	0	500
Slice 31	-358.57	-34.677226	2,288.6589	3,135.9761	0	500
Slice 32	-352.57	-34.532687	2,279.6397	3,003.6528	0	500
Slice 33	-346.57	-34.388148	2,270.6205	2,869.0046	0	500
Slice 34	-342.30799	-34.285477	2,264.2138	2,772.1473	0	500
Slice 35	-338.67698	-33.273806	2,201.0855	2,731.9712	0	500
Slice 36	-333.93899	-31.311267	2,078.623	2,395.1973	0	500
Slice 37	-330.88777	-30.047408	1,999.7583	2,179.1971	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation

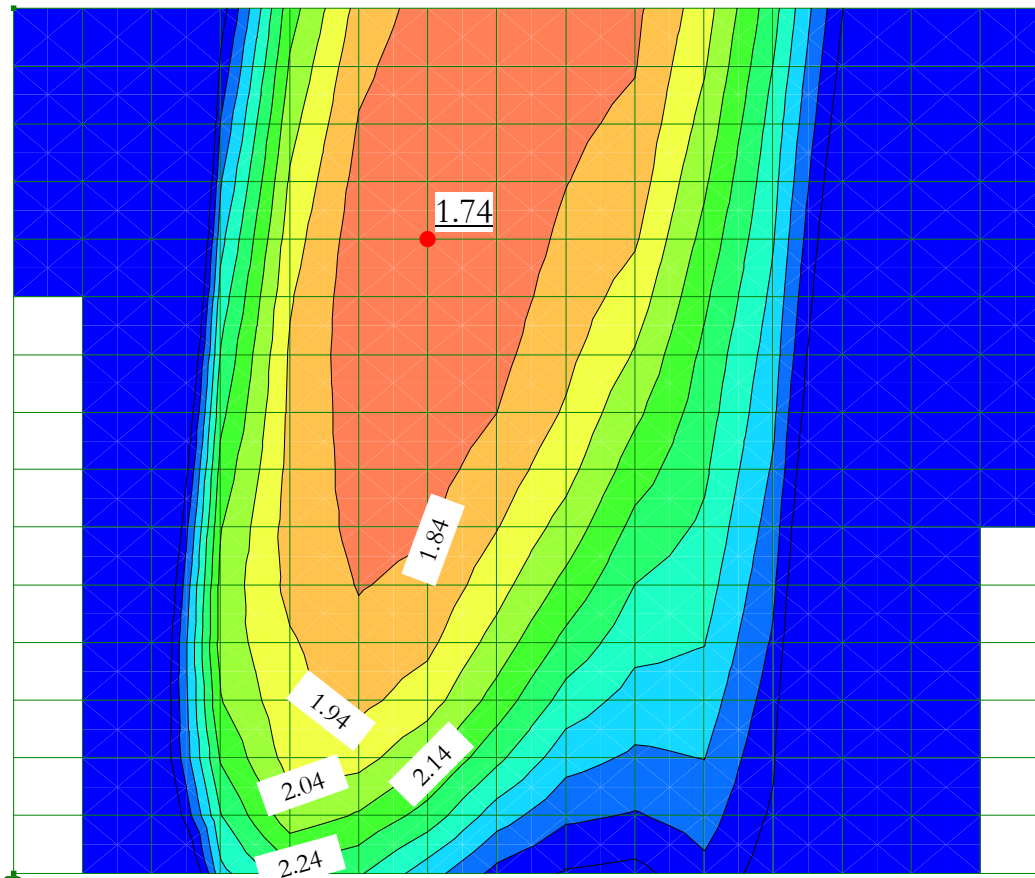
Location: Bayport Ship Channel

Station Analyzed: 66+00

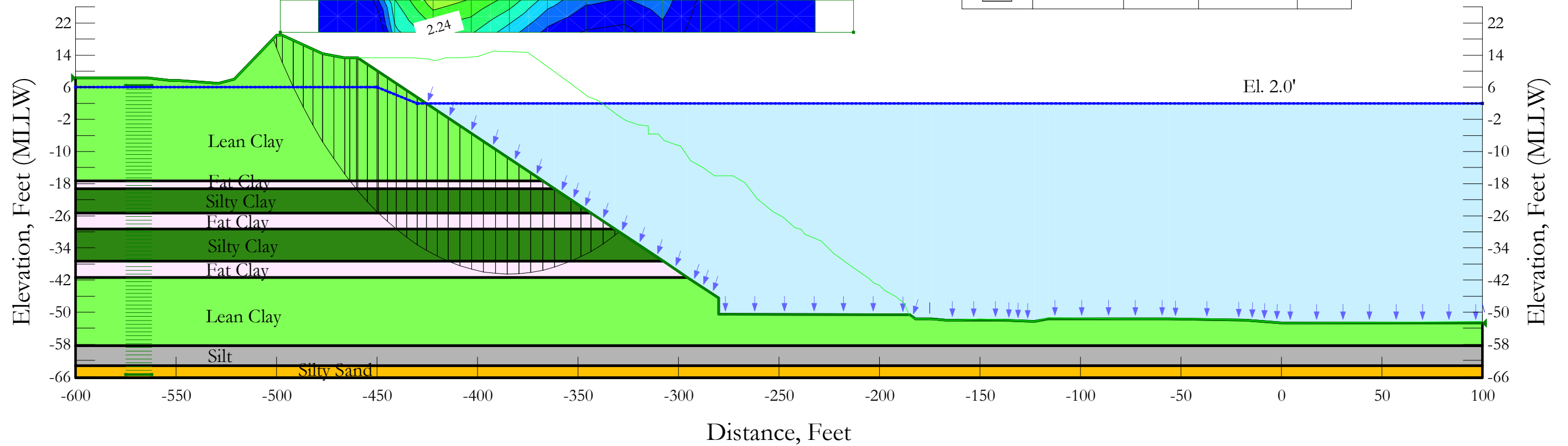
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Light Pink	Fat Clay	115	300	17
Light Green	Lean Clay	125	200	23
Dark Green	Silty Clay	115	100	30
Yellow	Silty Sand	120	0	34
Grey	Silt	110	0	30



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 81

Date: 4/26/2018

Time: 9:25:51 PM

Tool Version: 8.16.1.13452

File Name: 066+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\066+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:26:06 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: No

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 300 psf

Phi': 17 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 100 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-498.20961, 138.72892) ft

Lower Left: (-498.20961, 19.6738) ft

Lower Right: (-212.85988, 19.6738) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 15

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-575, 6.50221) ft

Upper Right Coordinate: (-562, 6.50221) ft

Lower Left Coordinate: (-575, -65.47066) ft

Lower Right Coordinate: (-562, -65.47066) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 8.33333) ft

Right Coordinate: (100, -52.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	6
Coordinate 2	-450	6

Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-17.31
Point 2	-600	-19.31
Point 3	-600	-25.31
Point 4	-600	-29.31
Point 5	-600	-37.31
Point 6	-600	-41.31
Point 7	-600	-58.31
Point 8	100	-58.31
Point 9	-600	-63.31
Point 10	100	-63.31
Point 11	-600	-66.31
Point 12	100	-66.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-295.57	-41.31
Point 16	-307.57	-37.31
Point 17	-331.57	-29.31
Point 18	-343.57	-25.31
Point 19	-361.57	-19.31
Point 20	-367.57	-17.31
Point 21	-459.5	13.33333
Point 22	-600	8.33333
Point 23	-564	8.33333
Point 24	-553	7.66667
Point 25	-549	7.66667
Point 26	-529	7
Point 27	-521	8
Point 28	-500	19
Point 29	-497	19
Point 30	-477	14.33333
Point 31	-466	13.33333
Point 32	-185	-50.66667
Point 33	-182	-51.66667
Point 34	-174	-51.66667
Point 35	-167	-52
Point 36	-139	-52
Point 37	-123	-52.33333
Point 38	-116	-51.66667
Point 39	-56	-51.66667
Point 40	-18	-52
Point 41	1	-52.66667
Point 42	100	-52.66667

Regions

--	--	--	--

	Material	Points	Area (ft ²)
Region 1	Fat Clay	19,2,1,20	470.86
Region 2	Silty Clay	18,3,2,19	1,484.6
Region 3	Fat Clay	17,4,3,18	1,049.7
Region 4	Silty Clay	16,5,4,17	2,243.4
Region 5	Fat Clay	15,6,5,16	1,193.7
Region 6	Silt	7,9,10,8	3,500
Region 7	Silty Sand	9,11,12,10	2,100
Region 8	Lean Clay	22,23,24,25,26,27,28,29,30,31,21,20,1	5,378.6
Region 9	Lean Clay	6,15,14,13,32,33,34,35,36,37,38,39,40,41,42,8,7	7,889.6

Current Slip Surface

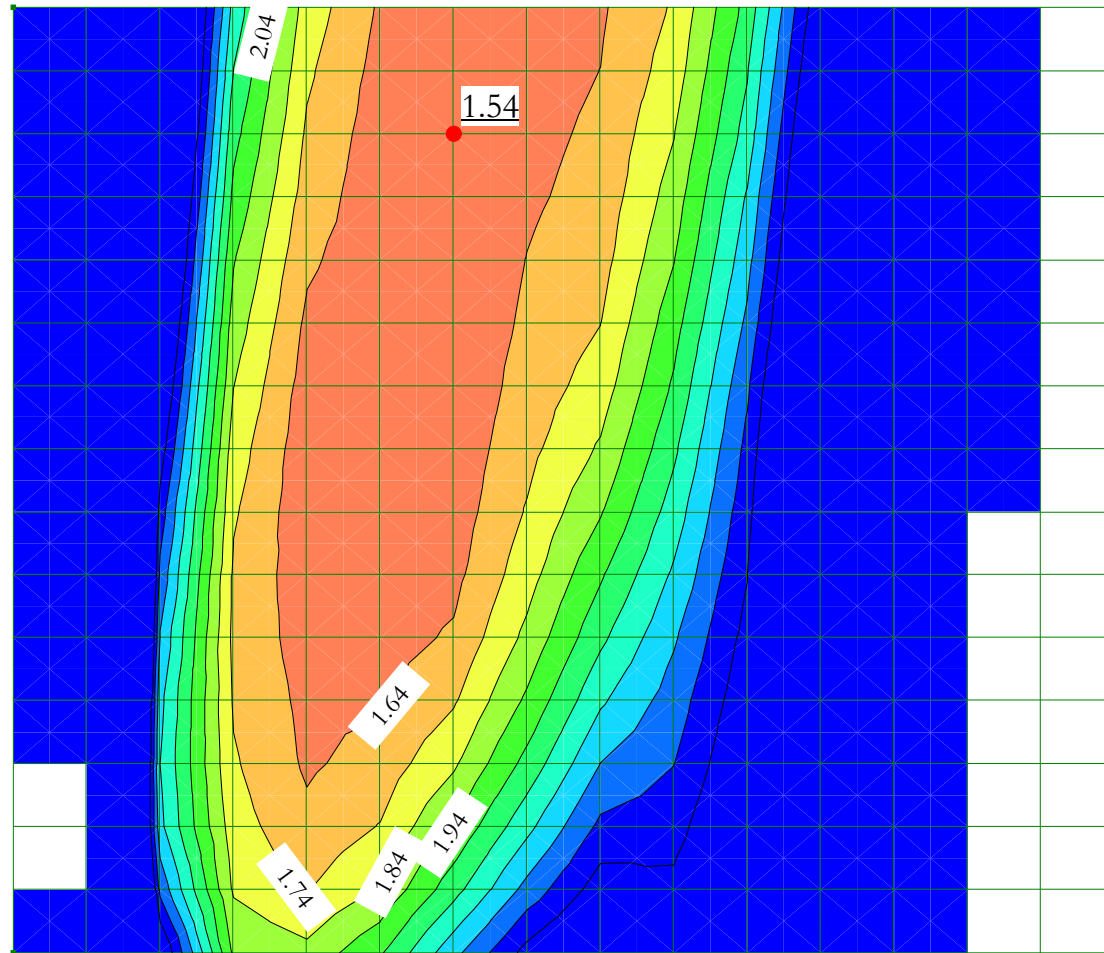
Slip Surface: 13,882
 F of S: 1.74
 Volume: 4,288.958 ft³
 Weight: 515,274.46 lbs
 Resisting Moment: 22,802,402 lbs-ft
 Activating Moment: 13,126,592 lbs-ft
 Resisting Force: 140,423.85 lbs
 Activating Force: 81,016.532 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (-329.42564, -30.024788) ft
 Entry: (-501.76555, 18.07519) ft
 Radius: 147.50095 ft
 Center: (-384.06972, 106.98089) ft

Slip Slices

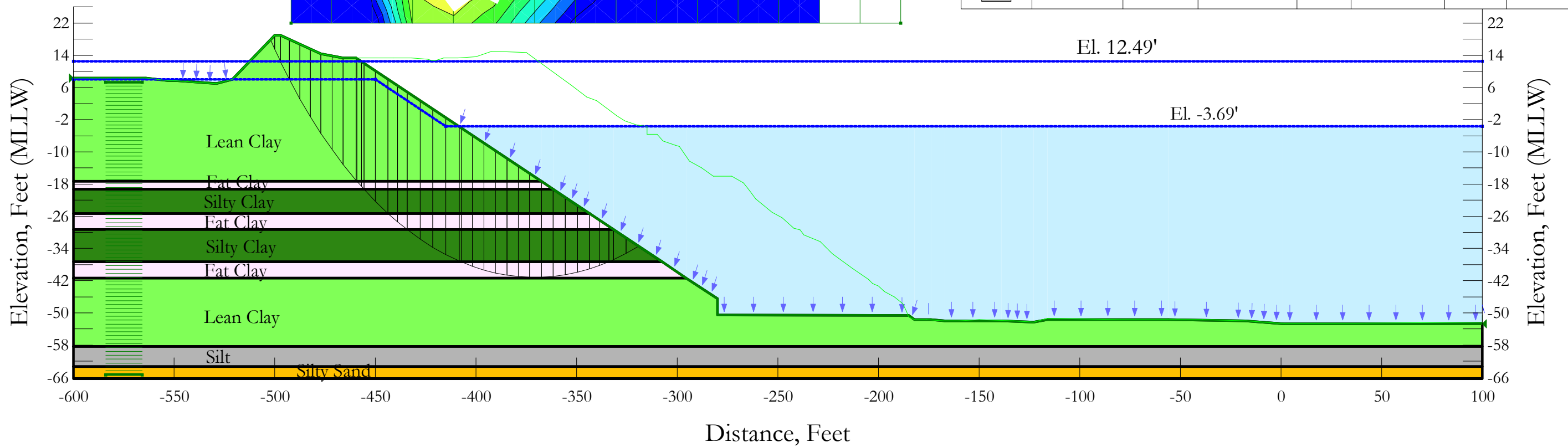
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-500.88277	16.930065	-682.03607	39.491479	16.763138	200
Slice 2	-498.5	13.9401	-495.46222	375.16142	159.24657	200
Slice 3	-494.29216	9.0476296	-190.17209	797.64189	338.57889	200
Slice 4	-489.15361	3.5308878	154.0726	1,264.2028	471.2223	200
Slice 5	-484.29216	-1.1903285	448.6765	1,682.4316	523.69799	200
Slice 6	-479.43072	-5.5031344	717.79559	2,052.8413	566.69326	200
Slice 7	-474.25	-9.6894474	979.02152	2,441.7285	620.88227	200
Slice 8	-468.75	-13.743996	1,232.0254	2,852.4699	687.83786	200
Slice 9	-464.74728	-16.491467	1,403.4675	3,144.5765	739.05692	200
Slice 10	-461.88445	-18.31	1,516.944	3,380.2523	569.67052	300
Slice 11	-459.88716	-19.542004	1,593.8211	3,442.4676	1,067.3165	100
Slice 12	-457.125	-21.12837	1,692.8103	3,540.3837	1,066.697	100
Slice 13	-452.375	-23.723888	1,854.7706	3,674.9776	1,050.897	100
Slice 14	-449.65254	-25.137522	1,938.6451	3,745.4654	1,043.1682	100
Slice 15	-447.09705	-26.353737	1,982.6443	3,849.7495	570.83136	300
Slice						

16	-442.68098	-28.353737	2,052.3319	3,927.7475	573.37208	300
Slice 17	-437.85472	-30.335529	2,115.7638	3,957.909	1,063.563	100
Slice 18	-432.61824	-32.273857	2,171.3643	4,022.8269	1,068.9424	100
Slice 19	-427.75	-33.884348	2,239.1833	4,067.6086	1,055.6418	100
Slice 20	-422.7937	-35.318506	2,328.6748	4,148.8718	1,050.8912	100
Slice 21	-417.3811	-36.682487	2,413.7872	4,268.2284	1,070.6621	100
Slice 22	-411.73075	-37.872193	2,488.0249	4,375.6267	577.09779	300
Slice 23	-405.84265	-38.873869	2,550.5294	4,448.1249	580.15315	300
Slice 24	-399.95455	-39.632325	2,597.8571	4,490.9022	578.76196	300
Slice 25	-394.06645	-40.151328	2,630.2429	4,501.1979	572.00835	300
Slice 26	-388.17835	-40.433413	2,647.845	4,476.1888	558.98079	300
Slice 27	-382.29025	-40.479941	2,650.7483	4,413.1556	538.82197	300
Slice 28	-376.40215	-40.291135	2,638.9668	4,309.6537	510.78025	300
Slice 29	-370.51405	-39.866086	2,612.4438	4,163.6761	474.25932	300
Slice 30	-364.57	-39.194117	2,570.5129	3,982.1492	431.58053	300
Slice 31	-357.51732	-38.051959	2,499.2422	3,716.8324	372.25469	300
Slice 32	-350.99098	-36.740666	2,417.4176	3,435.9747	588.06423	100
Slice 33	-346.04366	-35.511201	2,340.6989	3,163.934	475.29503	100
Slice 34	-340.57	-33.924924	2,241.7153	2,824.2231	336.31103	100
Slice 35	-334.57	-31.929753	2,117.2166	2,410.0173	169.04856	100
Slice 36	-330.49782	-30.442758	2,024.4281	2,107.9693	48.232559	100

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 66+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	Fat Clay	115	300	17	310	14	2
	Lean Clay	125	200	23	300	19	2
	Silty Clay	115	100	30	200	25	2
	Silty Sand	120	0	34	0.1	33.9	2
	Silt	110	0	30	0.1	29.9	2



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 81

Date: 4/26/2018

Time: 9:25:51 PM

Tool Version: 8.16.1.13452

File Name: 066+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\066+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:26:30 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 300 psf

Phi': 17 °

Phi-B: 0 °

Cohesion R: 310 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silty Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 100 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 200 psf

Phi R: 25 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 33.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 29.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (-491.87152, 152.04784) ft

Lower Left: (-491.87152, 21.99368) ft

Lower Right: (-188.86831, 21.99368) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 15

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-584.02884, 7.24626) ft

Upper Right Coordinate: (-565.91485, 7.24626) ft

Lower Left Coordinate: (-584.02884, -65.39904) ft

Lower Right Coordinate: (-565.91485, -65.39904) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 8.33333) ft

Right Coordinate: (100, -52.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12.49
Coordinate 2	100	12.49

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-415	-3.69
Coordinate 4	100	-3.69

Points

	X (ft)	Y (ft)
Point 1	-600	-17.31
Point 2	-600	-19.31
Point 3	-600	-25.31
Point 4	-600	-29.31
Point 5	-600	-37.31
Point 6	-600	-41.31
Point 7	-600	-58.31
Point 8	100	-58.31
Point 9	-600	-63.31
Point 10	100	-63.31
Point 11	-600	-66.31
Point 12	100	-66.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-295.57	-41.31
Point 16	-307.57	-37.31
Point 17	-331.57	-29.31
Point 18	-343.57	-25.31
Point 19	-361.57	-19.31
Point 20	-367.57	-17.31
Point 21	-459.5	13.33333
Point 22	-600	8.33333
Point 23	-564	8.33333
Point 24	-553	7.66667

Point 25	-549	7.66667
Point 26	-529	7
Point 27	-521	8
Point 28	-500	19
Point 29	-497	19
Point 30	-477	14.33333
Point 31	-466	13.33333
Point 32	-185	-50.66667
Point 33	-182	-51.66667
Point 34	-174	-51.66667
Point 35	-167	-52
Point 36	-139	-52
Point 37	-123	-52.33333
Point 38	-116	-51.66667
Point 39	-56	-51.66667
Point 40	-18	-52
Point 41	1	-52.66667
Point 42	100	-52.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay	19,2,1,20	470.86
Region 2	Silty Clay	18,3,2,19	1,484.6
Region 3	Fat Clay	17,4,3,18	1,049.7
Region 4	Silty Clay	16,5,4,17	2,243.4
Region 5	Fat Clay	15,6,5,16	1,193.7
Region 6	Silt	7,9,10,8	3,500
Region 7	Silty Sand	9,11,12,10	2,100
Region 8	Lean Clay	22,23,24,25,26,27,28,29,30,31,21,20,1	5,378.6
Region 9	Lean Clay	6,15,14,13,32,33,34,35,36,37,38,39,40,41,42,8,7	7,889.6

Current Slip Surface

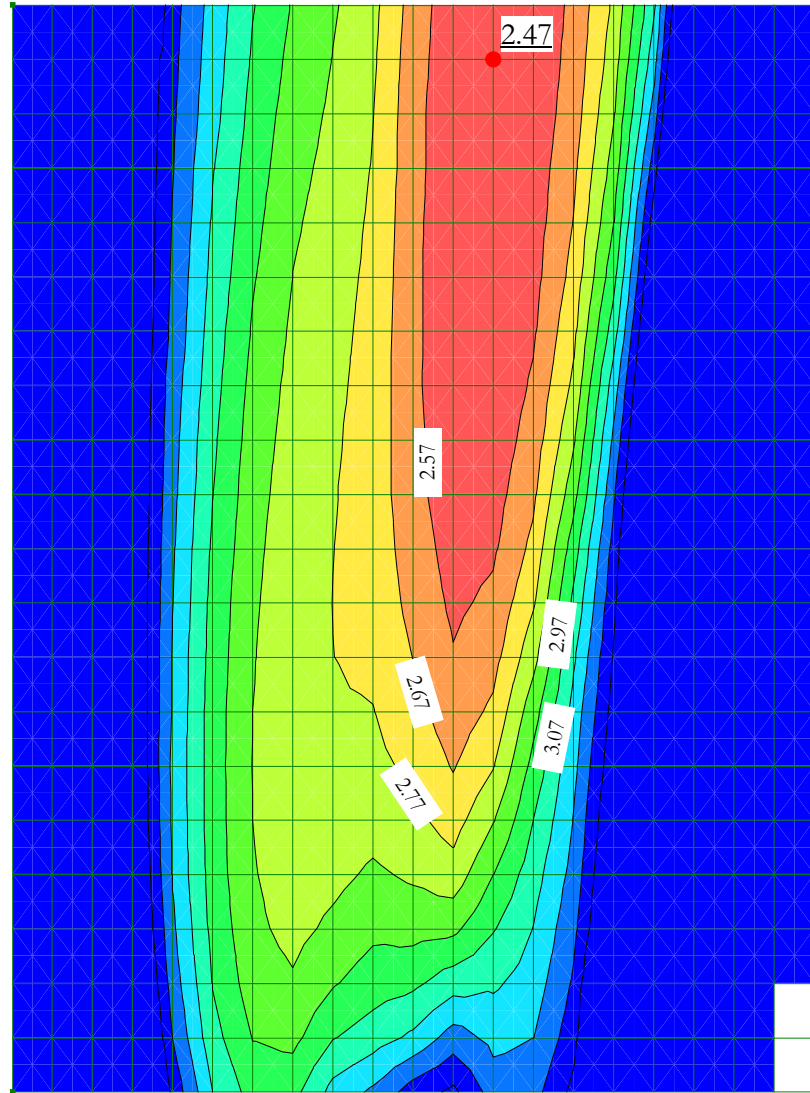
Slip Surface: 16,315
 F of S: 1.54
 Volume: 4,273.9922 ft³
 Weight: 512,908.53 lbs
 Resisting Moment: 27,204,821 lbs-ft
 Activating Moment: 17,638,480 lbs-ft
 Resisting Force: 142,484.73 lbs
 Activating Force: 92,407.347 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (-319.11972, -33.460094) ft
 Entry: (-502.1519, 17.872812) ft
 Radius: 175.89123 ft
 Center: (-370.67024, 134.70729) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

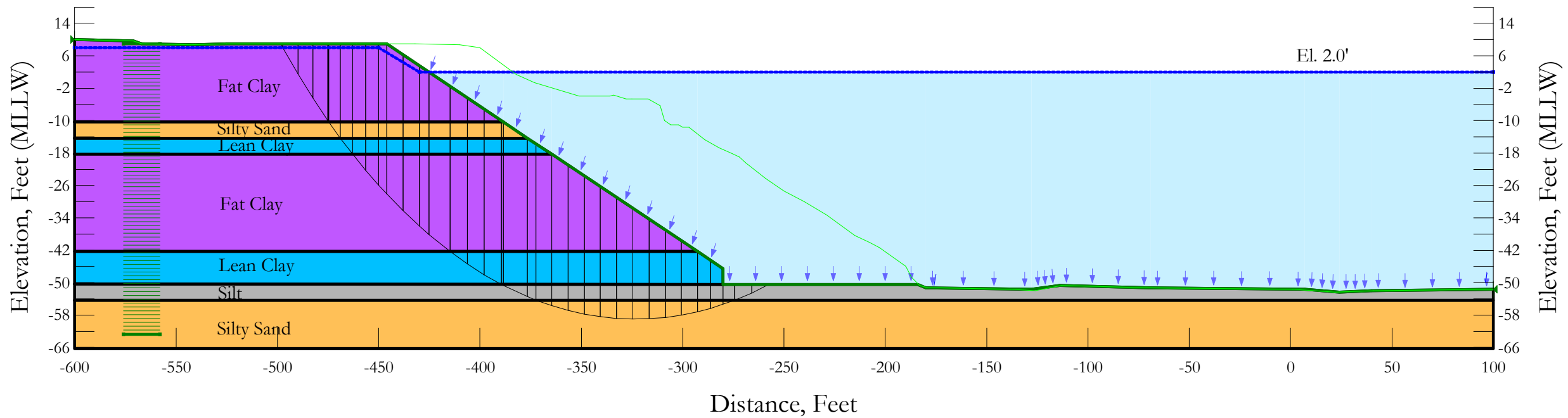
Slice 1	-501.07595	16.683977	-541.88015	58.60791	24.877582	200
Slice 2	-498.58197	13.992571	-373.93641	376.68174	159.89191	200
Slice 3	-497.08197	12.405273	-274.88905	533.2144	226.33608	200
Slice 4	-494.83304	10.160273	-134.80105	706.1258	299.73262	200
Slice 5	-490.05507	5.5858731	150.64152	1,082.0151	395.34463	200
Slice 6	-484.83304	0.94333784	440.33572	1,477.9168	440.42704	200
Slice 7	-479.61101	-3.3454847	707.95825	1,830.9861	476.697	200
Slice 8	-474.25	-7.4101871	961.59567	2,194.2856	523.24582	200
Slice 9	-468.75	-11.262253	1,201.9646	2,572.633	581.8142	200
Slice 10	-462.75	-15.107559	1,441.9117	2,982.0132	653.73432	200
Slice 11	-459.32443	-17.207543	1,572.9507	3,217.7299	698.16734	200
Slice 12	-458.05944	-17.933714	1,618.2637	3,276.2344	506.89251	300
Slice 13	-456.29482	-18.933714	1,680.6637	3,321.9084	501.77885	300
Slice 14	-452.80981	-20.79421	1,796.7587	3,354.5194	899.37357	100
Slice 15	-446.84605	-23.79421	1,725.7118	3,462.9599	1,003.0007	100
Slice 16	-441.31911	-26.350918	1,765.6094	3,607.601	0	863.20091
Slice 17	-436.57316	-28.350918	1,788.898	3,673.9187	0	871.5062
Slice 18	-431.00015	-30.478728	1,803.8545	3,699.7121	1,094.5739	100
Slice 19	-424.60009	-32.67847	1,807.3419	3,758.5226	1,126.5147	100
Slice 20	-418.20003	-34.60779	1,795.6485	3,793.8794	1,153.6792	100
Slice 21	-411.715	-36.294578	2,034.5257	3,808.3686	1,024.1287	100
Slice 22	-407.90616	-37.19653	2,090.8075	3,814.4951	995.17149	100
Slice 23	-404.53858	-37.86809	2,132.7128	3,868.0995	530.56095	300
Slice 24	-398.8511	-38.887824	2,196.3442	3,938.3761	532.59259	300
Slice 25	-393.16363	-39.716191	2,248.0343	3,985.266	531.12504	300
Slice 26	-387.47616	-40.355911	2,287.9529	4,006.6025	525.44393	300
Slice 27	-381.78868	-40.80905	2,316.2287	4,000.1883	514.83813	300
Slice 28	-376.10121	-41.077052	2,332.952	3,963.9103	498.634	300
Slice 29	-370.41374	-41.160763	2,338.1756	3,895.8568	476.23093	300
Slice 30	-364.57	-41.052492	2,331.4195	3,801.1853	449.35249	300
Slice 31	-358.57	-40.741467	2,312.0115	3,676.6561	417.21373	300
Slice 32	-352.57	-40.224153	2,279.7312	3,513.0431	377.0613	300

Slice 33	-346.57	-39.498712	2,234.4636	3,310.1706	328.87663	300
Slice 34	-341.16704	-38.674787	2,183.0507	3,095.5967	278.99331	300
Slice 35	-336.36112	-37.787946	2,127.7118	2,877.9458	229.36956	300
Slice 36	-332.76408	-37.046466	2,081.4435	2,695.4884	354.51901	100
Slice 37	-328.45743	-36.01331	2,016.9746	2,453.8369	252.22258	100
Slice 38	-322.23229	-34.351891	1,913.302	2,077.7008	94.915697	100



Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 76+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Silty Sand	120	0	33	
Grey	Silt	110	0	31	
Light Blue	Lean Clay (undrained)	125			1,000
Purple	Fat Clay (undrained)	115			1,200



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 78

Date: 4/26/2018

Time: 9:38:41 PM

Tool Version: 8.16.1.13452

File Name: 076+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\076+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:39:34 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-473.80158, 208.9749) ft

Lower Left: (-473.80158, 39.05527) ft

Lower Right: (-223.00018, 39.05527) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-576.03475, 8.94191) ft

Upper Right Coordinate: (-557.86914, 8.94191) ft

Lower Left Coordinate: (-576.03475, -62.80284) ft

Lower Right Coordinate: (-557.86914, -62.80284) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 10) ft

Right Coordinate: (100, -51.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-14.31
Point 2	-600	-18.31
Point 3	-600	-42.31
Point 4	-600	-50.31
Point 5	-600	-54.31
Point 6	100	-54.31

Point 7	-600	-66.31
Point 8	100	-66.31
Point 9	-600	-10.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-292.57	-42.31
Point 13	-364.57	-18.31
Point 14	-376.57	-14.31
Point 15	-388.57	-10.31
Point 16	-600	10
Point 17	-571	9.66667
Point 18	-567	9
Point 19	-541	8.66667
Point 20	-525	9
Point 21	-475	9
Point 22	-446	9
Point 23	-184	-50.5
Point 24	-180	-51.33333
Point 25	-128	-51.66667
Point 26	-114	-50.66667
Point 27	-69	-51.33333
Point 28	7	-51.66667
Point 29	24	-52.33333
Point 30	40	-52
Point 31	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (undrained)	1,14,13,2	917.72
Region 2	Fat Clay (undrained)	2,13,12,3	6,514.3
Region 3	Silty Sand	5,7,8,6	8,400
Region 4	Lean Clay (undrained)	10,4,3,12,11	2,564.1
Region 5	Silty Sand	9,1,14,15	869.72
Region 6	Fat Clay (undrained)	16,17,18,19,20,21,22,15,9	3,546.7
Region 7	Silt	4,10,23,24,25,26,27,28,29,30,31,6,5	2,403.7

Current Slip Surface

Slip Surface: 31,308
 F of S: 2.47
 Volume: 6,497.551 ft³
 Weight: 761,859.52 lbs
 Resisting Moment: 66,227,000 lbs-ft
 Activating Moment: 26,769,619 lbs-ft
 Resisting Force: 235,780.76 lbs
 Activating Force: 95,655.777 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-257.54329, -50.5) ft
 Entry: (-498.40048, 9) ft
 Radius: 259.45537 ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-497.85049	8.5	-31.2	-382.78396	0	1,200
Slice 2	-493.58375	4.7665561	201.7669	68.23255	0	1,200
Slice 3	-486.15025	-1.4637606	590.53866	813.25943	0	1,200
Slice 4	-478.71675	-7.2411449	951.04744	1,496.2078	0	1,200
Slice 5	-474.79952	-10.165828	1,133.5477	1,839.6032	0	1,200
Slice 6	-471.73146	-12.31	1,267.344	2,251.2591	638.96194	0
Slice 7	-465.82126	-16.31	1,516.944	2,644.8292	0	1,000
Slice 8	-459.58396	-20.28188	1,764.7893	3,075.1729	0	1,200
Slice 9	-453.19465	-24.101218	2,003.116	3,518.3012	0	1,200
Slice 10	-448	-27.044643	1,971.8768	3,860.0492	0	1,200
Slice 11	-442	-30.198536	2,049.3841	4,075.7767	0	1,200
Slice 12	-434	-34.143397	2,137.8238	4,234.8962	0	1,200
Slice 13	-427.59063	-37.087824	2,439.0802	4,339.9372	0	1,200
Slice 14	-419.99657	-40.227659	2,635.0059	4,536.0846	0	1,200
Slice 15	-410.56748	-43.825776	2,859.5284	4,851.2053	0	1,000
Slice 16	-402.07865	-46.693971	3,038.5038	5,086.4872	0	1,000
Slice 17	-393.58983	-49.240733	3,197.4217	5,285.6392	0	1,000
Slice 18	-388.95771	-50.536456	3,278.2748	5,361.743	1,251.874	0
Slice 19	-382.57	-52.045602	3,372.4456	5,436.3422	1,240.1142	0
Slice 20	-374.43872	-53.881684	3,487.0171	5,518.5087	1,220.6433	0
Slice 21	-368.43872	-54.99324	3,556.3782	5,547.6545	1,293.15	0
Slice 22	-360.57	-56.256832	3,635.2263	5,587.2591	1,267.6649	0
Slice 23	-352.57	-57.291066	3,699.7625	5,608.5328	1,239.5699	0
Slice 24	-344.57	-58.073689	3,748.5982	5,596.7815	1,200.2243	0
Slice 25	-336.57	-58.606985	3,781.8758	5,551.0366	1,148.9064	0
Slice 26	-328.57	-58.892492	3,799.6915	5,470.3408	1,084.9323	0
Slice 27	-320.57	-58.93103	3,802.0963	5,353.7886	1,007.6808	0
Slice 28	-312.57	-58.72271	3,789.0971	5,200.5614	916.6156	0
Slice 29	-304.57	-58.266933	3,760.6566	5,009.9548	811.30376	0
Slice						

30	-296.57	-57.562388	3,716.693	4,781.398	691.42752	0
Slice 31	-289.4275	-56.733623	3,664.9781	4,535.5182	565.33537	0
Slice 32	-283.1425	-55.826916	3,608.3996	4,314.1997	458.35196	0
Slice 33	-277.16702	-54.822151	3,545.7022	3,790.163	158.75471	0
Slice 34	-270.13635	-53.430745	3,458.8785	3,621.5713	97.755702	0
Slice 35	-261.74098	-51.525745	3,340.0065	3,397.4406	34.509877	0

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Bayport Ship Channel

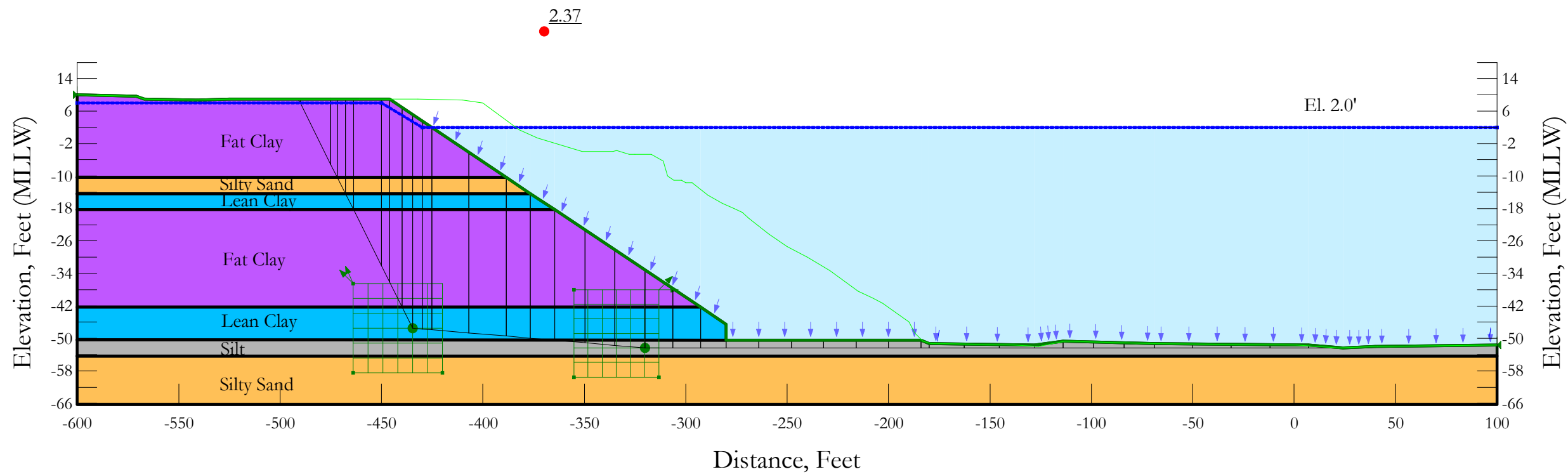
Station Analyzed: 76+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Silty Sand	120	0	33	
Grey	Silt	110	0	31	
Blue	Lean Clay (undrained)	125			1,000
Purple	Fat Clay (undrained)	115			1,200



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 78

Date: 4/26/2018

Time: 9:38:41 PM

Tool Version: 8.16.1.13452

File Name: 076+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\076+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:39:48 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-600, 10) ft
Right Coordinate: (100, -51.66667) ft

Slip Surface Block

Left Grid

Upper Left: (-463.96232, -36.51769) ft
Lower Left: (-463.96232, -58.46847) ft
Lower Right: (-419.93474, -58.46847) ft
X Increments: 6
Y Increments: 6
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2

Right Grid

Upper Left: (-355.00804, -37.96792) ft
Lower Left: (-355.00804, -59.50465) ft
Lower Right: (-313.23852, -59.50465) ft
X Increments: 6
Y Increments: 6
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-14.31
Point 2	-600	-18.31
Point 3	-600	-42.31
Point 4	-600	-50.31
Point 5	-600	-54.31
Point 6	100	-54.31
Point 7	-600	-66.31

Point 8	100	-66.31
Point 9	-600	-10.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-292.57	-42.31
Point 13	-364.57	-18.31
Point 14	-376.57	-14.31
Point 15	-388.57	-10.31
Point 16	-600	10
Point 17	-571	9.66667
Point 18	-567	9
Point 19	-541	8.66667
Point 20	-525	9
Point 21	-475	9
Point 22	-446	9
Point 23	-184	-50.5
Point 24	-180	-51.33333
Point 25	-128	-51.66667
Point 26	-114	-50.66667
Point 27	-69	-51.33333
Point 28	7	-51.66667
Point 29	24	-52.33333
Point 30	40	-52
Point 31	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (undrained)	1,14,13,2	917.72
Region 2	Fat Clay (undrained)	2,13,12,3	6,514.3
Region 3	Silty Sand	5,7,8,6	8,400
Region 4	Lean Clay (undrained)	10,4,3,12,11	2,564.1
Region 5	Silty Sand	9,1,14,15	869.72
Region 6	Fat Clay (undrained)	16,17,18,19,20,21,22,15,9	3,546.7
Region 7	Silt	4,10,23,24,25,26,27,28,29,30,31,6,5	2,403.7

Current Slip Surface

Slip Surface: 11,377
 F of S: 2.37
 Volume: 6,553.3681 ft³
 Weight: 768,218.25 lbs
 Resisting Moment: 28,778,550 lbs-ft
 Activating Moment: 12,273,957 lbs-ft
 Resisting Force: 202,846.04 lbs
 Activating Force: 85,702.351 lbs
 F of S Rank (Analysis): 1 of 21,609 slip surfaces
 F of S Rank (Query): 1 of 21,609 slip surfaces
 Exit: (23.806453, -52.32574) ft
 Entry: (-491.10368, 9) ft
 Radius: 201.20394 ft
 Center: (-228.1707, 24.331435) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-490.60368	8.5	-31.2	-453.93525	0	1,200
Slice 2	-482.55184	0.44816	471.23482	472.27673	0	1,200
Slice 3	-473.39684	-8.70684	1,042.5068	1,514.8817	0	1,200
Slice 4	-469.79368	-12.31	1,267.344	2,182.639	594.39955	0
Slice 5	-465.79368	-16.31	1,516.944	2,489.6537	0	1,000
Slice 6	-456.89684	-25.20684	2,072.1068	3,410.8606	0	1,200
Slice 7	-448	-34.10368	2,375.9905	4,385.2913	0	1,200
Slice 8	-442.89684	-39.20684	2,580.4914	4,821.0919	0	1,200
Slice 9	-437.20214	-44.90154	2,808.6974	5,326.0457	0	1,000
Slice 10	-432.3053	-47.590455	2,878.5318	6,016.8421	0	1,000
Slice 11	-427.59063	-47.789601	3,106.8711	5,861.111	0	1,000
Slice 12	-416.02844	-48.277984	3,137.3462	5,673.9865	0	1,000
Slice 13	-397.72281	-49.051207	3,185.5953	5,461.3618	0	1,000
Slice 14	-382.57	-49.691257	3,225.5344	5,278.5858	0	1,000
Slice 15	-370.57	-50.198133	3,257.1635	5,114.3292	0	1,000
Slice 16	-357.17502	-50.763932	3,292.4694	4,940.8026	990.41849	0
Slice 17	-342.38505	-51.388655	3,331.4521	4,766.6113	862.33065	0
Slice 18	-327.59509	-52.013378	3,370.4348	4,592.2164	734.12043	0
Slice 19	-313.29258	-52.32574	3,389.9262	4,416.6556	616.92128	0
Slice 20	-299.47753	-52.32574	3,389.9262	4,186.062	478.36666	0
Slice 21	-286.285	-52.32574	3,389.9262	4,027.4009	383.03347	0
Slice 22	-272	-52.32574	3,389.9262	3,477.3981	52.558415	0
Slice 23	-256	-52.32574	3,389.9262	3,478.0008	52.920587	0
Slice 24	-240	-52.32574	3,389.9262	3,478.5558	53.254063	0
Slice 25	-224	-52.32574	3,389.9262	3,479.0567	53.555034	0
Slice 26	-208	-52.32574	3,389.9262	3,479.4982	53.820279	0
Slice 27	-192	-52.32574	3,389.9262	3,479.8759	54.047212	0
Slice 28	-182	-52.32574	3,389.9262	3,516.8277	76.250122	0
Slice 29	-171.33333	-52.32574	3,389.9262	3,438.2434	29.031916	0
Slice 30	-154	-52.32574	3,389.9262	3,432.8591	25.796688	0
Slice						

31	-136.66667	-52.32574	3,389.9262	3,427.395	22.513499	0
Slice 32	-121	-52.32574	3,389.9262	3,431.984	25.270866	0
Slice 33	-106.5	-52.32574	3,389.9262	3,470.2831	48.283309	0
Slice 34	-91.5	-52.32574	3,389.9262	3,458.973	41.487528	0
Slice 35	-76.5	-52.32574	3,389.9262	3,447.5985	34.653004	0
Slice 36	-59.5	-52.32574	3,389.9262	3,438.1034	28.947796	0
Slice 37	-40.5	-52.32574	3,389.9262	3,433.7245	26.316683	0
Slice 38	-21.5	-52.32574	3,389.9262	3,429.319	23.66959	0
Slice 39	-2.5	-52.32574	3,389.9262	3,424.9015	21.015268	0
Slice 40	15.403227	-52.32574	3,389.9262	3,406.8087	10.144047	0

Project Name: HSC-ECIP Preliminary Slope Evaluation

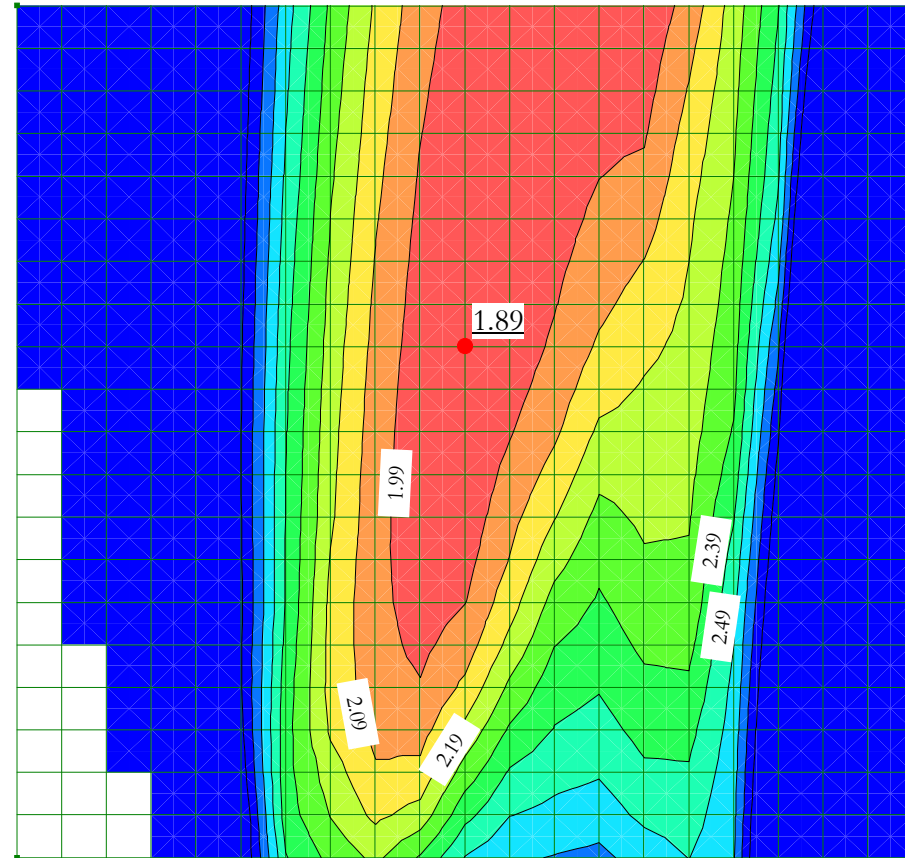
Location: Bayport Ship Channel

Station Analyzed: 76+00

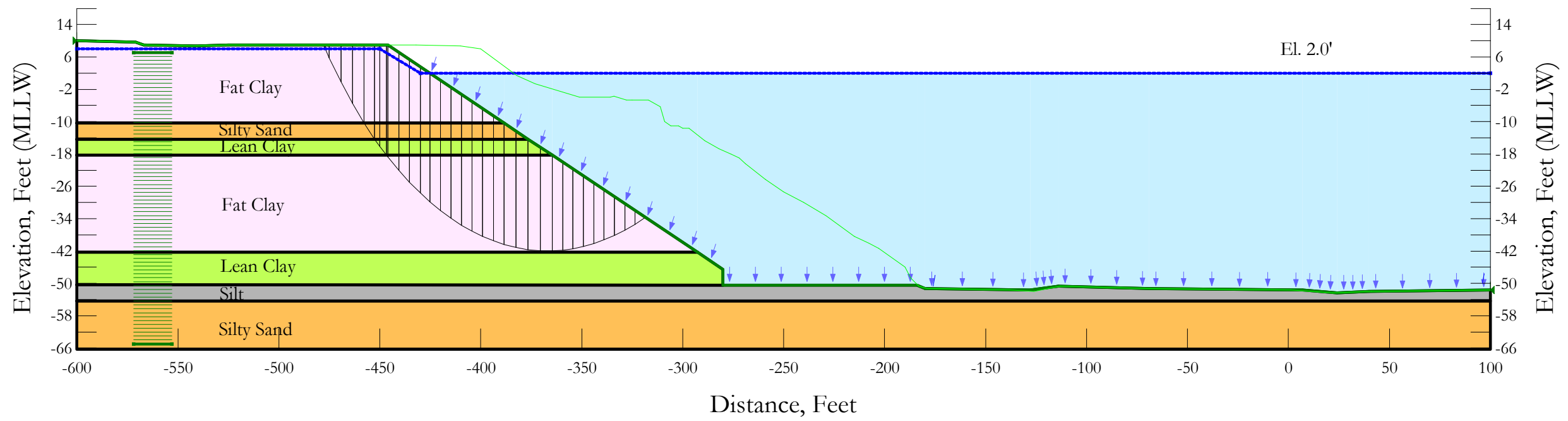
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Light Green	Lean Clay	125	200	23
Pink	Fat Clay	115	300	16
Orange	Silty Sand	120	0	33
Grey	Silt	110	0	31



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 78

Date: 4/26/2018

Time: 9:38:41 PM

Tool Version: 8.16.1.13452

File Name: 076+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\076+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:39:00 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 300 psf

Phi': 16 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion: 0 psf

Phi: 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-507.01079, 157.58996) ft

Lower Left: (-507.01079, 24.36187) ft

Lower Right: (-226.90128, 24.36187) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-572, 7.00687) ft

Upper Right Coordinate: (-553, 7.00687) ft

Lower Left Coordinate: (-572, -64.98816) ft

Lower Right Coordinate: (-553, -64.98816) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 10) ft

Right Coordinate: (100, -51.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-14.31
Point 2	-600	-18.31
Point 3	-600	-42.31

Point 4	-600	-50.31
Point 5	-600	-54.31
Point 6	100	-54.31
Point 7	-600	-66.31
Point 8	100	-66.31
Point 9	-600	-10.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-292.57	-42.31
Point 13	-364.57	-18.31
Point 14	-376.57	-14.31
Point 15	-388.57	-10.31
Point 16	-600	10
Point 17	-571	9.66667
Point 18	-567	9
Point 19	-541	8.66667
Point 20	-525	9
Point 21	-475	9
Point 22	-446	9
Point 23	-184	-50.5
Point 24	-180	-51.33333
Point 25	-128	-51.66667
Point 26	-114	-50.66667
Point 27	-69	-51.33333
Point 28	7	-51.66667
Point 29	24	-52.33333
Point 30	40	-52
Point 31	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	1,14,13,2	917.72
Region 2	Fat Clay	2,13,12,3	6,514.3
Region 3	Silty Sand	5,7,8,6	8,400
Region 4	Lean Clay	10,4,3,12,11	2,564.1
Region 5	Silty Sand	9,1,14,15	869.72
Region 6	Fat Clay	16,17,18,19,20,21,22,15,9	3,546.7
Region 7	Silt	4,10,23,24,25,26,27,28,29,30,31,6,5	2,403.7

Current Slip Surface

Slip Surface: 19,964

F of S: 1.89

Volume: 3,530.2649 ft³

Weight: 410,594.87 lbs

Resisting Moment: 15,990,776 lbs-ft

Activating Moment: 8,479,373.6 lbs-ft

Resisting Force: 100,878.5 lbs

Activating Force: 53,754.98 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (-318.46729, -33.67757) ft

Entry: (-477.89191, 9) ft

Radius: 146.24847 ft

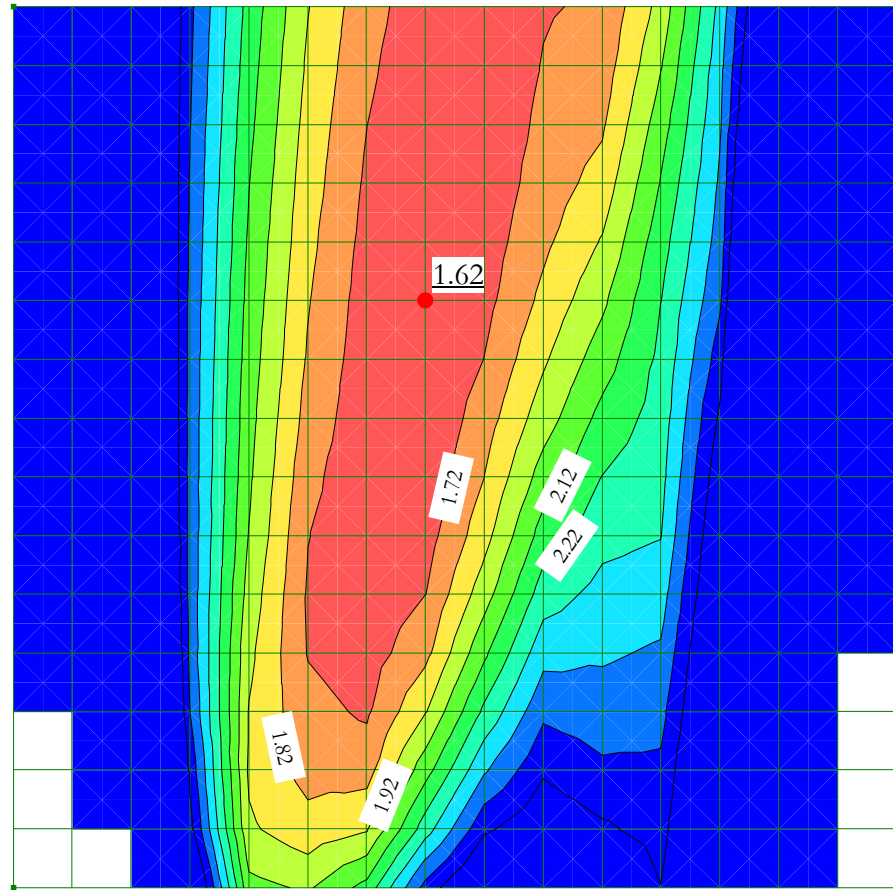
Center: (-366.95603, 104.29872) ft

Slip Slices

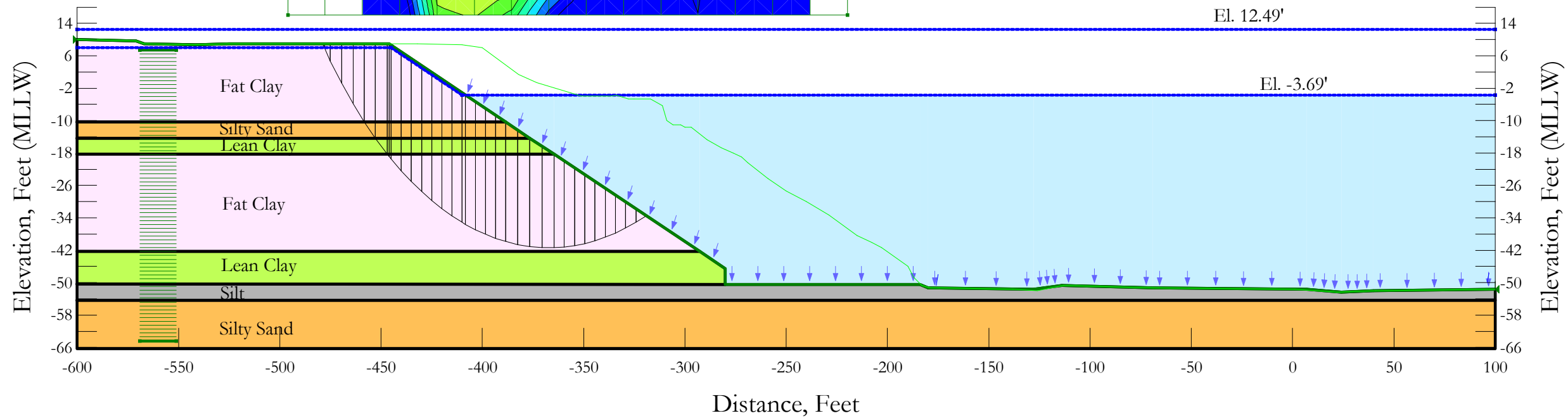
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-477.45845	8.5	-31.2	-106.77165	-30.616277	300
Slice 2	-476.01249	6.8667132	70.717096	68.614507	-0.60290764	300
Slice 3	-472.1341	2.7646659	326.68485	517.098	54.600093	300
Slice 4	-466.40229	-2.8636427	677.8913	1,126.801	128.72278	300
Slice 5	-460.67048	-7.9165954	993.19556	1,669.832	194.02238	300
Slice 6	-455.16052	-12.31	1,267.344	2,144.0171	569.31819	0
Slice 7	-451.25823	-15.197656	1,447.5337	2,465.2612	431.9997	200
Slice 8	-448.33939	-17.197656	1,413.9882	2,677.5697	536.35854	200
Slice 9	-446.33939	-18.529349	1,455.876	2,851.1289	400.08233	300
Slice 10	-443.33333	-20.382249	1,510.3232	2,959.3651	415.50609	300
Slice 11	-438	-23.498234	1,597.1099	3,116.2801	435.61504	300
Slice 12	-432.66667	-26.322172	1,667.1775	3,247.3351	453.10291	300
Slice 13	-427.59063	-28.761608	1,919.5244	3,360.5856	413.21766	300
Slice 14	-422.56616	-30.934906	2,055.1381	3,496.267	413.23706	300
Slice 15	-417.33598	-32.970053	2,182.1313	3,667.7031	425.98086	300
Slice 16	-412.10581	-34.778791	2,294.9965	3,819.4694	437.13557	300
Slice 17	-406.87563	-36.369869	2,394.2798	3,951.5848	446.55003	300
Slice 18	-401.64545	-37.750614	2,480.4383	4,063.6797	453.98717	300
Slice 19	-396.41527	-38.927118	2,553.8522	4,155.0544	459.13735	300
Slice 20	-391.18509	-39.904388	2,614.8338	4,224.7396	461.63306	300
Slice 21	-385.57	-40.728819	2,666.2783	4,268.457	459.41736	300
Slice 22	-379.57	-41.373637	2,706.5149	4,281.0641	451.49471	300
Slice 23	-373.57	-41.769251	2,731.2013	4,254.4594	436.78724	300
Slice 24	-367.57	-41.917688	2,740.4637	4,186.4777	414.63784	300
Slice 25	-362.00874	-41.84358	2,735.8394	4,099.1296	390.91717	300
Slice 26	-356.88621	-41.580074	2,719.3966	3,997.1197	366.38121	300
Slice 27	-351.76369	-41.135719	2,691.6689	3,865.6286	336.62753	300
Slice 28	-346.64117	-40.508849	2,652.5522	3,704.1319	301.53563	300

Slice 29	-341.51864	-39.697077	2,601.8976	3,512.382	261.07719	300
Slice 30	-336.39612	-38.697249	2,539.5083	3,290.4167	215.31952	300
Slice 31	-331.2736	-37.505382	2,465.1358	3,038.5501	164.4239	300
Slice 32	-326.15107	-36.116579	2,378.4745	2,757.3434	108.63891	300
Slice 33	-321.02855	-34.524921	2,279.1551	2,447.557	48.288455	300

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 76+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Light Green	Lean Clay	125	200	23	300	19	2
Pink	Fat Clay	115	300	16	310	14	2
Orange	Silty Sand	120	0	33	0.1	32.9	2
Grey	Silt	110	0	31	0.1	30.9	2



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 78

Date: 4/26/2018

Time: 9:38:41 PM

Tool Version: 8.16.1.13452

File Name: 076+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\076+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:39:26 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 300 psf

Phi': 16 °

Phi-B: 0 °

Cohesion R: 310 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 32.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 30.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (-495.93678, 153.76171) ft

Lower Left: (-495.93678, 16.00861) ft

Lower Right: (-219.84049, 16.00861) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 15

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-569.06304, 7.45119) ft

Upper Right Coordinate: (-551.00644, 7.45119) ft

Lower Left Coordinate: (-569.06304, -64.38558) ft

Lower Right Coordinate: (-551.00644, -64.38558) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 10) ft

Right Coordinate: (100, -51.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

--	--	--

	X (ft)	Y (ft)
Coordinate 1	-600	12.49
Coordinate 2	100	12.49

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-445	8
Coordinate 3	-410	-3.69
Coordinate 4	100	-3.69

Points

	X (ft)	Y (ft)
Point 1	-600	-14.31
Point 2	-600	-18.31
Point 3	-600	-42.31
Point 4	-600	-50.31
Point 5	-600	-54.31
Point 6	100	-54.31
Point 7	-600	-66.31
Point 8	100	-66.31
Point 9	-600	-10.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-292.57	-42.31
Point 13	-364.57	-18.31
Point 14	-376.57	-14.31
Point 15	-388.57	-10.31
Point 16	-600	10
Point 17	-571	9.66667
Point 18	-567	9
Point 19	-541	8.66667
Point 20	-525	9
Point 21	-475	9
Point 22	-446	9
Point 23	-184	-50.5
Point 24	-180	-51.33333
Point 25	-128	-51.66667
Point 26	-114	-50.66667
Point 27	-69	-51.33333
Point 28	7	-51.66667
Point 29	24	-52.33333
Point 30	40	-52
Point 31	100	-51.66667

Regions

	Material	Points	Area (ft ²)

Region 1	Lean Clay	1,14,13,2	917.72
Region 2	Fat Clay	2,13,12,3	6,514.3
Region 3	Silty Sand	5,7,8,6	8,400
Region 4	Lean Clay	10,4,3,12,11	2,564.1
Region 5	Silty Sand	9,1,14,15	869.72
Region 6	Fat Clay	16,17,18,19,20,21,22,15,9	3,546.7
Region 7	Silt	4,10,23,24,25,26,27,28,29,30,31,6,5	2,403.7

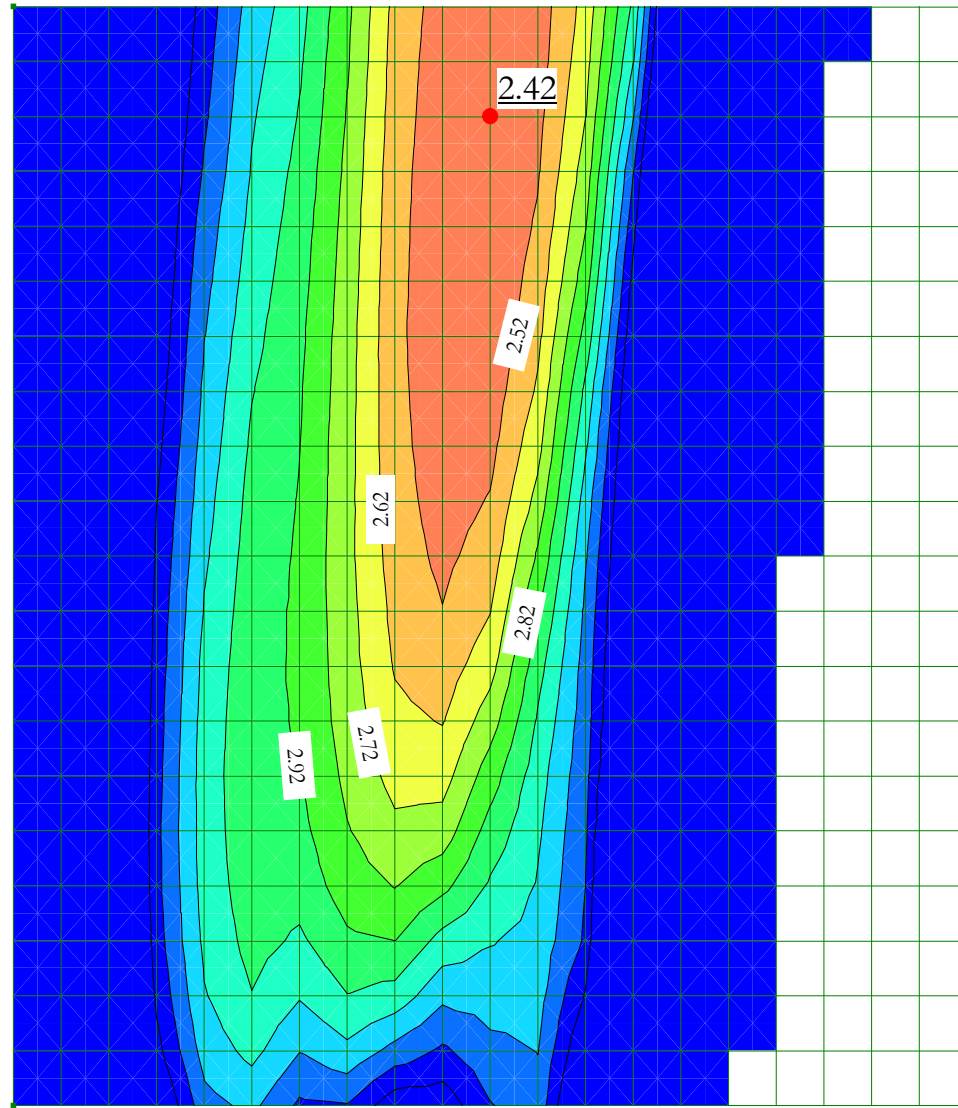
Current Slip Surface

Slip Surface: 12,744
 F of S: 1.62
 Volume: 3,495.0611 ft³
 Weight: 406,562.09 lbs
 Resisting Moment: 16,214,315 lbs-ft
 Activating Moment: 9,992,128.6 lbs-ft
 Resisting Force: 100,663.29 lbs
 Activating Force: 62,198.57 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (-319.0937, -33.468765) ft
 Entry: (-478.90859, 9) ft
 Radius: 149.24182 ft
 Center: (-367.09184, 107.84401) ft

Slip Slices

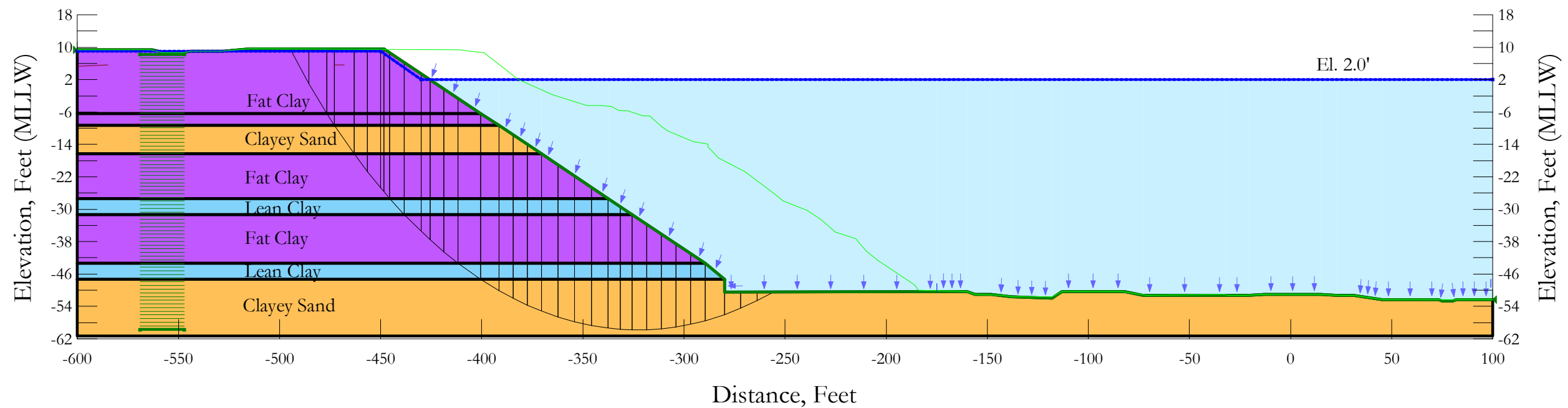
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-478.46258	8.5	-31.2	-124.32799	-35.650478	300
Slice 2	-476.50829	6.3736007	101.48731	105.12107	0	298.72332
Slice 3	-472.21102	1.977902	375.77892	580.11016	58.591041	300
Slice 4	-466.63307	-3.2894586	704.46221	1,142.5438	125.61786	300
Slice 5	-461.05512	-8.0487598	1,001.4426	1,644.9219	184.51473	300
Slice 6	-455.54949	-12.31	1,267.344	2,100.896	541.31497	0
Slice 7	-449.83178	-16.31	1,516.944	2,537.9219	433.37941	200
Slice 8	-446.41536	-18.570632	1,658.0074	2,809.7664	330.26157	300
Slice 9	-445.5	-19.139996	1,693.5357	2,854.2132	332.81891	300
Slice 10	-442.5	-20.912886	1,576.223	2,928.1603	387.66177	300
Slice 11	-437.5	-23.715001	1,639.7771	3,061.9667	407.8063	300
Slice 12	-432.5	-26.272203	1,689.5824	3,176.3541	426.32491	300
Slice 13	-427.5	-28.598291	1,726.4136	3,272.6331	443.37131	300
Slice 14	-422.5	-30.70493	1,750.9254	3,351.6091	458.98866	300
Slice 15	-417.5	-32.60201	1,763.6731	3,413.6455	473.12197	300
Slice 16	-412.5	-34.297938	1,765.1287	3,458.7201	485.62953	300
Slice 17	-409.12929	-35.352189	1,975.7206	3,486.9565	433.33992	300
Slice						

18	-405.79751	-36.268791	2,032.9165	3,548.854	434.68809	300
Slice 19	-400.87537	-37.501824	2,109.8578	3,656.0121	443.35261	300
Slice 20	-395.95322	-38.559032	2,175.8276	3,745.7874	450.17873	300
Slice 21	-391.03107	-39.444205	2,231.0624	3,816.9935	454.75843	300
Slice 22	-385.57	-40.21861	2,279.3853	3,866.7057	455.15681	300
Slice 23	-379.57	-40.844773	2,318.4578	3,887.8332	450.01116	300
Slice 24	-373.57	-41.226907	2,342.303	3,868.8275	437.72387	300
Slice 25	-367.57	-41.366892	2,351.038	3,806.8633	417.45119	300
Slice 26	-362.04354	-41.290983	2,346.3014	3,724.0037	395.04977	300
Slice 27	-356.99062	-41.034043	2,330.2683	3,625.5942	371.42872	300
Slice 28	-351.9377	-40.604716	2,303.4783	3,496.7508	342.16539	300
Slice 29	-346.88477	-40.001497	2,265.8374	3,336.9946	307.14938	300
Slice 30	-341.83185	-39.222245	2,217.2121	3,146.2479	266.39674	300
Slice 31	-336.77893	-38.26414	2,157.4263	2,924.8449	220.05374	300
Slice 32	-331.72601	-37.12363	2,086.2585	2,673.5168	168.3936	300
Slice 33	-326.67309	-35.796366	2,003.4372	2,393.3503	111.80578	300
Slice 34	-321.62017	-34.277107	1,908.6355	2,085.7207	50.778352	300



Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 92+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	115	0	32	
Light Blue	Lean Clay (undrained)	125			1,000
Purple	Fat Clay (undrained)	115			1,200



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 90

Date: 4/26/2018

Time: 9:49:04 PM

Tool Version: 8.16.1.13452

File Name: 092+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\092+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:50:04 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 2 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-470, 204.62228) ft

Lower Left: (-470, 35.16828) ft

Lower Right: (-176, 35.16828) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-569.09642, 8.23153) ft
Upper Right Coordinate: (-547.0701, 8.23153) ft
Lower Left Coordinate: (-569.09642, -59.79444) ft
Lower Right Coordinate: (-547.0701, -59.79444) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 9.33333) ft
Right Coordinate: (100, -52.33333) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	9
Coordinate 2	-450	9
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-6.31
Point 2	-600	-9.31
Point 3	-600	-16.31
Point 4	-600	-27.31
Point 5	-600	-31.31
Point 6	-600	-43.31
Point 7	-600	-47.31
Point 8	-175	-48.64333
Point 9	-600	9.33333
Point 10	-563	9.33333
Point 11	-557	8.66667
Point 12	-548	8.66667
Point 13	-544	9
Point 14	-528	9
Point 15	-515	9.66667

Point 16	-448.5	9.66667
Point 17	-400.57	-6.31
Point 18	-280	-47.31
Point 19	-280	-50.5
Point 20	-175	-50.33333
Point 21	-160	-50.33333
Point 22	-156	-51
Point 23	-148	-51
Point 24	-138	-51.66667
Point 25	-118	-52
Point 26	-113	-50.33333
Point 27	-82	-50.33333
Point 28	-73	-51.33333
Point 29	-32	-51.33333
Point 30	-21	-51.33333
Point 31	-13	-51
Point 32	15	-51
Point 33	23	-51.33333
Point 34	31	-51.33333
Point 35	45	-52.33333
Point 36	73	-52.33333
Point 37	75	-52.66667
Point 38	80	-52.66667
Point 39	82	-52.33333
Point 40	100	-52.33333
Point 41	100	-61.33333
Point 42	-600	-61.33333
Point 43	-280	-46.5
Point 44	-289.57	-43.31
Point 45	-325.57	-31.31
Point 46	-337.57	-27.31
Point 47	-370.57	-16.31
Point 48	-391.57	-9.31

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay (undrained)	48,2,1,17	611.79
Region 2	Clayey Sand	47,3,2,48	1,532.5
Region 3	Fat Clay (undrained)	46,4,3,47	2,705.2
Region 4	Lean Clay (undrained)	45,5,4,46	1,073.7
Region 5	Fat Clay (undrained)	44,6,5,45	3,509.2
Region 6	Lean Clay (undrained)	18,7,6,44	1,260.9
Region 7	Fat Clay (undrained)	9,10,11,12,13,14,15,16,17,1	2,759.7
Region		7,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42	8,378

8	Clayey Sand	
---	-------------	--

Current Slip Surface

Slip Surface: 29,564
 F of S: 2.42
 Volume: 6,478.1988 ft³
 Weight: 754,263.69 lbs
 Resisting Moment: 62,296,168 lbs-ft
 Activating Moment: 25,691,002 lbs-ft
 Resisting Force: 231,389.58 lbs
 Activating Force: 95,811.67 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-255.67826, -50.461393) ft
 Entry: (-494.91399, 9.66667) ft
 Radius: 247.47132 ft
 Center: (-323, 187.67688) ft

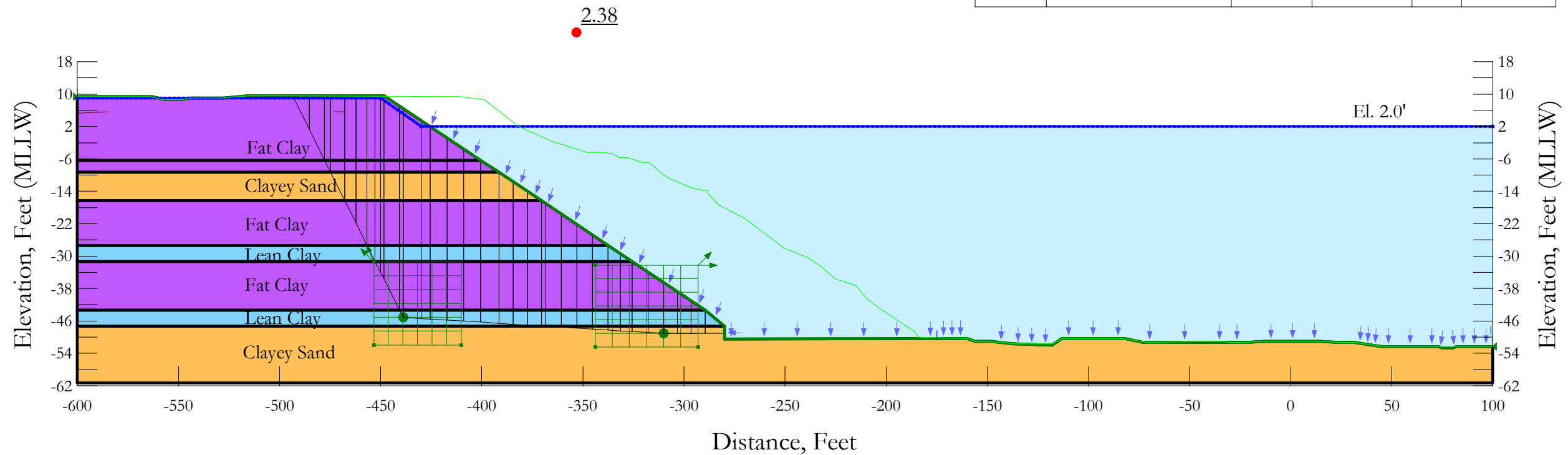
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-494.56749	9.333335	-20.800104	-437.21766	0	1,200
Slice 2	-489.83054	4.9906056	250.18621	89.51442	0	1,200
Slice 3	-481.04963	-2.6643944	727.85821	1,005.6634	0	1,200
Slice 4	-474.72656	-7.81	1,048.944	1,613.5345	0	1,200
Slice 5	-467.95303	-12.81	1,360.944	2,361.2671	625.07122	0
Slice 6	-459.83409	-18.485692	1,715.1072	2,856.4772	0	1,200
Slice 7	-453.27803	-22.691422	1,977.5447	3,344.0767	0	1,200
Slice 8	-449.25	-25.166328	1,884.7206	3,630.8606	0	1,200
Slice 9	-447.03355	-26.460599	1,913.5449	3,725.9145	0	1,200
Slice 10	-441.91775	-29.31	1,972.4076	3,925.7211	0	1,000
Slice 11	-434.13419	-33.388347	2,047.6825	4,089.0199	0	1,200
Slice 12	-427.75	-36.517956	2,403.5205	4,218.4401	0	1,200
Slice 13	-422.07735	-39.064781	2,562.4423	4,379.7091	0	1,200
Slice 14	-415.23207	-41.935171	2,741.5547	4,610.0482	0	1,200
Slice 15	-406.18972	-45.316506	2,952.55	4,916.2112	0	1,000
Slice 16	-396.07	-48.713992	3,164.5531	5,161.5636	1,247.8707	0
Slice 17	-388.07	-51.058935	3,310.8775	5,327.6814	1,260.2389	0
Slice 18	-381.07	-52.857869	3,423.131	5,446.8801	1,264.5788	0
Slice 19	-374.07	-54.441096	3,521.9244	5,542.9944	1,262.9047	0
Slice 20	-366.445	-55.915052	3,613.8992	5,619.7582	1,253.3998	0
Slice						

21	-358.195	-57.243514	3,696.7952	5,671.7733	1,234.1033	0
Slice 22	-349.945	-58.288161	3,761.9812	5,689.1874	1,204.2521	0
Slice 23	-341.695	-59.052603	3,809.6824	5,670.8309	1,162.9746	0
Slice 24	-334.57	-59.505582	3,837.9483	5,617.2287	1,111.8178	0
Slice 25	-328.57	-59.71355	3,850.9255	5,536.7346	1,053.4105	0
Slice 26	-321.97	-59.76611	3,854.2052	5,435.3462	988.00653	0
Slice 27	-314.77	-59.631322	3,845.7945	5,307.8285	913.58023	0
Slice 28	-307.57	-59.286597	3,824.2836	5,149.5059	828.09078	0
Slice 29	-300.37	-58.73105	3,789.6175	4,959.8612	731.24941	0
Slice 30	-293.17	-57.963251	3,741.7069	4,738.4862	622.85682	0
Slice 31	-284.785	-56.778049	3,667.7502	4,420.9787	470.6694	0
Slice 32	-275.94638	-55.244841	3,572.0781	3,863.5757	182.14789	0
Slice 33	-267.83913	-53.532658	3,465.2379	3,654.1727	118.05957	0
Slice 34	-259.73188	-51.533525	3,340.492	3,407.0292	41.577085	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 92+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	115	0	32	
Light Blue	Lean Clay (undrained)	125			1,000
Purple	Fat Clay (undrained)	115			1,200



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 90

Date: 4/26/2018

Time: 9:49:04 PM

Tool Version: 8.16.1.13452

File Name: 092+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\092+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:50:20 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 2 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-600, 9.33333) ft

Right Coordinate: (100, -52.33333) ft

Slip Surface Block

Left Grid

Upper Left: (-453.30442, -31.40467) ft
Lower Left: (-453.30442, -51.98319) ft
Lower Right: (-410.10442, -51.98319) ft
X Increments: 6
Y Increments: 6
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2

Right Grid

Upper Left: (-343.94775, -32.31147) ft
Lower Left: (-343.94775, -52.48459) ft
Lower Right: (-293.096, -52.48459) ft
X Increments: 6
Y Increments: 6
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	9
Coordinate 2	-450	9
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-6.31
Point 2	-600	-9.31
Point 3	-600	-16.31
Point 4	-600	-27.31
Point 5	-600	-31.31
Point 6	-600	-43.31
Point 7	-600	-47.31
Point 8	-175	-48.64333
Point 9	-600	9.33333
Point 10	-563	9.33333
Point 11	-557	8.66667
Point 12	-548	8.66667
Point 13	-544	9
Point 14	-528	9
Point 15	-515	9.66667
Point 16	-448.5	9.66667

Point 17	-400.57	-6.31
Point 18	-280	-47.31
Point 19	-280	-50.5
Point 20	-175	-50.33333
Point 21	-160	-50.33333
Point 22	-156	-51
Point 23	-148	-51
Point 24	-138	-51.66667
Point 25	-118	-52
Point 26	-113	-50.33333
Point 27	-82	-50.33333
Point 28	-73	-51.33333
Point 29	-32	-51.33333
Point 30	-21	-51.33333
Point 31	-13	-51
Point 32	15	-51
Point 33	23	-51.33333
Point 34	31	-51.33333
Point 35	45	-52.33333
Point 36	73	-52.33333
Point 37	75	-52.66667
Point 38	80	-52.66667
Point 39	82	-52.33333
Point 40	100	-52.33333
Point 41	100	-61.33333
Point 42	-600	-61.33333
Point 43	-280	-46.5
Point 44	-289.57	-43.31
Point 45	-325.57	-31.31
Point 46	-337.57	-27.31
Point 47	-370.57	-16.31
Point 48	-391.57	-9.31

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay (undrained)	48,2,1,17	611.79
Region 2	Clayey Sand	47,3,2,48	1,532.5
Region 3	Fat Clay (undrained)	46,4,3,47	2,705.2
Region 4	Lean Clay (undrained)	45,5,4,46	1,073.7
Region 5	Fat Clay (undrained)	44,6,5,45	3,509.2
Region 6	Lean Clay (undrained)	18,7,6,44	1,260.9
Region 7	Fat Clay (undrained)	9,10,11,12,13,14,15,16,17,1	2,759.7
Region 8	Clayey Sand	7,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42	8,378

Current Slip Surface

Slip Surface: 7,384

F of S: 2.38

Volume: 5,849.2838 ft³

Weight: 683,004.62 lbs

Resisting Moment: 17,015,925 lbs-ft

Activating Moment: 7,205,425.5 lbs-ft

Resisting Force: 185,396.93 lbs

Activating Force: 78,365.672 lbs

F of S Rank (Analysis): 1 of 21,609 slip surfaces

F of S Rank (Query): 1 of 21,609 slip surfaces

Exit: (-280, -49.122403) ft

Entry: (-493.69477, 9.66667) ft

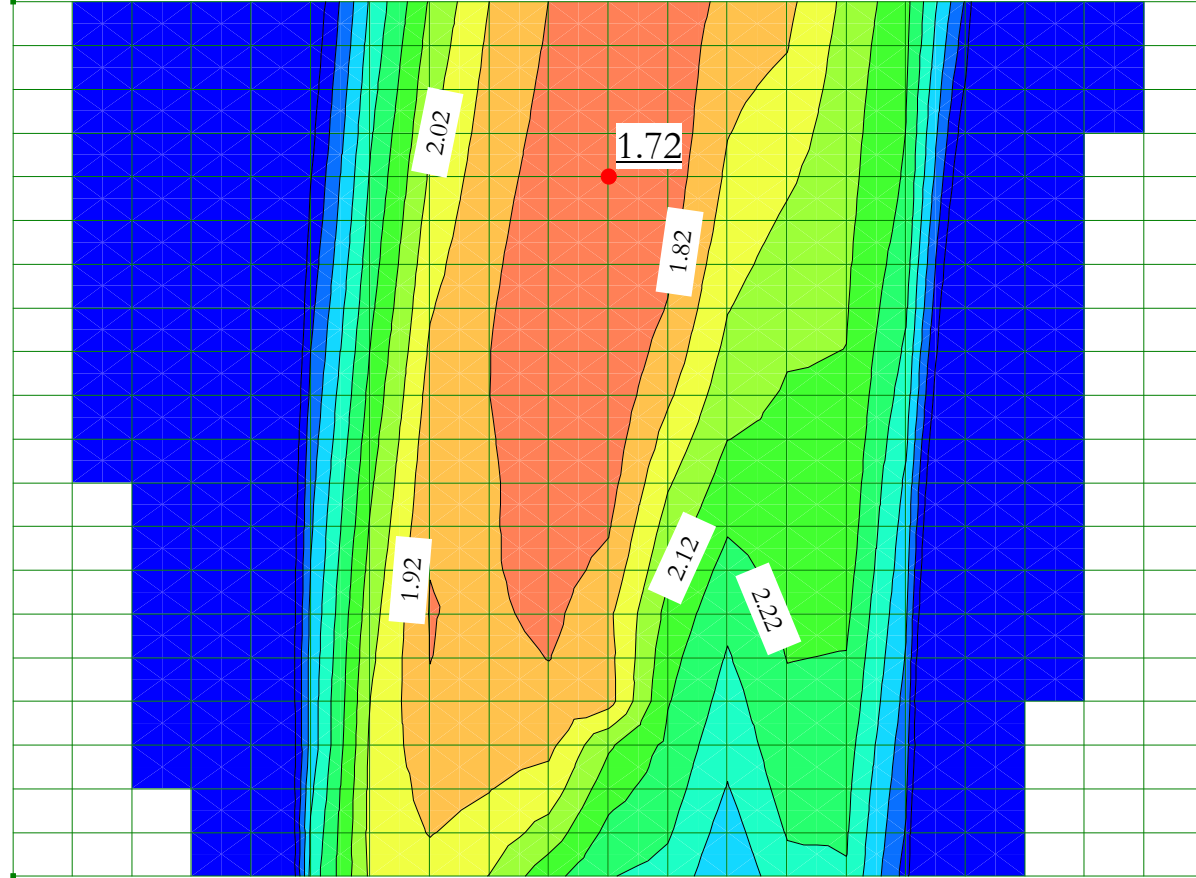
Radius: 103.96458 ft

Center: (-374.71739, 24.363938) ft

Slip Slices

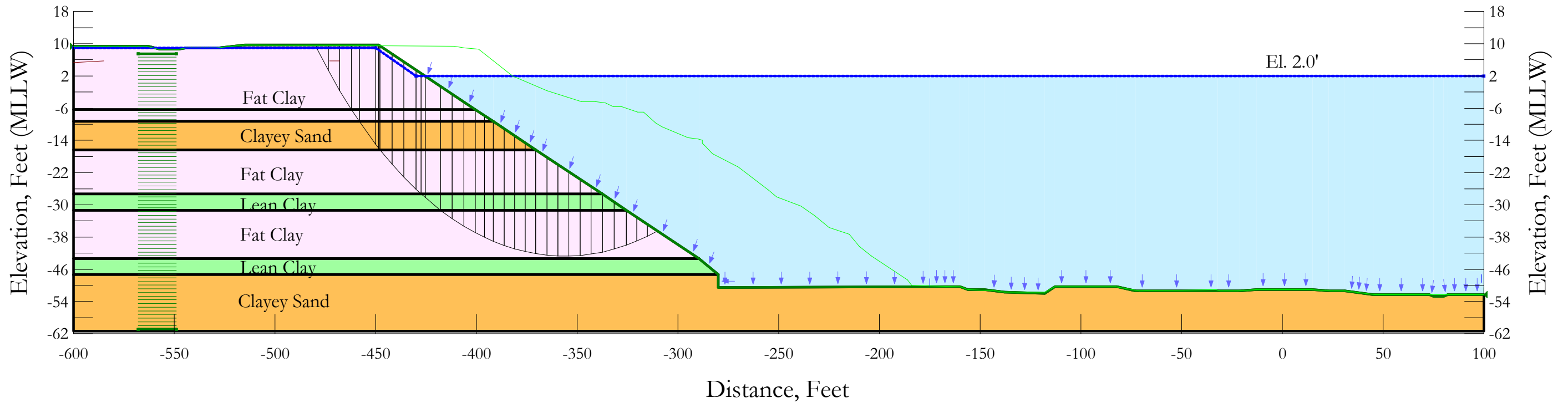
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-493.36144	9.333335	-20.800104	-469.09899	0	1,200
Slice 2	-489.2006	5.1725	238.836	13.43565	0	1,200
Slice 3	-481.5456	-2.4825	716.508	887.42529	0	1,200
Slice 4	-476.2181	-7.81	1,048.944	1,485.0921	0	1,200
Slice 5	-471.2181	-12.81	1,360.944	2,287.2908	578.84572	0
Slice 6	-464.9681	-19.06	1,750.944	2,715.1434	0	1,200
Slice 7	-459.4681	-24.56	2,094.144	3,306.6607	0	1,200
Slice 8	-454.7181	-29.31	2,390.544	3,910.334	0	1,000
Slice 9	-451.35905	-32.669052	2,600.1488	4,205.8477	0	1,200
Slice 10	-449.25	-34.778103	2,419.0411	4,428.0034	0	1,200
Slice 11	-444.60905	-39.419052	2,586.7354	4,772.2678	0	1,200
Slice 12	-439.81126	-44.216842	2,760.097	5,184.8751	0	1,000
Slice 13	-434.45221	-45.261844	2,713.9201	5,764.7777	0	1,000
Slice 14	-427.75	-45.469828	2,962.1172	5,544.9221	0	1,000
Slice 15	-421.345	-45.668588	2,974.5199	5,423.1125	0	1,000
Slice 16	-413.035	-45.926464	2,990.6114	5,327.3802	0	1,000
Slice 17	-404.725	-46.18434	3,006.7028	5,231.8458	0	1,000
Slice 18	-396.07	-46.452922	3,023.4623	5,131.9218	0	1,000
Slice 19	-388.07	-46.701178	3,038.9535	5,038.6568	0	1,000
Slice 20	-381.07	-46.918403	3,052.5083	4,955.8937	0	1,000
Slice 21	-374.07	-47.135627	3,066.0631	4,871.7382	0	1,000
Slice 22	-369.51043	-47.277119	3,074.8923	4,816.1053	0	1,000

Slice 23	-364.59076	-47.429787	3,084.4187	4,754.4076	1,043.5249	0
Slice 24	-356.87054	-47.669361	3,099.3681	4,653.2975	971.00284	0
Slice 25	-349.15032	-47.908935	3,114.3175	4,549.7707	896.97068	0
Slice 26	-341.43011	-48.148509	3,129.267	4,443.7667	821.39059	0
Slice 27	-334.57	-48.361392	3,142.5509	4,337.5068	746.6913	0
Slice 28	-328.57	-48.547584	3,154.1693	4,231.7178	673.32701	0
Slice 29	-321.68915	-48.761111	3,167.4933	4,121.6424	596.2185	0
Slice 30	-313.92744	-49.001973	3,182.5231	4,006.7393	515.02744	0
Slice 31	-306.63382	-49.122403	3,190.038	3,893.2439	439.41181	0
Slice 32	-299.80829	-49.122403	3,190.038	3,762.0377	357.42506	0
Slice 33	-292.98276	-49.122403	3,190.038	3,629.7176	274.74232	0
Slice 34	-284.785	-49.122403	3,190.038	3,428.3673	148.92467	0



Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 92+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Light Green	Lean Clay	125	200	23
Light Pink	Fat Clay	115	200	18
Light Orange	Clayey Sand	115	0	32



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 90

Date: 4/26/2018

Time: 9:49:04 PM

Tool Version: 8.16.1.13452

File Name: 092+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\092+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:49:24 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-520.01625, 153.9474) ft
Lower Left: (-520.01625, 33.6521) ft
Lower Right: (-192.19958, 33.6521) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-568, 7.45533) ft
Upper Right Coordinate: (-549, 7.45533) ft
Lower Left Coordinate: (-568, -60.97977) ft
Lower Right Coordinate: (-549, -60.97977) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 9.33333) ft
Right Coordinate: (100, -52.33333) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	9
Coordinate 2	-450	9
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-6.31
Point 2	-600	-9.31
Point 3	-600	-16.31
Point 4	-600	-27.31
Point 5	-600	-31.31
Point 6	-600	-43.31
Point 7	-600	-47.31
Point 8	-175	-48.64333
Point 9	-600	9.33333
Point 10	-563	9.33333
Point 11	-557	8.66667

Point 12	-548	8.66667
Point 13	-544	9
Point 14	-528	9
Point 15	-515	9.66667
Point 16	-448.5	9.66667
Point 17	-400.57	-6.31
Point 18	-280	-47.31
Point 19	-280	-50.5
Point 20	-175	-50.33333
Point 21	-160	-50.33333
Point 22	-156	-51
Point 23	-148	-51
Point 24	-138	-51.66667
Point 25	-118	-52
Point 26	-113	-50.33333
Point 27	-82	-50.33333
Point 28	-73	-51.33333
Point 29	-32	-51.33333
Point 30	-21	-51.33333
Point 31	-13	-51
Point 32	15	-51
Point 33	23	-51.33333
Point 34	31	-51.33333
Point 35	45	-52.33333
Point 36	73	-52.33333
Point 37	75	-52.66667
Point 38	80	-52.66667
Point 39	82	-52.33333
Point 40	100	-52.33333
Point 41	100	-61.33333
Point 42	-600	-61.33333
Point 43	-280	-46.5
Point 44	-289.57	-43.31
Point 45	-325.57	-31.31
Point 46	-337.57	-27.31
Point 47	-370.57	-16.31
Point 48	-391.57	-9.31

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay	48,2,1,17	611.79
Region 2	Clayey Sand	47,3,2,48	1,532.5
Region 3	Fat Clay	46,4,3,47	2,705.2
Region 4	Lean Clay	45,5,4,46	1,073.7
Region 5	Fat Clay	44,6,5,45	3,509.2
Region	Lean Clay	18,7,6,44	1,260.9

6			
Region 7	Fat Clay	9,10,11,12,13,14,15,16,17,1	2,759.7
Region 8	Clayey Sand	7,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42	8,378

Current Slip Surface

Slip Surface: 26,352

F of S: 1.72

Volume: 3,597.7186 ft³

Weight: 417,382.97 lbs

Resisting Moment: 17,787,737 lbs-ft

Activating Moment: 10,369,497 lbs-ft

Resisting Force: 96,046.248 lbs

Activating Force: 56,186.935 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (-310.06789, -36.477369) ft

Entry: (-479.97875, 9.66667) ft

Radius: 172.61875 ft

Center: (-356.10791, 129.88834) ft

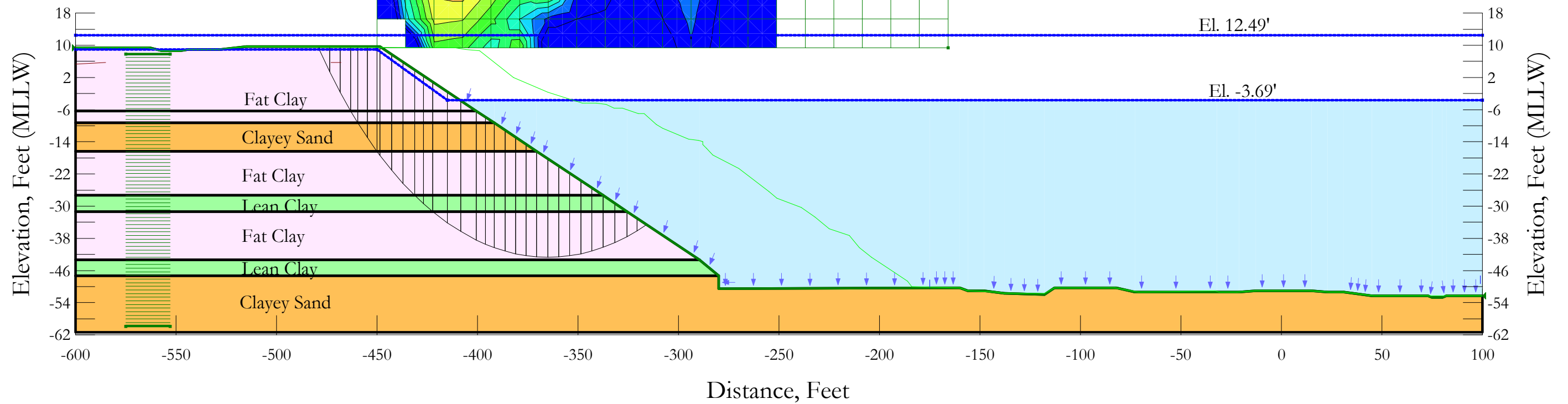
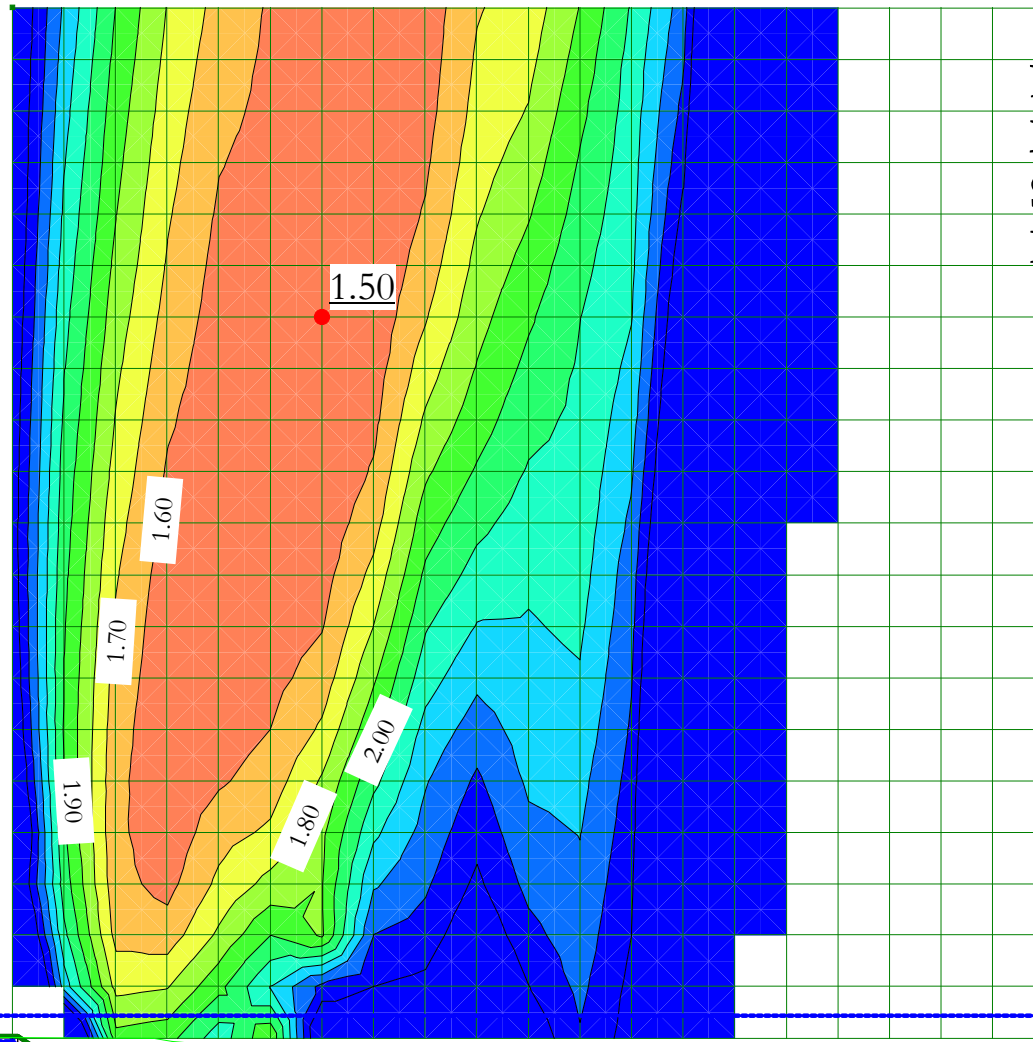
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-479.65348	9.333335	-20.800104	-67.738516	-22.009578	200
Slice 2	-476.467	6.2154542	173.75566	265.22035	29.718678	200
Slice 3	-470.74458	0.88827582	506.17159	835.47706	106.99783	200
Slice 4	-465.02216	-3.9821783	810.08793	1,352.1699	176.1331	200
Slice 5	-460.17621	-7.81	1,048.944	1,756.6907	229.96085	200
Slice 6	-454.09574	-12.135807	1,318.8744	2,193.8599	546.7516	0
Slice 7	-449.25	-15.442288	1,344.1592	2,504.9734	725.35723	0
Slice 8	-448.19317	-16.11648	1,361.0754	2,562.2757	750.59326	0
Slice 9	-444.90528	-18.098737	1,407.2984	2,705.8227	421.91613	200
Slice 10	-438.94317	-21.518421	1,481.3971	2,867.7369	450.4491	200
Slice 11	-432.98106	-24.632425	1,538.503	3,003.3037	475.94261	200
Slice 12	-428.71176	-26.712741	1,791.6751	3,102.0714	425.77358	200
Slice 13	-426.46175	-27.739262	1,855.7299	3,123.3937	538.09137	200
Slice 14	-421.67598	-29.739262	1,980.5299	3,287.6542	554.84136	200
Slice 15	-414.97164	-32.355016	2,143.753	3,537.9557	453.00391	200
Slice 16	-409.21098	-34.331431	2,267.0813	3,698.5249	465.10421	200
Slice 17	-403.45033	-36.084421	2,376.4679	3,839.2385	475.28296	200
Slice 18	-398.32	-37.473508	2,463.1469	3,948.559	482.63964	200
Slice						

19	-393.82	-38.544778	2,529.9941	4,029.7188	487.2901	200
Slice 20	-388.945	-39.557254	2,593.1726	4,101.8941	490.21333	200
Slice 21	-383.695	-40.490985	2,651.4375	4,161.8588	490.76563	200
Slice 22	-378.445	-41.258613	2,699.3374	4,201.6499	488.13091	200
Slice 23	-373.195	-41.862368	2,737.0117	4,220.1278	481.89365	200
Slice 24	-367.82	-42.310564	2,764.9792	4,215.5138	471.30727	200
Slice 25	-362.32	-42.596646	2,782.8307	4,185.4034	455.7235	200
Slice 26	-356.82	-42.707034	2,789.7189	4,128.1914	434.89609	200
Slice 27	-351.32	-42.642064	2,785.6648	4,042.8646	408.48897	200
Slice 28	-345.82	-42.401538	2,770.656	3,928.6326	376.24941	200
Slice 29	-340.32	-41.984719	2,744.6464	3,784.9718	338.02221	200
Slice 30	-334.57	-41.354787	2,705.3387	3,592.1351	288.13763	200
Slice 31	-328.57	-40.492589	2,651.5376	3,347.0102	225.97273	200
Slice 32	-322.98632	-39.502515	2,589.757	3,097.6223	165.01543	200
Slice 33	-317.81895	-38.409511	2,521.5535	2,849.656	106.60696	200
Slice 34	-312.65158	-37.149537	2,442.9311	2,577.4281	43.70073	200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 92+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Light Green	Lean Clay	125	200	23	300	19	2
Light Purple	Fat Clay	115	200	18	300	14	2
Orange	Clayey Sand	115	0	32	0.1	31.9	2



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 90

Date: 4/26/2018

Time: 9:49:04 PM

Tool Version: 8.16.1.13452

File Name: 092+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\092+00\

Last Solved Date: 4/26/2018

Last Solved Time: 9:49:54 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 31.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (-449.94274, 151.23333) ft

Lower Left: (-449.94274, 9.32857) ft

Lower Right: (-165.92983, 9.32857) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-574.99231, 7.86324) ft

Upper Right Coordinate: (-552.98645, 7.86324) ft

Lower Left Coordinate: (-574.99231, -59.87761) ft

Lower Right Coordinate: (-552.98645, -59.87761) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 9.33333) ft

Right Coordinate: (100, -52.33333) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12.49
Coordinate 2	100	12.49

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	9
Coordinate 2	-450	9
Coordinate 3	-415	-3.69

Coordinate 4	100	-3.69
--------------	-----	-------

Points

	X (ft)	Y (ft)
Point 1	-600	-6.31
Point 2	-600	-9.31
Point 3	-600	-16.31
Point 4	-600	-27.31
Point 5	-600	-31.31
Point 6	-600	-43.31
Point 7	-600	-47.31
Point 8	-175	-48.64333
Point 9	-600	9.33333
Point 10	-563	9.33333
Point 11	-557	8.66667
Point 12	-548	8.66667
Point 13	-544	9
Point 14	-528	9
Point 15	-515	9.66667
Point 16	-448.5	9.66667
Point 17	-400.57	-6.31
Point 18	-280	-47.31
Point 19	-280	-50.5
Point 20	-175	-50.33333
Point 21	-160	-50.33333
Point 22	-156	-51
Point 23	-148	-51
Point 24	-138	-51.66667
Point 25	-118	-52
Point 26	-113	-50.33333
Point 27	-82	-50.33333
Point 28	-73	-51.33333
Point 29	-32	-51.33333
Point 30	-21	-51.33333
Point 31	-13	-51
Point 32	15	-51
Point 33	23	-51.33333
Point 34	31	-51.33333
Point 35	45	-52.33333
Point 36	73	-52.33333
Point 37	75	-52.66667
Point 38	80	-52.66667
Point 39	82	-52.33333
Point 40	100	-52.33333
Point 41	100	-61.33333
Point 42	-600	-61.33333
Point 43	-280	-46.5
Point 44	-289.57	-43.31
Point 45	-325.57	-31.31
Point 46	-337.57	-27.31
Point 47	-370.57	-16.31

Point 48	-391.57	-9.31
----------	---------	-------

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay	48,2,1,17	611.79
Region 2	Clayey Sand	47,3,2,48	1,532.5
Region 3	Fat Clay	46,4,3,47	2,705.2
Region 4	Lean Clay	45,5,4,46	1,073.7
Region 5	Fat Clay	44,6,5,45	3,509.2
Region 6	Lean Clay	18,7,6,44	1,260.9
Region 7	Fat Clay	9,10,11,12,13,14,15,16,17,1	2,759.7
Region 8	Clayey Sand	7,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42	8,378

Current Slip Surface

Slip Surface: 22,857

F of S: 1.50

Volume: 3,655.9036 ft³

Weight: 424,243.18 lbs

Resisting Moment: 15,836,636 lbs-ft

Activating Moment: 10,527,021 lbs-ft

Resisting Force: 97,065.01 lbs

Activating Force: 64,685.404 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (-315.76891, -34.577032) ft

Entry: (-479.26132, 9.66667) ft

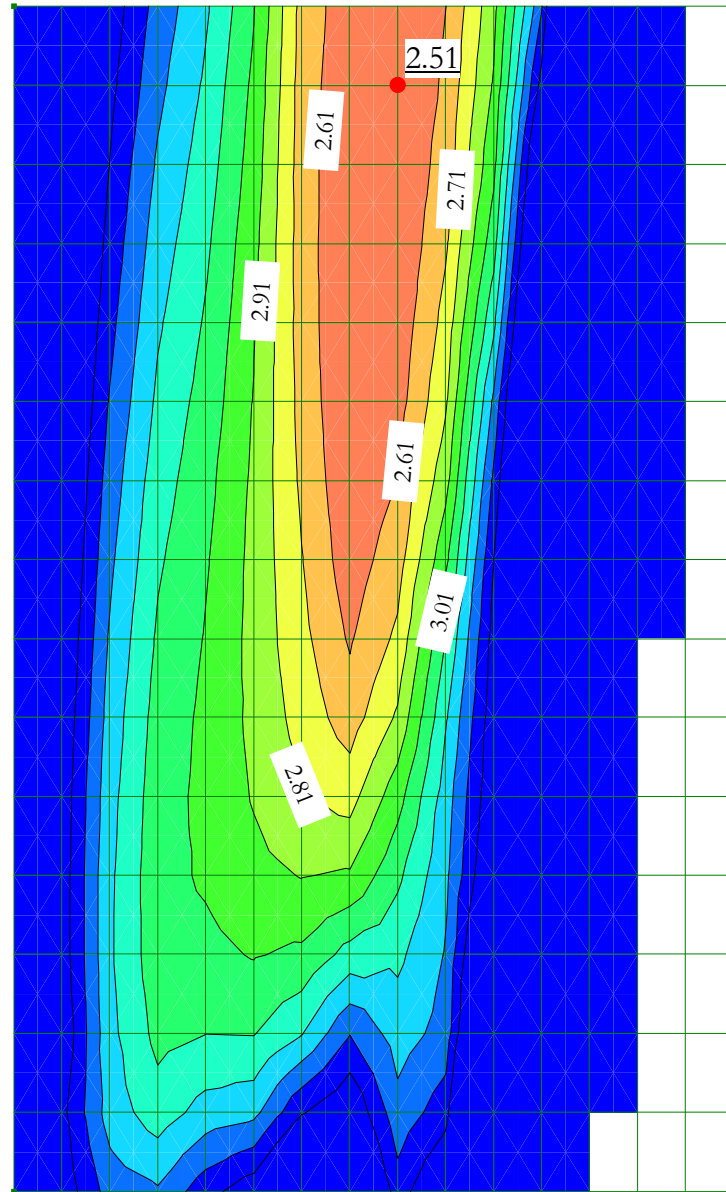
Radius: 151.3785 ft

Center: (-364.73887, 108.6619) ft

Slip Slices

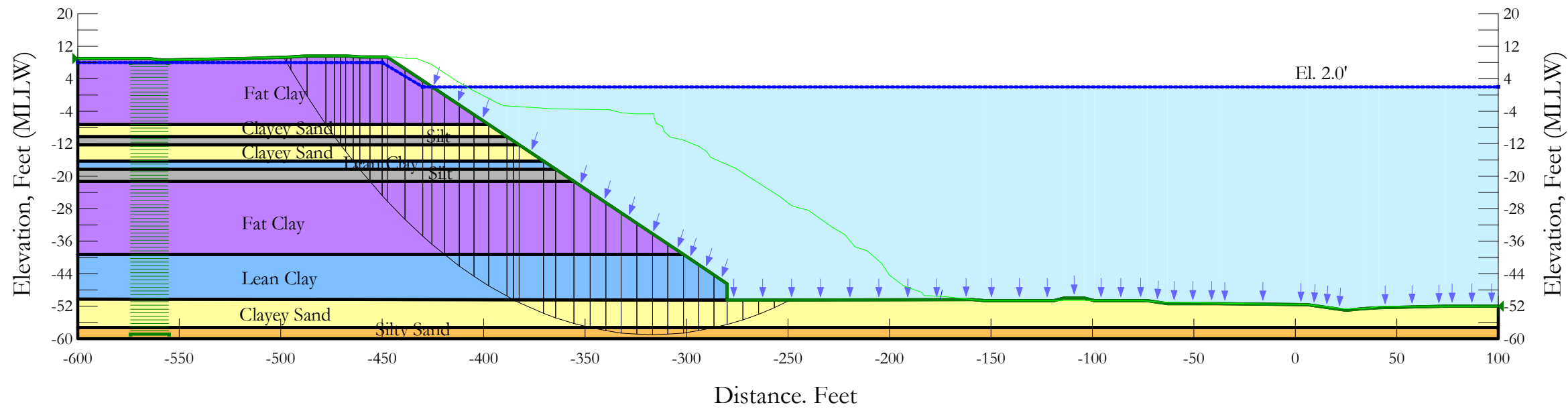
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-478.97148	9.333335	-20.800104	-91.431504	-29.707897	200
Slice 2	-476.10332	6.1977293	174.86169	238.1154	20.552376	200
Slice 3	-470.9467	0.85538068	508.22425	799.993	94.801415	200
Slice 4	-465.79007	-3.9973486	811.03455	1,303.2147	159.91902	200
Slice 5	-461.40442	-7.81	1,048.944	1,695.7702	210.16658	200
Slice 6	-457.23883	-11.130953	1,256.1714	2,024.9303	480.37387	0
Slice 7	-452.4403	-14.686965	1,478.0666	2,379.0594	563.00277	0
Slice 8	-449.25	-16.926714	1,414.8634	2,615.2626	390.03336	200
Slice 9	-445.62921	-19.24691	1,470.4217	2,758.8217	418.62654	200
Slice 10	-439.88763	-22.704663	1,546.3093	2,931.746	450.15569	200

Slice 11	-434.14605	-25.828455	1,603.7789	3,079.0347	479.33968	200
Slice 12	-429.05321	-28.353021	1,641.1733	3,170.587	649.19759	200
Slice 13	-424.60912	-30.353021	1,662.6101	3,274.2008	684.07965	200
Slice 14	-418.69354	-32.719546	1,674.8371	3,398.2569	559.97303	200
Slice 15	-411.715	-35.20175	1,966.3332	3,487.6261	494.29803	200
Slice 16	-404.5	-37.344643	2,100.0498	3,613.4709	491.74034	200
Slice 17	-398.32	-38.926824	2,198.7778	3,756.4778	506.12742	200
Slice 18	-393.82	-39.879272	2,258.2106	3,840.8977	514.2462	200
Slice 19	-388.945	-40.745062	2,312.2359	3,914.3889	520.57108	200
Slice 20	-383.695	-41.501722	2,359.4514	3,972.6382	524.15617	200
Slice 21	-378.445	-42.071782	2,395.0232	4,006.5058	523.60244	200
Slice 22	-373.195	-42.457358	2,419.0832	4,013.9682	518.20955	200
Slice 23	-367.82	-42.660239	2,431.7429	3,991.8854	506.92102	200
Slice 24	-362.32	-42.672278	2,432.4941	3,936.7079	488.7487	200
Slice 25	-356.82	-42.484244	2,420.7608	3,846.4699	463.24098	200
Slice 26	-351.32	-42.095389	2,396.4963	3,719.7633	429.95551	200
Slice 27	-345.82	-41.50415	2,359.603	3,555.6966	388.63436	200
Slice 28	-340.32	-40.70812	2,309.9307	3,353.964	339.22698	200
Slice 29	-334.57	-39.648301	2,243.798	3,091.8016	275.53307	200
Slice 30	-328.57	-38.299716	2,159.6463	2,766.3128	197.1179	200
Slice 31	-323.11973	-36.86061	2,069.8461	2,444.9567	121.88081	200
Slice 32	-318.21918	-35.368434	1,976.7343	2,136.9897	52.070144	200



Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 98+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Grey	Silt	110	0	32	
Yellow	Clayey Sand	115	0	33	
Orange	Silty Sand	120	0	32	
Light Blue	Lean Clay (undrained)	125			1,200
Purple	Fat Clay (undrained)	115			1,200



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 79

Date: 4/27/2018

Time: 11:08:27 AM

Tool Version: 8.16.1.13452

File Name: 098+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\098+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:10:06 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 3 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf
Cohesion: 1,200 psf
Pore Water Pressure
Piezometric Line: 1

Fat Clay (undrained)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 1,200 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-443.82911, 229.6386) ft
Lower Left: (-443.82911, 33.88454) ft
Lower Right: (-206.00367, 33.88454) ft
Grid Horizontal Increment: 15
Grid Vertical Increment: 15
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-573.94258, 7.85919) ft
Upper Right Coordinate: (-555.4229, 7.85919) ft
Lower Left Coordinate: (-573.94258, -58.99534) ft
Lower Right Coordinate: (-555.04494, -58.99534) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 9) ft
Right Coordinate: (100, -52) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-7.31
Point 2	-600	-10.31
Point 3	-600	-12.31
Point 4	-600	-16.31
Point 5	-600	-18.31
Point 6	-600	-21.31
Point 7	-600	-39.31
Point 8	-600	-50.31
Point 9	-600	-57.31
Point 10	100	-57.31
Point 11	-600	-60
Point 12	100	-60
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-301.57	-39.31
Point 16	-355.57	-21.31
Point 17	-364.57	-18.31
Point 18	-370.57	-16.31
Point 19	-382.57	-12.31
Point 20	-388.57	-10.31
Point 21	-397.57	-7.31
Point 22	-447.5	9.33333
Point 23	-600	9
Point 24	-565	9
Point 25	-559	8.66667
Point 26	-518	9
Point 27	-495	9.33333
Point 28	-487	9.66667
Point 29	-468	9.66667
Point 30	-461	9.33333
Point 31	-159	-50.33333
Point 32	-153	-50.66667
Point 33	-119	-50.66667
Point 34	-114	-50
Point 35	-104	-50
Point 36	-99	-50.66667
Point 37	-73	-50.66667
Point 38	-63	-51.33333
Point 39	-38	-51.33333
Point 40	6	-51.66667
Point 41	25	-53
Point 42	33	-52.66667
Point 43	41	-52.33333
Point 44	74	-52
Point 45	100	-52

Regions

	Material	Points	Area (ft ²)
--	----------	--------	-------------------------

Region 1	Clayey Sand	20,2,1,21	620.79
Region 2	Silt	19,3,2,20	428.86
Region 3	Clayey Sand	18,4,3,19	893.72
Region 4	Lean Clay (undrained)	17,5,4,18	464.86
Region 5	Silt	16,6,5,17	719.79
Region 6	Fat Clay (undrained)	15,7,6,16	4,885.7
Region 7	Silty Sand	9,11,12,10	1,883
Region 8	Lean Clay (undrained)	7,15,14,13,8	3,472.9
Region 9	Fat Clay (undrained)	23,24,25,26,27,28,29,30,22,21,1	2,923.4
Region 10	Clayey Sand	8,13,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,10,9	4,570.8

Current Slip Surface

Slip Surface: 17,708

F of S: 2.51

Volume: 6,430.6525 ft³

Weight: 752,412.25 lbs

Resisting Moment: 70,689,159 lbs-ft

Activating Moment: 28,111,272 lbs-ft

Resisting Force: 238,157.98 lbs

Activating Force: 95,027.475 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces

F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (-248.92238, -50.457192) ft

Entry: (-498.56613, 9.2816475) ft

Radius: 275.58367 ft

Center: (-316.98888, 216.58833) ft

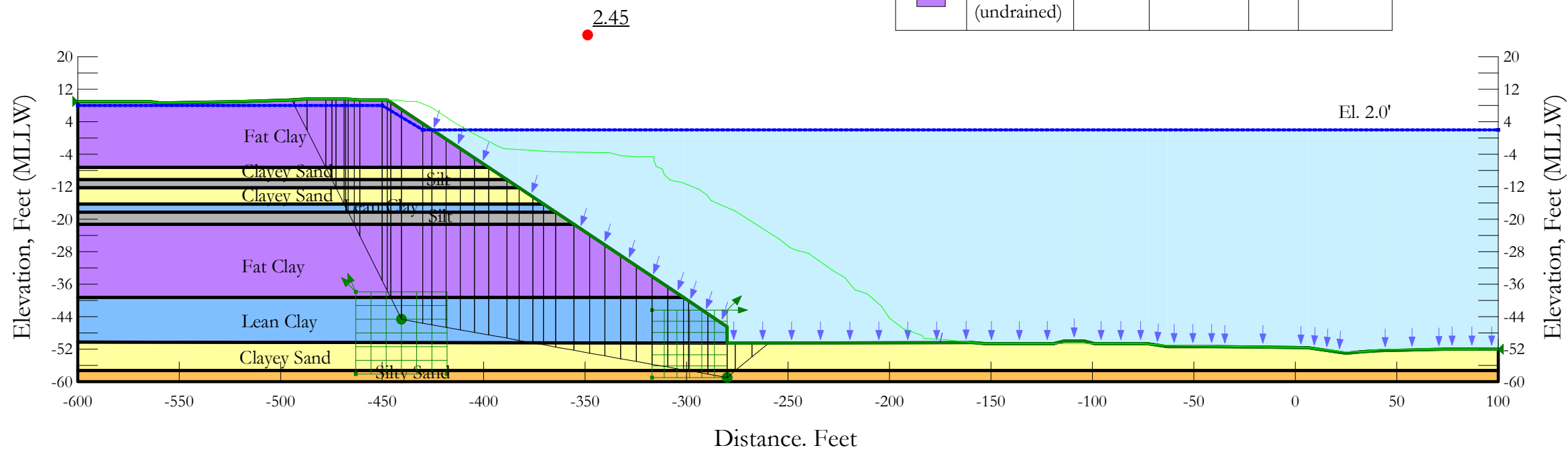
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-497.82925	8.6408238	-39.987402	-339.17445	0	1,200
Slice 2	-496.04618	7.1057643	55.800309	-150.87069	0	1,200
Slice 3	-491	2.9534257	314.90624	367.67498	0	1,200
Slice 4	-482.33107	-3.8073386	736.77793	1,187.8239	0	1,200
Slice 5	-475.52958	-8.81	1,048.944	1,940.873	579.2255	0
Slice 6	-471.92611	-11.31	1,204.944	2,207.4774	626.45238	0
Slice 7	-469.2276	-13.123578	1,318.1112	2,390.6601	696.52139	0
Slice 8	-466.15706	-15.123578	1,442.9112	2,595.2006	748.30551	0
Slice 9	-462.65706	-17.34185	1,581.3314	2,733.5063	0	1,200
Slice 10	-458.54791	-19.84185	1,737.3314	3,093.5435	847.4554	0
Slice 11	-453.04791	-23.040576	1,936.932	3,377.2199	0	1,200
Slice 12	-448.75	-25.451625	1,893.5609	3,655.8	0	1,200
Slice 13	-443.125	-28.384775	1,964.8715	3,831.2979	0	1,200
Slice 14	-434.375	-32.697594	2,061.4953	4,005.2267	0	1,200
Slice 15	-427.75	-35.745365	2,355.3108	4,114.4203	0	1,200
Slice						

16	-422.38739	-38.021498	2,497.3414	4,247.2927	0	1,200
Slice 17	-415.65731	-40.697288	2,664.3108	4,467.8149	0	1,200
Slice 18	-408.42238	-43.356987	2,830.276	4,694.4945	0	1,200
Slice 19	-401.18746	-45.790258	2,982.1121	4,896.0257	0	1,200
Slice 20	-393.07	-48.243882	3,135.2182	5,091.0295	0	1,200
Slice 21	-386.85114	-49.987111	3,243.9957	5,228.0558	0	1,200
Slice 22	-383.85114	-50.757986	3,292.0983	5,279.7161	1,290.7741	0
Slice 23	-376.57	-52.407363	3,395.0194	5,377.7208	1,287.5813	0
Slice 24	-367.57	-54.296508	3,512.9021	5,470.5244	1,271.2948	0
Slice 25	-360.07	-55.569011	3,592.3063	5,518.9446	1,251.1735	0
Slice 26	-351.49509	-56.795669	3,668.8498	5,556.8404	1,226.0754	0
Slice 27	-343.59933	-57.680711	3,724.0764	5,557.0993	1,145.3998	0
Slice 28	-335.95763	-58.315066	3,763.6601	5,528.8136	1,102.9903	0
Slice 29	-328.31594	-58.735903	3,789.9203	5,470.8089	1,050.3358	0
Slice 30	-320.67424	-58.944201	3,802.9182	5,382.3177	986.91835	0
Slice 31	-313.03254	-58.940443	3,802.6836	5,262.6345	912.27856	0
Slice 32	-305.39085	-58.724619	3,789.2163	5,111.1413	826.0304	0
Slice 33	-297.81689	-58.301903	3,762.8387	4,916.3478	720.79246	0
Slice 34	-290.31068	-57.675073	3,723.7245	4,678.2705	596.46654	0
Slice 35	-283.27879	-56.905866	3,675.7261	4,477.6383	520.76784	0
Slice 36	-276.1153	-55.919063	3,614.1495	3,941.5259	212.60074	0
Slice 37	-268.34589	-54.639698	3,534.3171	3,787.4405	164.38026	0
Slice 38	-260.57649	-53.130506	3,440.1436	3,603.2163	105.90062	0
Slice 39	-252.80708	-51.387601	3,331.3863	3,388.5665	37.13325	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 98+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Grey	Silt	110	0	32	
Yellow	Clayey Sand	115	0	33	
Orange	Silty Sand	120	0	32	
Blue	Lean Clay (undrained)	125			1,200
Purple	Fat Clay (undrained)	115			1,200



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 79

Date: 4/27/2018

Time: 11:08:27 AM

Tool Version: 8.16.1.13452

File Name: 098+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\098+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:10:26 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-600, 9) ft

Right Coordinate: (100, -52) ft

Slip Surface Block

Left Grid

Upper Left: (-462.96184, -37.90826) ft

Lower Left: (-462.96184, -58.16958) ft

Lower Right: (-418.02584, -58.16958) ft

X Increments: 6

Y Increments: 6

Starting Angle: 115 °

Ending Angle: 135 °

Angle Increments: 2

Right Grid

Upper Left: (-316.97852, -42.41549) ft

Lower Left: (-316.97852, -59.00036) ft

Lower Right: (-280.0596, -59.00036) ft

X Increments: 6

Y Increments: 6

Starting Angle: 0 °

Ending Angle: 45 °

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-7.31
Point 2	-600	-10.31
Point 3	-600	-12.31
Point 4	-600	-16.31
Point 5	-600	-18.31
Point 6	-600	-21.31
Point 7	-600	-39.31
Point 8	-600	-50.31
Point 9	-600	-57.31
Point 10	100	-57.31
Point 11	-600	-60
Point 12	100	-60
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-301.57	-39.31
Point 16	-355.57	-21.31
Point 17	-364.57	-18.31
Point 18	-370.57	-16.31
Point 19	-382.57	-12.31
Point 20	-388.57	-10.31
Point 21	-397.57	-7.31
Point 22	-447.5	9.33333
Point 23	-600	9
Point 24	-565	9
Point 25	-559	8.66667
Point 26	-518	9
Point 27	-495	9.33333
Point 28	-487	9.66667
Point 29	-468	9.66667
Point 30	-461	9.33333
Point 31	-159	-50.33333
Point 32	-153	-50.66667
Point 33	-119	-50.66667
Point 34	-114	-50
Point 35	-104	-50
Point 36	-99	-50.66667
Point 37	-73	-50.66667
Point 38	-63	-51.33333
Point 39	-38	-51.33333
Point 40	6	-51.66667
Point 41	25	-53
Point 42	33	-52.66667
Point 43	41	-52.33333
Point 44	74	-52
Point 45	100	-52

Regions

	Material	Points	Area (ft ²)
--	----------	--------	-------------------------

Region 1	Clayey Sand	20,2,1,21	620.79
Region 2	Silt	19,3,2,20	428.86
Region 3	Clayey Sand	18,4,3,19	893.72
Region 4	Lean Clay (undrained)	17,5,4,18	464.86
Region 5	Silt	16,6,5,17	719.79
Region 6	Fat Clay (undrained)	15,7,6,16	4,885.7
Region 7	Silty Sand	9,11,12,10	1,883
Region 8	Lean Clay (undrained)	7,15,14,13,8	3,472.9
Region 9	Fat Clay (undrained)	23,24,25,26,27,28,29,30,22,21,1	2,923.4
Region 10	Clayey Sand	8,13,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,10,9	4,570.8

Current Slip Surface

Slip Surface: 13,985

F of S: 2.45

Volume: 6,694.3554 ft³

Weight: 784,884.18 lbs

Resisting Moment: 21,352,816 lbs-ft

Activating Moment: 8,810,965.4 lbs-ft

Resisting Force: 227,631.44 lbs

Activating Force: 93,149.365 lbs

F of S Rank (Analysis): 1 of 21,609 slip surfaces

F of S Rank (Query): 1 of 21,609 slip surfaces

Exit: (-259.46964, -50.471721) ft

Entry: (-494.50964, 9.3537623) ft

Radius: 111.70889 ft

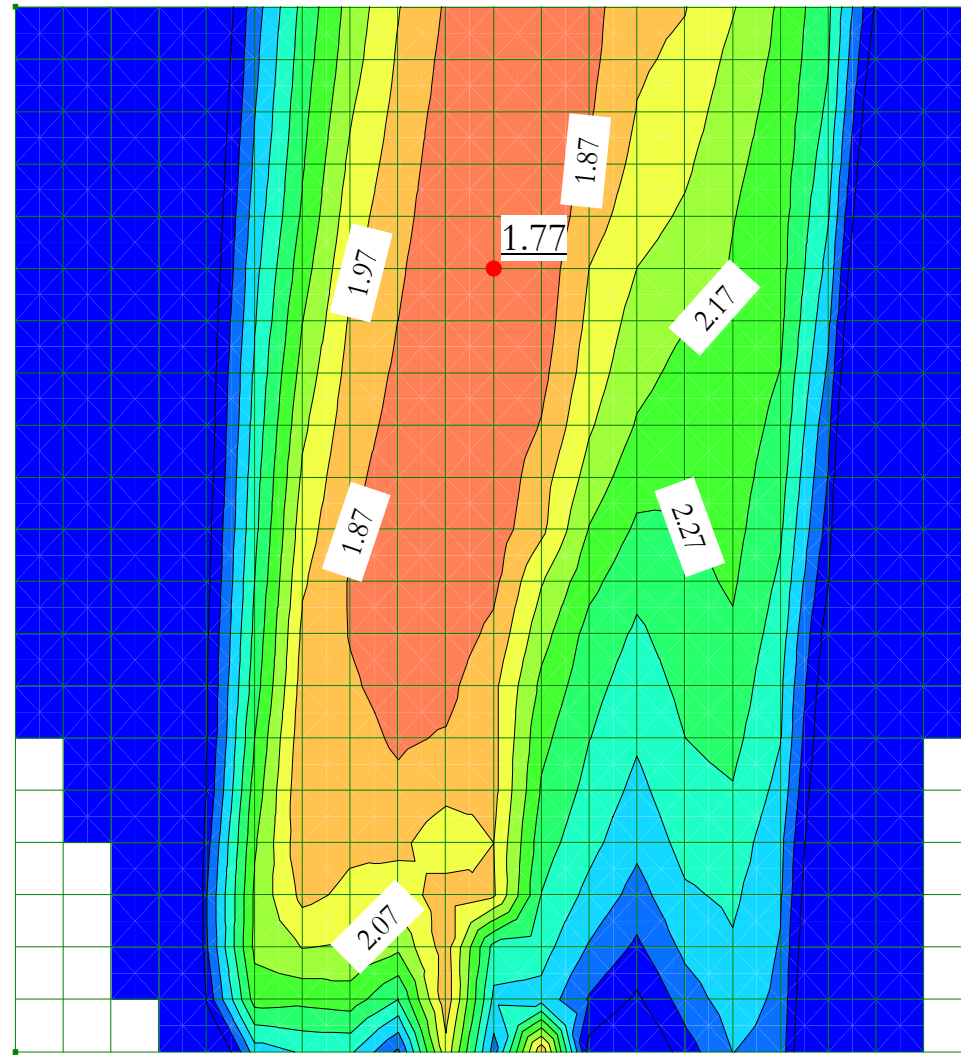
Center: (-365.56896, 24.310133) ft

Slip Slices

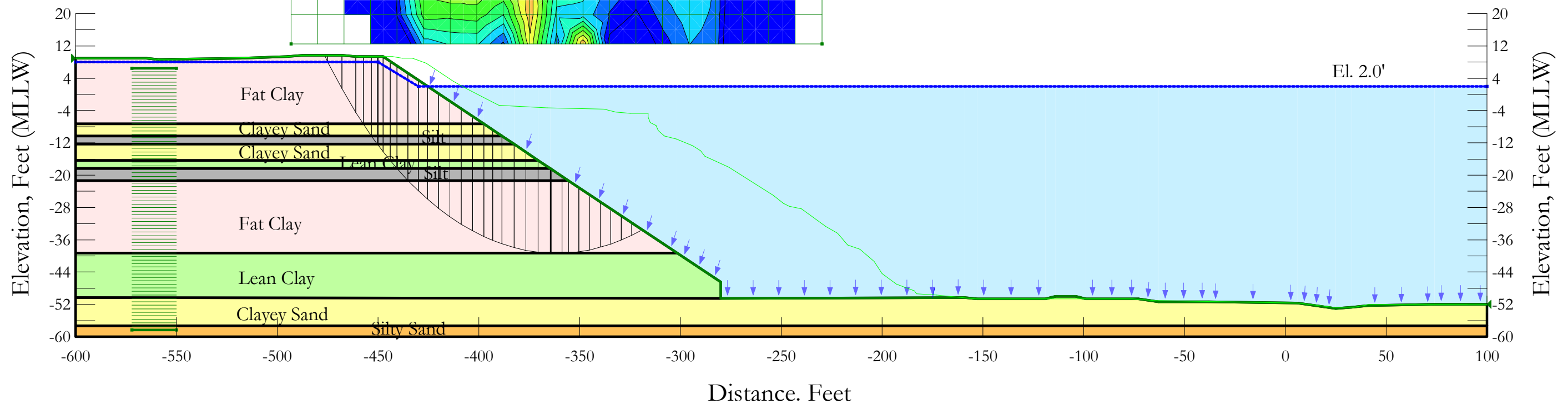
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-493.83275	8.6768811	-42.237382	-412.73892	0	1,200
Slice 2	-490.07794	4.9220633	192.06325	40.62143	0	1,200
Slice 3	-482.42294	-2.7329367	669.73525	927.23975	0	1,200
Slice 4	-476.34587	-8.81	1,048.944	1,870.3796	533.44655	0
Slice 5	-473.84587	-11.31	1,204.944	2,122.5483	573.38281	0
Slice 6	-470.84587	-14.31	1,392.144	2,408.6166	660.10502	0
Slice 7	-468.42294	-16.732937	1,543.3352	2,462.9573	0	1,200
Slice 8	-467.42294	-17.732937	1,605.7352	2,577.6357	0	1,200
Slice 9	-465.34587	-19.81	1,735.344	2,957.4171	763.63601	0
Slice 10	-462.42294	-22.732937	1,917.7352	3,077.2895	0	1,200
Slice 11	-455.5	-29.655873	2,349.7265	3,801.4686	0	1,200
Slice 12	-448.75	-36.405873	2,520.6665	4,507.4168	0	1,200
Slice 13	-446.67294	-38.482937	2,603.9015	4,692.6042	0	1,200
Slice 14	-443.16986	-41.986017	2,744.2818	4,952.4981	0	1,200
Slice 15	-435.24692	-45.130961	2,788.2517	5,716.05	0	1,200
Slice						

16	-427.75	-45.800975	2,982.7809	5,522.36	0	1,200
Slice 17	-422.00875	-46.314082	3,014.7987	5,448.6224	0	1,200
Slice 18	-415.02625	-46.938122	3,053.7388	5,417.7264	0	1,200
Slice 19	-408.04375	-47.562162	3,092.6789	5,387.7485	0	1,200
Slice 20	-401.06125	-48.186202	3,131.619	5,358.3995	0	1,200
Slice 21	-393.07	-48.900396	3,176.1847	5,325.1929	0	1,200
Slice 22	-385.57	-49.570686	3,218.0108	5,298.9739	0	1,200
Slice 23	-379.18912	-50.140958	3,253.5958	5,277.0877	0	1,200
Slice 24	-373.18912	-50.67719	3,287.0566	5,248.7516	1,273.9396	0
Slice 25	-367.57	-51.179382	3,318.3934	5,209.3342	1,227.9913	0
Slice 26	-360.07	-51.849672	3,360.2195	5,166.2947	1,172.8789	0
Slice 27	-351.71286	-52.596566	3,406.8257	5,126.8073	1,116.9691	0
Slice 28	-343.99857	-53.286007	3,449.8468	5,081.5752	1,059.6568	0
Slice 29	-336.28429	-53.975448	3,492.868	5,034.3247	1,001.0337	0
Slice 30	-328.57	-54.664889	3,535.8891	4,984.9144	941.00805	0
Slice 31	-320.85571	-55.35433	3,578.9102	4,933.249	879.51788	0
Slice 32	-313.14143	-56.043771	3,621.9313	4,879.2802	816.53195	0
Slice 33	-305.42714	-56.733212	3,664.9524	4,823.009	752.05072	0
Slice 34	-300.27168	-57.193966	3,693.7035	4,779.9672	705.42787	0
Slice 35	-294.24492	-57.73259	3,727.3136	4,716.0981	617.86112	0
Slice 36	-284.75824	-58.565426	3,779.2826	4,640.6761	538.25841	0
Slice 37	-277.98935	-58.142836	3,752.913	4,284.4801	332.16	0
Slice 38	-271.85144	-55.60043	3,594.2668	3,944.9287	227.72249	0
Slice 39	-263.59691	-52.181291	3,380.9125	3,496.2929	74.928925	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 98+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Light Green	Lean Clay	125	200	23
Pink	Fat Clay	115	200	18
Grey	Silt	110	0	32
Yellow	Clayey Sand	115	0	33
Orange	Silty Sand	120	0	32



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 79

Date: 4/27/2018

Time: 11:08:27 AM

Tool Version: 8.16.1.13452

File Name: 098+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\098+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:09:00 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-493.03183, 156.31112) ft

Lower Left: (-493.03183, 12.4996) ft

Lower Right: (-229.87401, 12.4996) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-572, 6.44308) ft

Upper Right Coordinate: (-550, 6.44308) ft

Lower Left Coordinate: (-572, -58.3341) ft

Lower Right Coordinate: (-550, -58.3341) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 9) ft

Right Coordinate: (100, -52) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8

Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-7.31
Point 2	-600	-10.31
Point 3	-600	-12.31
Point 4	-600	-16.31
Point 5	-600	-18.31
Point 6	-600	-21.31
Point 7	-600	-39.31
Point 8	-600	-50.31
Point 9	-600	-57.31
Point 10	100	-57.31
Point 11	-600	-60
Point 12	100	-60
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-301.57	-39.31
Point 16	-355.57	-21.31
Point 17	-364.57	-18.31
Point 18	-370.57	-16.31
Point 19	-382.57	-12.31
Point 20	-388.57	-10.31
Point 21	-397.57	-7.31
Point 22	-447.5	9.33333
Point 23	-600	9
Point 24	-565	9
Point 25	-559	8.66667
Point 26	-518	9
Point 27	-495	9.33333
Point 28	-487	9.66667
Point 29	-468	9.66667
Point 30	-461	9.33333
Point 31	-159	-50.33333
Point 32	-153	-50.66667
Point 33	-119	-50.66667
Point 34	-114	-50
Point 35	-104	-50
Point 36	-99	-50.66667
Point 37	-73	-50.66667
Point 38	-63	-51.33333
Point 39	-38	-51.33333
Point 40	6	-51.66667
Point 41	25	-53
Point 42	33	-52.66667
Point 43	41	-52.33333
Point 44	74	-52
Point 45	100	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	20,2,1,21	620.79
Region 2	Silt	19,3,2,20	428.86
Region 3	Clayey Sand	18,4,3,19	893.72
Region 4	Lean Clay	17,5,4,18	464.86
Region 5	Silt	16,6,5,17	719.79
Region 6	Fat Clay	15,7,6,16	4,885.7
Region 7	Silty Sand	9,11,12,10	1,883
Region 8	Lean Clay	7,15,14,13,8	3,472.9
Region 9	Fat Clay	23,24,25,26,27,28,29,30,22,21,1	2,923.4
Region 10	Clayey Sand	8,13,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,10,9	4,570.8

Current Slip Surface

Slip Surface: 24,754

F of S: 1.77

Volume: 3,088.7144 ft³

Weight: 354,868.11 lbs

Resisting Moment: 14,611,261 lbs-ft

Activating Moment: 8,257,179.9 lbs-ft

Resisting Force: 84,910.868 lbs

Activating Force: 48,147.036 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (-318.85814, -33.547286) ft

Entry: (-476.55549, 9.66667) ft

Radius: 159.69103 ft

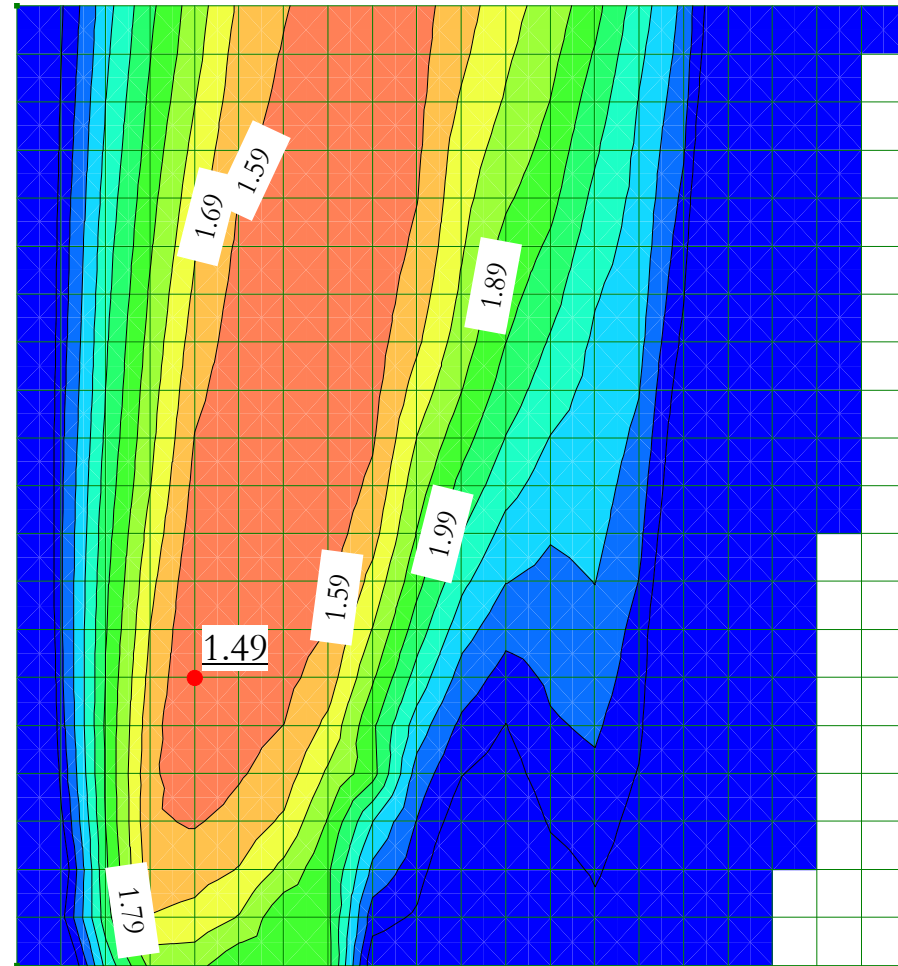
Center: (-361.45292, 120.35824) ft

Slip Slices

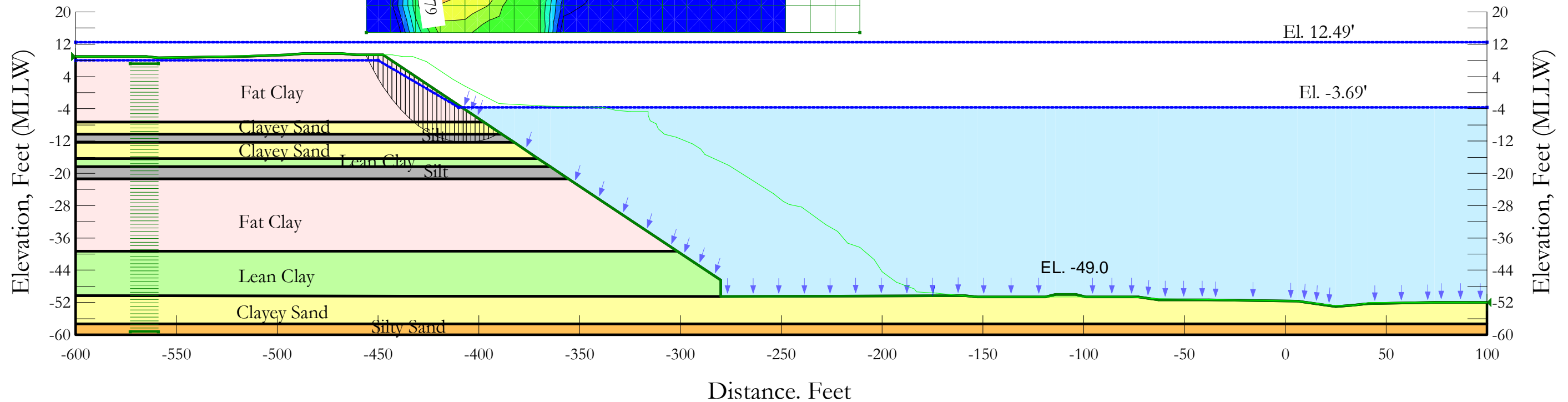
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-475.74232	8.833335	-52.000104	-16.411325	-5.3323627	200
Slice 2	-471.46457	4.7044488	205.64239	421.36055	70.091078	200
Slice 3	-464.5	-1.5496058	595.8954	1,074.1438	155.39232	200
Slice 4	-459.19011	-5.9090546	867.92501	1,520.7681	212.12157	200
Slice 5	-455.31602	-8.81	1,048.944	1,812.3539	495.76418	0
Slice 6	-451.79437	-11.31	1,204.944	2,070.9452	541.13761	0
Slice 7	-450.16846	-12.422552	1,274.3672	2,175.8682	585.44159	0
Slice 8	-448.75	-13.351212	1,200.84	2,249.4657	680.98546	0
Slice 9	-445.77724	-15.23866	1,257.837	2,385.1656	732.09577	0
Slice 10	-442.35277	-17.31	1,317.6036	2,513.2805	507.53473	200
Slice 11	-437.90079	-19.81	1,384.2631	2,623.7212	774.49941	0
Slice 12	-432.57526	-22.591281	1,452.0227	2,780.0727	431.50961	200
Slice 13	-427.75	-24.899483	1,678.5277	2,883.1083	391.39196	200
Slice 14	-422.707	-27.08672	1,815.0113	3,018.1698	390.92991	200
Slice						

15	-417.121	-29.286039	1,952.2489	3,197.4492	404.59012	200
Slice 16	-411.535	-31.247694	2,074.6561	3,356.4273	416.47271	200
Slice 17	-405.949	-32.98082	2,182.8032	3,495.1135	426.39545	200
Slice 18	-400.363	-34.493103	2,277.1696	3,613.0615	434.05759	200
Slice 19	-395.32	-35.683249	2,351.4347	3,702.0713	438.84843	200
Slice 20	-390.82	-36.592584	2,408.1772	3,765.0711	440.88156	200
Slice 21	-385.57	-37.471994	2,463.0524	3,822.4955	441.70985	200
Slice 22	-379.57	-38.273032	2,513.0372	3,862.0267	438.31327	200
Slice 23	-373.57	-38.843992	2,548.6651	3,865.8014	427.96352	200
Slice 24	-367.57	-39.187347	2,570.0905	3,826.7199	408.30363	200
Slice 25	-364.36048	-39.306185	2,577.5059	3,790.8762	394.24792	200
Slice 26	-361.45292	-39.31	2,577.744	3,757.2745	383.2527	200
Slice 27	-357.16244	-39.267198	2,575.0731	3,698.4195	364.99738	200
Slice 28	-352.94772	-39.084515	2,563.6737	3,614.1805	341.33035	200
Slice 29	-347.70317	-38.717978	2,540.8018	3,482.324	305.91912	200
Slice 30	-342.45862	-38.177144	2,507.0538	3,321.5638	264.65034	200
Slice 31	-337.21407	-37.460219	2,462.3177	3,131.9332	217.57126	200
Slice 32	-331.96952	-36.564787	2,406.4427	2,913.7747	164.84215	200
Slice 33	-326.72497	-35.487767	2,339.2367	2,667.7164	106.72952	200
Slice 34	-321.48042	-34.225359	2,260.4624	2,394.6274	43.592862	200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 98+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Light Green	Lean Clay	125	200	23	300	19	1
Pink	Fat Clay	115	200	18	300	14	1
Grey	Silt	110	0	32	0.1	31.9	1
Yellow	Clayey Sand	115	0	33	0.1	32.9	1
Orange	Silty Sand	120	0	32	0.1	31.9	1



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 79

Date: 4/27/2018

Time: 11:08:27 AM

Tool Version: 8.16.1.13452

File Name: 098+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\098+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:09:56 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 31.9 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 32.9 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 31.9 °

Pore Water Pressure

Piezometric Line: 2

Piezometric Line After Drawdown: 1

Slip Surface Grid

Upper Left: (-455.74787, 146.99344) ft

Lower Left: (-455.74787, 14.8442) ft

Lower Right: (-211.08753, 14.8442) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-573.00809, 7.1797) ft

Upper Right Coordinate: (-559.02196, 7.1797) ft

Lower Left Coordinate: (-573.00809, -59.27302) ft

Lower Right Coordinate: (-559.02196, -59.27302) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 9) ft

Right Coordinate: (100, -52) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	8
Coordinate 2	-450	8
Coordinate 3	-410	-3.69
Coordinate 4	100	-3.69

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	12.49
Coordinate 2	100	12.49

Points

	X (ft)	Y (ft)
Point 1	-600	-7.31
Point 2	-600	-10.31
Point 3	-600	-12.31
Point 4	-600	-16.31
Point 5	-600	-18.31
Point 6	-600	-21.31
Point 7	-600	-39.31
Point 8	-600	-50.31
Point 9	-600	-57.31
Point 10	100	-57.31
Point 11	-600	-60
Point 12	100	-60
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-301.57	-39.31
Point 16	-355.57	-21.31
Point 17	-364.57	-18.31
Point 18	-370.57	-16.31
Point 19	-382.57	-12.31
Point 20	-388.57	-10.31
Point 21	-397.57	-7.31
Point 22	-447.5	9.33333
Point 23	-600	9
Point 24	-565	9

Point 25	-559	8.66667
Point 26	-518	9
Point 27	-495	9.33333
Point 28	-487	9.66667
Point 29	-468	9.66667
Point 30	-461	9.33333
Point 31	-159	-50.33333
Point 32	-153	-50.66667
Point 33	-119	-50.66667
Point 34	-114	-50
Point 35	-104	-50
Point 36	-99	-50.66667
Point 37	-73	-50.66667
Point 38	-63	-51.33333
Point 39	-38	-51.33333
Point 40	6	-51.66667
Point 41	25	-53
Point 42	33	-52.66667
Point 43	41	-52.33333
Point 44	74	-52
Point 45	100	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	20,2,1,21	620.79
Region 2	Silt	19,3,2,20	428.86
Region 3	Clayey Sand	18,4,3,19	893.72
Region 4	Lean Clay	17,5,4,18	464.86
Region 5	Silt	16,6,5,17	719.79
Region 6	Fat Clay	15,7,6,16	4,885.7
Region 7	Silty Sand	9,11,12,10	1,883
Region 8	Lean Clay	7,15,14,13,8	3,472.9
Region 9	Fat Clay	23,24,25,26,27,28,29,30,22,21,1	2,923.4
Region 10	Clayey Sand	8,13,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,10,9	4,570.8

Current Slip Surface

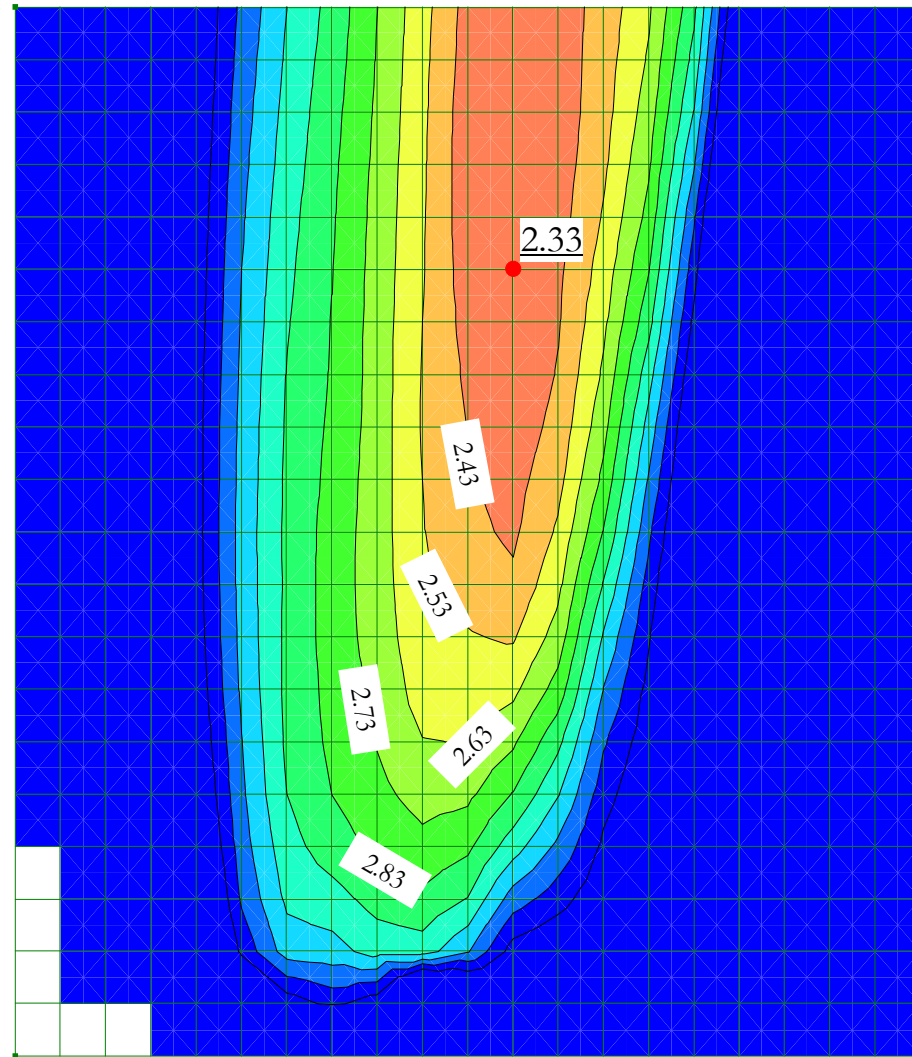
Slip Surface: 9,903
 F of S: 1.49
 Volume: 537.70945 ft³
 Weight: 61,620.056 lbs
 Resisting Moment: 1,494,359.3 lbs-ft
 Activating Moment: 1,001,249.6 lbs-ft
 Resisting Force: 20,527.747 lbs
 Activating Force: 13,765.093 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-389.45041, -10.01653) ft
 Entry: (-456.0447, 9.33333) ft
 Radius: 66.80207 ft
 Center: (-406.8158, 54.488972) ft

Slip Slices

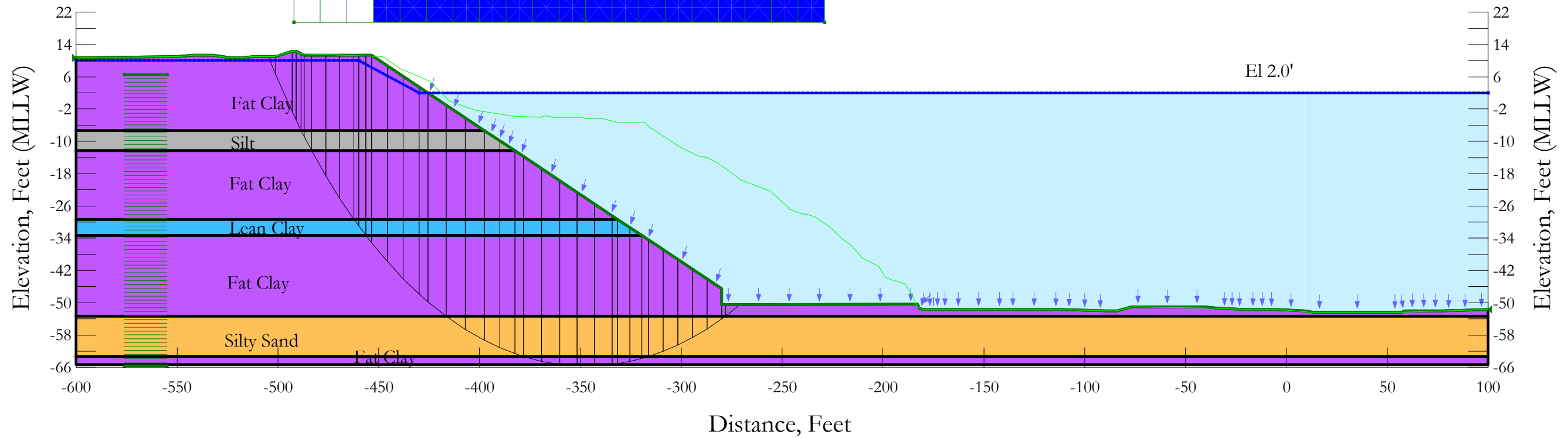
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-455.41614	8.666665	-41.599896	-51.043013	-16.58488	200
Slice 2	-453.59069	6.8254192	73.293842	148.79086	0	216.26201
Slice 3	-451.1969	4.5863734	213.0103	386.34594	0	251.87652
Slice 4	-448.75	2.5134009	294.42171	594.53541	97.512852	200
Slice 5	-446.4058	0.69954262	359.31423	742.66903	124.55952	200
Slice 6	-444.2174	-0.84539959	411.36448	829.85494	135.97579	200
Slice 7	-442.029	-2.263904	456.14585	905.9787	146.15955	200
Slice 8	-439.8406	-3.5652649	494.19266	972.66228	155.4642	200
Slice 9	-437.6522	-4.7572206	525.94979	1,031.1017	164.13382	200
Slice 10	-435.4638	-5.8462697	551.79083	1,082.1313	172.31807	200
Slice 11	-433.2754	-6.8379054	572.03161	1,126.2705	180.08313	200
Slice 12	-431.04004	-7.754128	587.14778	1,165.5543	375.6216	0
Slice 13	-428.7577	-8.5951762	597.15307	1,196.554	389.2555	0
Slice 14	-426.47537	-9.3435607	601.83114	1,220.4959	401.76558	0
Slice 15	-424.19303	-10.002512	601.36775	1,236.7731	412.63703	0
Slice 16	-421.96421	-10.563277	596.15867	1,243.2865	404.37034	0
Slice 17	-419.7889	-11.031909	586.55199	1,239.5623	408.04612	0
Slice 18	-417.61359	-11.425439	572.62768	1,226.698	408.70851	0
Slice 19	-415.43828	-11.745207	554.46279	1,203.7676	405.73065	0
Slice 20	-413.26297	-11.992277	532.11857	1,169.8767	398.5155	0
Slice 21	-411.08766	-12.16746	505.64156	1,124.229	386.53634	0
Slice 22	-409.215	-12.265379	535.10364	1,071.7587	335.33928	0
Slice 23	-407.94457	-12.301796	537.37608	1,043.217	316.0845	0
Slice 24	-406.8158	-12.31	537.888	1,030.2164	307.64096	0
Slice 25	-405.09716	-12.282322	536.16092	1,003.1838	291.82828	0
Slice 26	-402.94654	-12.192249	530.54032	958.52263	267.43303	0
Slice 27	-400.79593	-12.032542	520.57464	900.68925	237.52197	0
Slice 28	-398.64531	-11.8027	506.23245	829.84739	202.21706	0
Slice 29	-396.40496	-11.486324	486.49063	742.51982	159.98479	0
Slice 30	-394.07487	-11.076084	460.89165	638.3177	110.8681	0
Slice						

31	-391.74478	-10.579843	429.92623	521.4406	57.184522	0
Slice 32	-390.01507	-10.163265	403.93172	427.44898	15.272289	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 110+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Grey	Silt	110	0	33	
Orange	Silty Sand	120	0	31	
Purple	Fat Clay (Undrained)	115			1,200
Light Blue	Lean Clay (undrained)	125			1,000



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 76

Date: 4/27/2018

Time: 11:14:57 AM

Tool Version: 8.16.1.13452

File Name: 110+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\110+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:16:20 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-492, 171.98336) ft

Lower Left: (-492, 19.453) ft

Lower Right: (-229, 19.453) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-576.03354, 6.56951) ft

Upper Right Coordinate: (-555.05901, 6.56951) ft

Lower Left Coordinate: (-576.03354, -65.73101) ft

Lower Right Coordinate: (-555.05901, -65.73101) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 10.66667) ft

Right Coordinate: (100, -51.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	10
Coordinate 2	-460	10
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-12.31
Point 2	-600	-29.31
Point 3	-600	-33.31
Point 4	-600	-53.31
Point 5	100	-53.31
Point 6	-600	-63.31

Point 7	100	-63.31
Point 8	-600	-65.31
Point 9	100	-65.31
Point 10	-175	-48.31
Point 11	-600	-7.31
Point 12	-280	-50.5
Point 13	-280	-46.5
Point 14	-319.57	-33.31
Point 15	-331.57	-29.31
Point 16	-382.57	-12.31
Point 17	-397.57	-7.31
Point 18	-453.5	11.33333
Point 19	-600	10.66667
Point 20	-550	11
Point 21	-542	11.33333
Point 22	-532	11.33333
Point 23	-523	10.66667
Point 24	-518	10.66667
Point 25	-512	11
Point 26	-501	11
Point 27	-493	12.33333
Point 28	-491	12.33333
Point 29	-487	11.33333
Point 30	-183	-50.33333
Point 31	-182	-51.33333
Point 32	-180	-51.66667
Point 33	-166	-51.66667
Point 34	-139	-51.66667
Point 35	-111	-51.66667
Point 36	-89	-52
Point 37	-84	-52
Point 38	-77	-51
Point 39	-41	-51
Point 40	-34	-51.33333
Point 41	-20	-51.66667
Point 42	-4	-51.66667
Point 43	9	-52
Point 44	13	-52.33333
Point 45	57	-52.33333
Point 46	59	-52
Point 47	77	-52
Point 48	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay (Undrained)	1,2,15,16	4,129.8
Region 2	Lean Clay (undrained)	2,3,14,15	1,097.7
Region			

3	Silty Sand	4,6,7,5	7,000
Region 4	Fat Clay (Undrained)	6,8,9,7	1,400
Region 5	Silt	11,1,16,17	1,049.7
Region 6	Fat Clay (Undrained)	19,20,21,22,23,24,25,26,27,28,29,18,17,11	3,219.9
Region 7	Fat Clay (Undrained)	3,14,13,12,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,5,4	6,867.3

Current Slip Surface

Slip Surface: 24,852
 F of S: 2.33
 Volume: 8,391.3637 ft³
 Weight: 973,228.29 lbs
 Resisting Moment: 59,558,010 lbs-ft
 Activating Moment: 25,563,732 lbs-ft
 Resisting Force: 269,394.31 lbs
 Activating Force: 116,391.74 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-270.84195, -50.484264) ft
 Entry: (-504.64137, 11) ft
 Radius: 199.58178 ft
 Center: (-347.35, 133.85077) ft

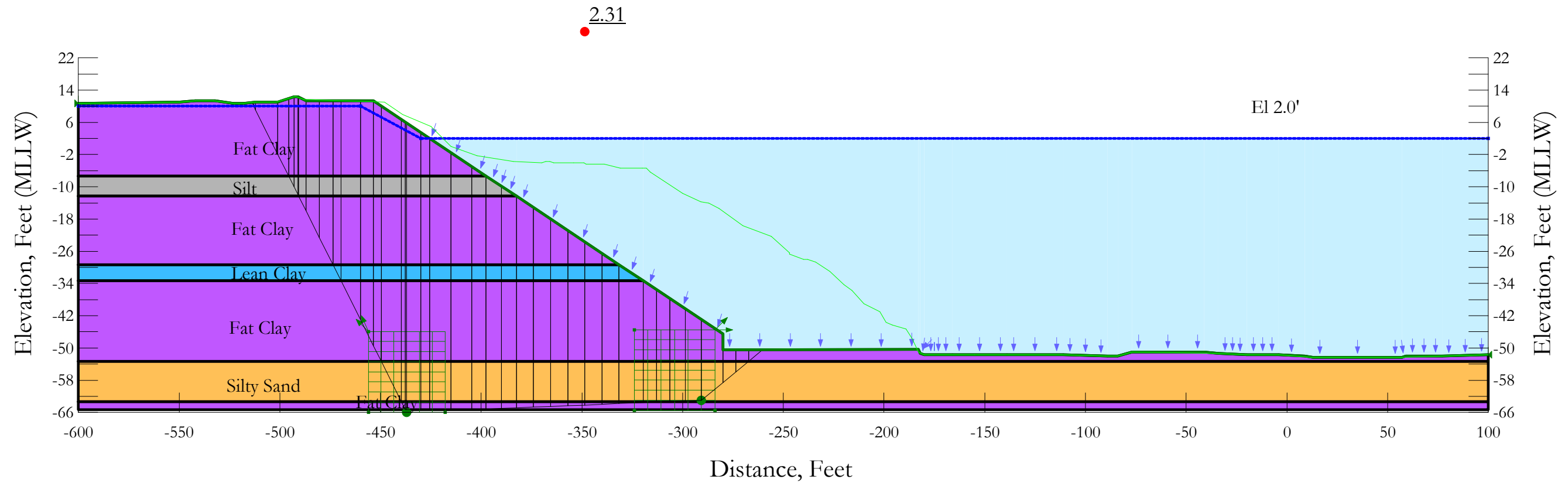
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-504.24828	10.5	-31.2	-596.62301	0	1,200
Slice 2	-502.42759	8.2375439	109.97726	-313.81235	0	1,200
Slice 3	-497	1.9372658	503.11461	537.18232	0	1,200
Slice 4	-492	-3.6525309	851.91793	1,287.9918	0	1,200
Slice 5	-489.72024	-6.0072528	998.85258	1,532.3728	0	1,200
Slice 6	-487.72024	-8.0226098	1,124.6108	1,976.3672	553.13705	0
Slice 7	-485.12703	-10.52261	1,280.6108	2,207.5138	601.93782	0
Slice 8	-479.76024	-15.409415	1,585.5475	2,534.6291	0	1,200
Slice 9	-472.77257	-21.332621	1,955.1556	3,222.239	0	1,200
Slice 10	-465.7849	-26.733206	2,292.1521	3,845.6675	0	1,200
Slice 11	-461.14554	-30.105073	2,502.5566	4,296.4889	0	1,000
Slice 12	-458.19601	-32.105073	2,424.9008	4,544.1338	0	1,000
Slice 13	-454.94601	-34.235627	2,498.5315	4,750.1707	0	1,200
Slice 14	-449.58333	-37.498089	2,605.2828	4,984.2278	0	1,200
Slice 15	-441.75	-41.938202	2,742.2588	5,215.3908	0	1,200
Slice 16	-433.91667	-45.927432	2,852.9674	5,402.0262	0	1,200

Slice 17	-427.75	-48.803776	3,170.1556	5,523.5177	0	1,200
Slice 18	-421.07949	-51.552085	3,341.6501	5,710.2505	0	1,200
Slice 19	-411.88673	-54.941344	3,553.1399	5,973.5545	1,454.3318	0
Slice 20	-402.34224	-57.941027	3,740.3201	6,234.7896	1,498.8285	0
Slice 21	-393.82	-60.207358	3,881.7392	6,432.4154	1,532.6009	0
Slice 22	-386.32	-61.852081	3,984.3699	6,575.4288	1,556.8653	0
Slice 23	-380.45611	-62.954406	4,053.155	6,663.3026	1,568.3349	0
Slice 24	-373.83333	-63.913801	4,113.0212	6,728.0244	0	1,200
Slice 25	-364.81554	-64.913801	4,175.4212	6,756.6446	0	1,200
Slice 26	-355.98776	-65.31	4,200.144	6,754.4843	0	1,200
Slice 27	-347.35	-65.31	4,200.144	6,616.5098	0	1,200
Slice 28	-338.71224	-65.31	4,200.144	6,473.7843	0	1,200
Slice 29	-332.98168	-65.208103	4,193.7856	6,427.5227	0	1,200
Slice 30	-328.57	-64.822626	4,169.7318	6,311.8624	0	1,200
Slice 31	-322.57	-64.163617	4,128.6097	6,127.8262	0	1,200
Slice 32	-317.96389	-63.549095	4,090.2635	5,975.6139	0	1,200
Slice 33	-312.722	-62.669355	4,035.3677	5,770.7346	1,042.7136	0
Slice 34	-305.45045	-61.247886	3,946.6681	5,458.1657	908.1994	0
Slice 35	-298.17889	-59.542651	3,840.2614	5,098.517	756.03621	0
Slice 36	-290.90733	-57.546053	3,715.6737	4,691.1947	586.15215	0
Slice 37	-283.63578	-55.248847	3,572.3281	4,253.4159	409.23882	0
Slice 38	-279.02052	-53.666914	3,473.6154	3,689.4097	129.6623	0
Slice 39	-274.44149	-51.897132	3,363.181	3,653.5422	0	1,200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 110+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Grey	Silt	110	0	33	
Orange	Silty Sand	120	0	31	
Purple	Fat Clay (Undrained)	115			1,200
Blue	Lean Clay (undrained)	125			1,000



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 76

Date: 4/27/2018

Time: 11:14:57 AM

Tool Version: 8.16.1.13452

File Name: 110+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\110+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:16:48 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-600, 10.66667) ft
Right Coordinate: (100, -51.66667) ft

Slip Surface Block

Left Grid

Upper Left: (-456, -45.97041) ft
Lower Left: (-456, -65.96841) ft
Lower Right: (-418, -65.96841) ft
X Increments: 6
Y Increments: 8
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2

Right Grid

Upper Left: (-324, -45.47946) ft
Lower Left: (-324, -65.48944) ft
Lower Right: (-284, -65.48944) ft
X Increments: 6
Y Increments: 8
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	10
Coordinate 2	-460	10
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-12.31
Point 2	-600	-29.31
Point 3	-600	-33.31
Point 4	-600	-53.31
Point 5	100	-53.31
Point 6	-600	-63.31
Point 7	100	-63.31

Point 8	-600	-65.31
Point 9	100	-65.31
Point 10	-175	-48.31
Point 11	-600	-7.31
Point 12	-280	-50.5
Point 13	-280	-46.5
Point 14	-319.57	-33.31
Point 15	-331.57	-29.31
Point 16	-382.57	-12.31
Point 17	-397.57	-7.31
Point 18	-453.5	11.33333
Point 19	-600	10.66667
Point 20	-550	11
Point 21	-542	11.33333
Point 22	-532	11.33333
Point 23	-523	10.66667
Point 24	-518	10.66667
Point 25	-512	11
Point 26	-501	11
Point 27	-493	12.33333
Point 28	-491	12.33333
Point 29	-487	11.33333
Point 30	-183	-50.33333
Point 31	-182	-51.33333
Point 32	-180	-51.66667
Point 33	-166	-51.66667
Point 34	-139	-51.66667
Point 35	-111	-51.66667
Point 36	-89	-52
Point 37	-84	-52
Point 38	-77	-51
Point 39	-41	-51
Point 40	-34	-51.33333
Point 41	-20	-51.66667
Point 42	-4	-51.66667
Point 43	9	-52
Point 44	13	-52.33333
Point 45	57	-52.33333
Point 46	59	-52
Point 47	77	-52
Point 48	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay (Undrained)	1,2,15,16	4,129.8
Region 2	Lean Clay (undrained)	2,3,14,15	1,097.7
Region 3	Silty Sand	4,6,7,5	7,000

Region 4	Fat Clay (Undrained)	6,8,9,7	1,400
Region 5	Silt	11,1,16,17	1,049.7
Region 6	Fat Clay (Undrained)	19,20,21,22,23,24,25,26,27,28,29,18,17,11	3,219.9
Region 7	Fat Clay (Undrained)	3,14,13,12,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,5,4	6,867.3

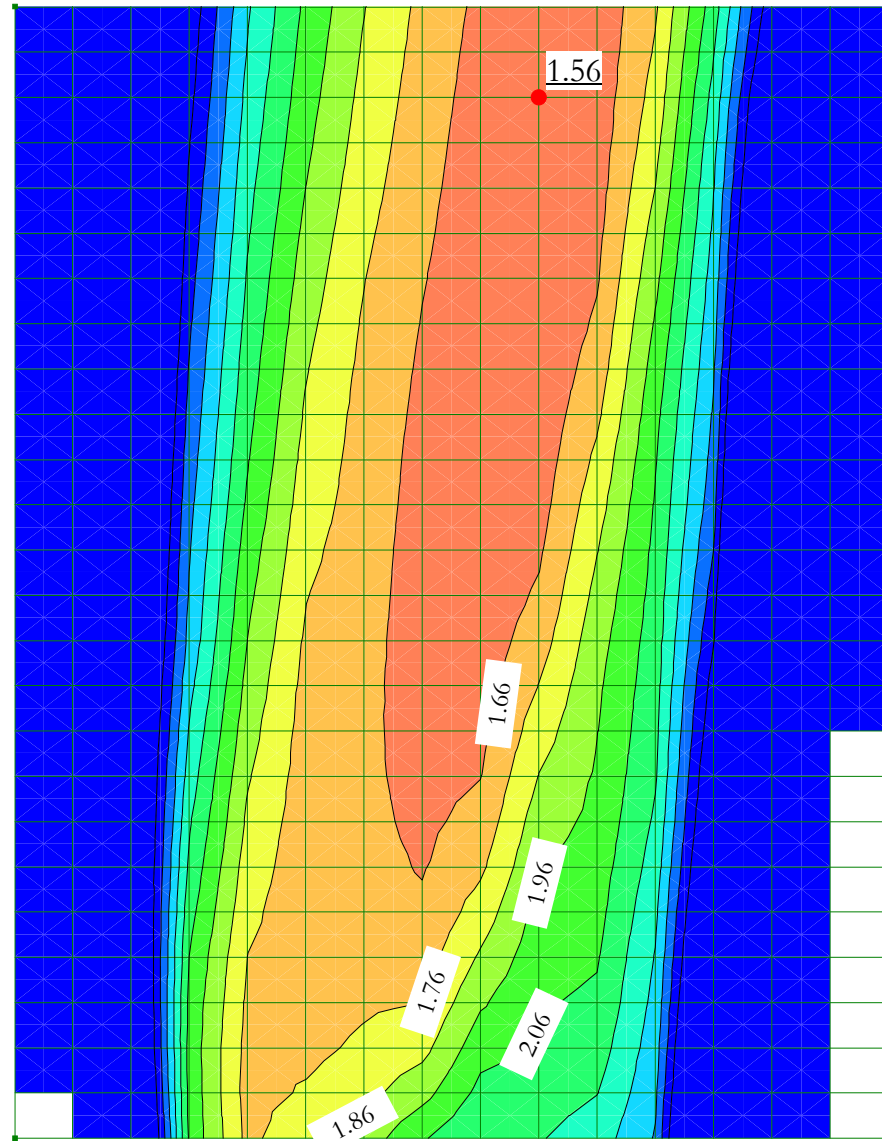
Current Slip Surface

Slip Surface: 2,117
 F of S: 2.31
 Volume: 9,903.9711 ft³
 Weight: 1,150,475.2 lbs
 Resisting Moment: 32,040,958 lbs-ft
 Activating Moment: 13,975,190 lbs-ft
 Resisting Force: 281,784.78 lbs
 Activating Force: 123,309.97 lbs
 F of S Rank (Analysis): 1 of 35,721 slip surfaces
 F of S Rank (Query): 1 of 35,721 slip surfaces
 Exit: (-260.43635, -50.466385) ft
 Entry: (-513.86481, 10.8964) ft
 Radius: 123.09521 ft
 Center: (-376.00722, 26.237097) ft

Slip Slices

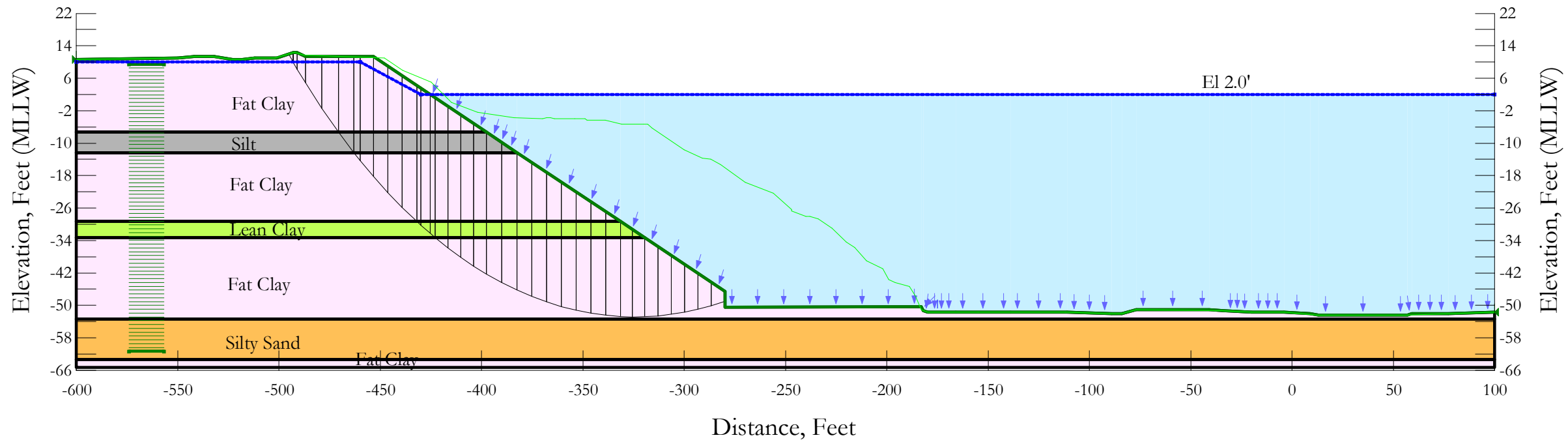
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-513.41661	10.4482	-27.967694	-468.09127	0	1,200
Slice 2	-512.4842	9.515795	30.214392	-353.33322	0	1,200
Slice 3	-506.5	3.53159	403.62878	339.48133	0	1,200
Slice 4	-498.32921	-4.639205	913.48639	1,316.2544	0	1,200
Slice 5	-494.32921	-8.639205	1,163.0864	2,082.8017	597.2701	0
Slice 6	-492	-10.96841	1,308.4288	2,324.6726	659.95643	0
Slice 7	-490.82921	-12.139205	1,381.4864	2,432.2568	682.37828	0
Slice 8	-488.82921	-14.139205	1,506.2864	2,377.568	0	1,200
Slice 9	-483.6646	-19.303808	1,828.5576	2,886.1536	0	1,200
Slice 10	-476.99381	-25.974603	2,244.8152	3,600.3179	0	1,200
Slice 11	-471.65841	-31.31	2,577.744	4,264.5053	0	1,000
Slice 12	-464.82921	-38.139205	3,003.8864	4,916.7884	0	1,200
Slice 13	-456.75	-46.21841	3,224.641	5,754.1129	0	1,200
Slice 14	-451.57921	-51.389205	3,445.5476	6,216.9512	0	1,200
Slice 15	-444.65841	-58.31	3,741.2178	6,520.7807	1,670.1299	0
Slice 16	-438.65841	-64.31	3,997.5497	7,129.2593	0	1,200
Slice 17	-437.32921	-65.31	4,035.1574	8,159.3515	0	1,200

Slice 18	-433.5	-65.31	3,975.6697	8,023.6445	0	1,200
Slice 19	-427.75	-65.31	4,200.144	7,819.9262	0	1,200
Slice 20	-420.29276	-65.31	4,200.144	7,666.6431	0	1,200
Slice 21	-409.87828	-65.31	4,200.144	7,519.5293	0	1,200
Slice 22	-401.12052	-65.23769	4,195.6319	7,409.234	0	1,200
Slice 23	-393.82	-65.089008	4,186.3541	7,293.9305	0	1,200
Slice 24	-386.32	-64.936264	4,176.8228	7,180.033	0	1,200
Slice 25	-378.32	-64.773336	4,166.6562	7,049.2957	0	1,200
Slice 26	-369.82	-64.600225	4,155.8541	6,900.9114	0	1,200
Slice 27	-361.32	-64.427115	4,145.052	6,749.1666	0	1,200
Slice 28	-352.82	-64.254004	4,134.2499	6,593.6917	0	1,200
Slice 29	-344.32	-64.080894	4,123.4478	6,434.1903	0	1,200
Slice 30	-335.82	-63.907783	4,112.6457	6,270.4463	0	1,200
Slice 31	-325.57	-63.699032	4,099.6196	6,046.9643	0	1,200
Slice 32	-316.29448	-63.510127	4,087.8319	5,837.7277	0	1,200
Slice 33	-309.74344	-63.376709	4,079.5066	5,700.7931	0	1,200
Slice 34	-302.5176	-63.229548	4,070.3238	5,538.6812	882.27811	0
Slice 35	-294.61698	-63.068644	4,060.2834	5,366.101	784.61435	0
Slice 36	-285.33333	-60.779054	3,917.4129	5,089.138	704.04345	0
Slice 37	-276.82536	-57.254936	3,697.508	4,183.0237	291.72728	0
Slice 38	-270.47608	-54.624979	3,533.3987	3,823.5023	174.31183	0
Slice 39	-263.8689	-51.888192	3,362.6232	3,667.2934	0	1,200



Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 110+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Grey	Silt	110	0	33
Pink	Fat Clay	115	200	18
Light Green	Lean Clay	125	200	23
Orange	Silty Sand	120	0	31



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 76

Date: 4/27/2018

Time: 11:14:57 AM

Tool Version: 8.16.1.13452

File Name: 110+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\110+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:15:16 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: No

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 0 psf

Phi: 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-493.09257, 219.03047) ft

Lower Left: (-493.09257, 37.21206) ft

Lower Right: (-212.2191, 37.21206) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 25

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-574.0045, 9.47012) ft

Upper Right Coordinate: (-556.92375, 9.47012) ft

Lower Left Coordinate: (-574.0045, -61.33591) ft

Lower Right Coordinate: (-556.92375, -61.33591) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 10.66667) ft

Right Coordinate: (100, -51.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	10
Coordinate 2	-460	10
Coordinate 3	-430	2
Coordinate 4	100	2

Points

	X (ft)	Y (ft)
Point 1	-600	-12.31
Point 2	-600	-29.31
Point 3	-600	-33.31

Point 4	-600	-53.31
Point 5	100	-53.31
Point 6	-600	-63.31
Point 7	100	-63.31
Point 8	-600	-65.31
Point 9	100	-65.31
Point 10	-175	-48.31
Point 11	-600	-7.31
Point 12	-280	-50.5
Point 13	-280	-46.5
Point 14	-319.57	-33.31
Point 15	-331.57	-29.31
Point 16	-382.57	-12.31
Point 17	-397.57	-7.31
Point 18	-453.5	11.33333
Point 19	-600	10.66667
Point 20	-550	11
Point 21	-542	11.33333
Point 22	-532	11.33333
Point 23	-523	10.66667
Point 24	-518	10.66667
Point 25	-512	11
Point 26	-501	11
Point 27	-493	12.33333
Point 28	-491	12.33333
Point 29	-487	11.33333
Point 30	-183	-50.33333
Point 31	-182	-51.33333
Point 32	-180	-51.66667
Point 33	-166	-51.66667
Point 34	-139	-51.66667
Point 35	-111	-51.66667
Point 36	-89	-52
Point 37	-84	-52
Point 38	-77	-51
Point 39	-41	-51
Point 40	-34	-51.33333
Point 41	-20	-51.66667
Point 42	-4	-51.66667
Point 43	9	-52
Point 44	13	-52.33333
Point 45	57	-52.33333
Point 46	59	-52
Point 47	77	-52
Point 48	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay	1,2,15,16	4,129.8
Region 2	Lean Clay	2,3,14,15	1,097.7

Region 3	Silty Sand	4,6,7,5	7,000
Region 4	Fat Clay	6,8,9,7	1,400
Region 5	Silt	11,1,16,17	1,049.7
Region 6	Fat Clay	19,20,21,22,23,24,25,26,27,28,29,18,17,11	3,219.9
Region 7	Fat Clay	3,14,13,12,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,5,4	6,867.3

Current Slip Surface

Slip Surface: 28,719

F of S: 1.56

Volume: 5,264.1912 ft³

Weight: 607,539.23 lbs

Resisting Moment: 35,788,839 lbs-ft

Activating Moment: 22,919,789 lbs-ft

Resisting Force: 130,695.61 lbs

Activating Force: 83,885.787 lbs

F of S Rank (Analysis): 1 of 31,616 slip surfaces

F of S Rank (Query): 1 of 31,616 slip surfaces

Exit: (-280, -48.950173) ft

Entry: (-495.29201, 11.951329) ft

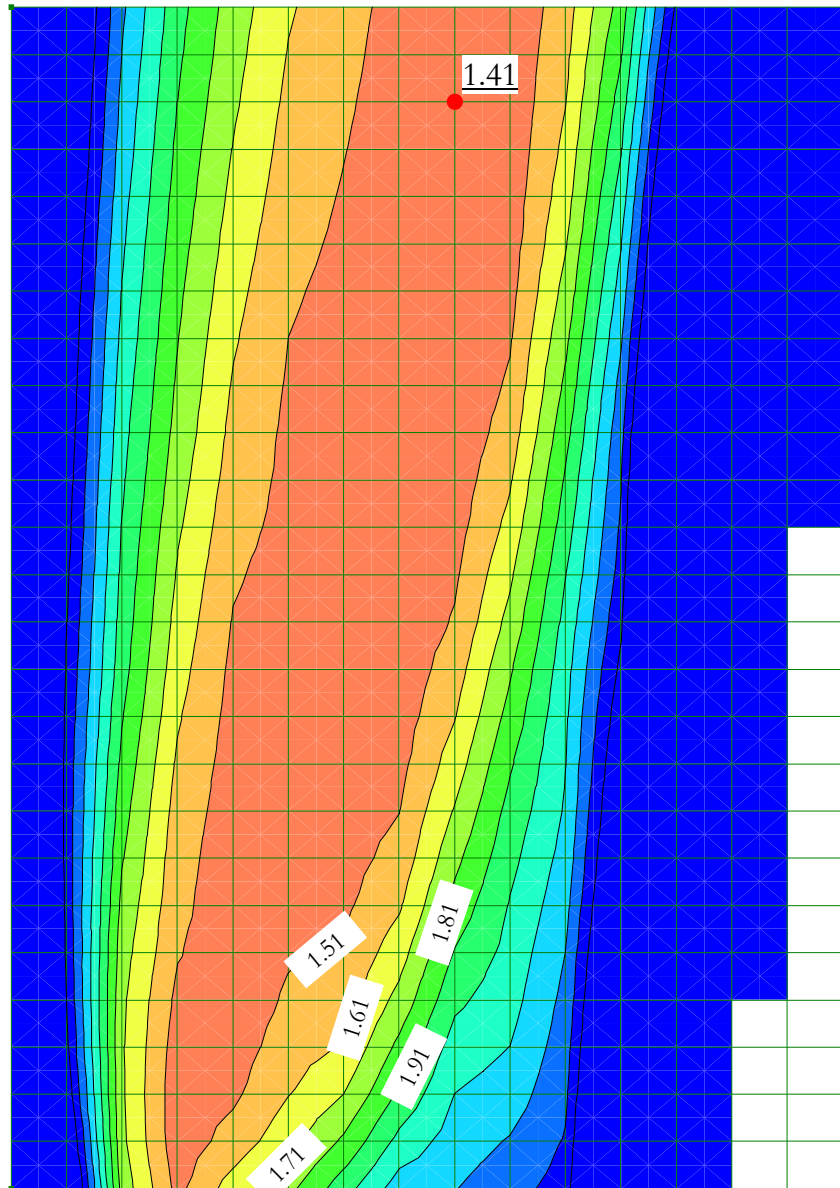
Radius: 257.32418 ft

Center: (-324.56849, 204.485) ft

Slip Slices

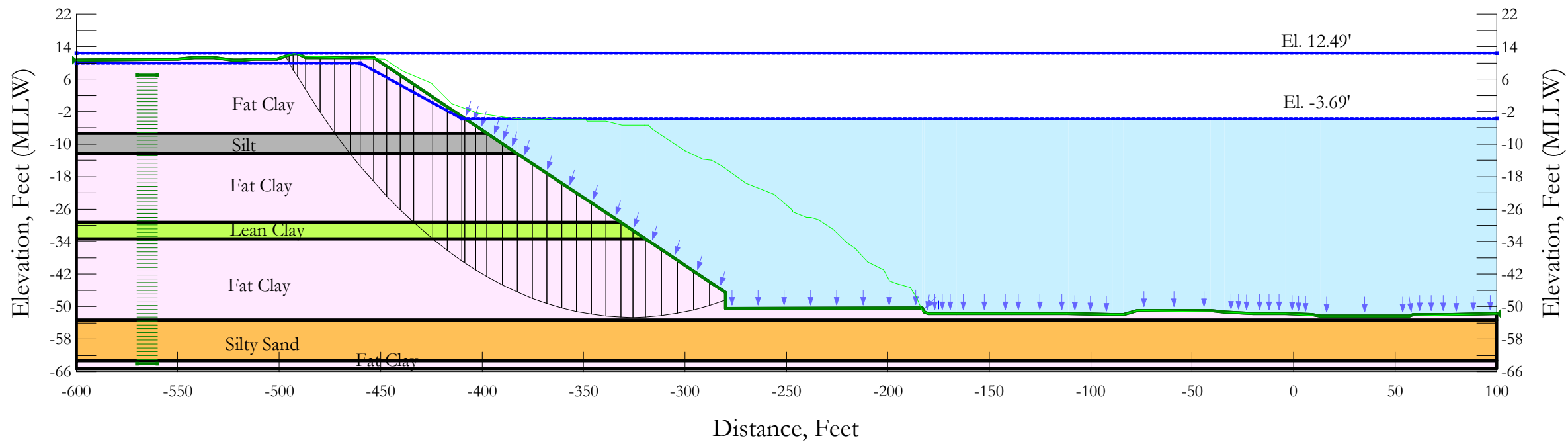
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-494.17887	10.975664	-60.881458	18.379357	5.971815	200
Slice 2	-493.03287	9.9715353	1.7761993	136.39485	43.740251	200
Slice 3	-492	9.0861998	57.021133	232.60228	57.049776	200
Slice 4	-489	6.5677106	214.17486	455.18751	78.309757	200
Slice 5	-482.92859	1.7262098	516.28451	924.29707	132.57132	200
Slice 6	-474.78577	-4.3818362	897.42658	1,573.4483	219.65278	200
Slice 7	-466.95171	-9.81	1,236.144	2,109.0047	566.84239	0
Slice 8	-461.59453	-13.313188	1,454.7429	2,498.0929	339.00498	200
Slice 9	-456.75	-16.262446	1,584.6966	2,806.0435	396.83967	200
Slice 10	-449.9276	-20.201657	1,716.9788	3,097.8685	448.67825	200
Slice 11	-442.78281	-24.042751	1,837.7737	3,263.5376	463.25877	200
Slice 12	-435.63802	-27.600352	1,940.8786	3,403.7623	475.31973	200
Slice 13	-431.03281	-29.779375	2,000.219	3,458.3255	618.92949	200
Slice 14	-427.75	-31.233644	2,073.7794	3,524.1111	615.62928	200
Slice 15	-424.20048	-32.76427	2,169.2904	3,617.3847	614.67956	200
Slice 16	-419.73459	-34.570507	2,281.9996	3,791.0823	490.33068	200
Slice 17	-413.40185	-36.995823	2,433.3394	3,980.9916	502.86269	200
Slice 18	-407.06911	-39.232479	2,572.9067	4,154.8334	513.99913	200
Slice						

19	-400.73637	-41.285628	2,701.0232	4,312.5904	523.62991	200
Slice 20	-393.82	-43.314928	2,827.6515	4,471.1338	533.99976	200
Slice 21	-386.32	-45.29003	2,950.8979	4,626.8936	544.56401	200
Slice 22	-378.92714	-47.004529	3,057.8826	4,750.8446	550.07669	200
Slice 23	-371.64143	-48.469828	3,149.3173	4,842.2163	550.05624	200
Slice 24	-364.35571	-49.717907	3,227.1974	4,907.5766	545.98831	200
Slice 25	-357.07	-50.751955	3,291.722	4,945.4157	537.31766	200
Slice 26	-349.78429	-51.574566	3,343.0529	4,954.2143	523.49806	200
Slice 27	-342.49857	-52.187776	3,381.3172	4,932.5264	504.01842	200
Slice 28	-335.21286	-52.593084	3,406.6084	4,879.0594	478.42833	200
Slice 29	-328.57	-52.790577	3,418.932	4,792.6746	446.35604	200
Slice 30	-322.57	-52.813936	3,420.3896	4,678.5093	408.78787	200
Slice 31	-316.2725	-52.684261	3,412.2979	4,544.4842	367.86962	200
Slice 32	-309.6775	-52.386729	3,393.7319	4,387.9595	323.04412	200
Slice 33	-303.0825	-51.91925	3,364.5612	4,203.6079	272.62281	200
Slice 34	-296.4875	-51.28089	3,324.7275	3,991.7882	216.74115	200
Slice 35	-289.8925	-50.470365	3,274.1508	3,753.0951	155.61845	200
Slice 36	-283.2975	-49.486025	3,212.728	3,488.3322	89.54925	200



Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 110+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Grey	Silt	110	0	33	0.1	32.9	2
Pink	Fat Clay	115	200	18	300	14	2
Light Green	Lean Clay	125	200	23	300	19	2
Orange	Silty Sand	120	0	31	0.1	30.9	2



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 76

Date: 4/27/2018

Time: 11:14:57 AM

Tool Version: 8.16.1.13452

File Name: 110+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\110+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:16:04 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silt

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 33 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 32.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 18 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 31 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 30.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (-470.9994, 220.97486) ft

Lower Left: (-470.9994, 28.49448) ft

Lower Right: (-199.88481, 28.49448) ft

Grid Horizontal Increment: 15

Grid Vertical Increment: 25

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-570, 6.99985) ft

Upper Right Coordinate: (-560, 6.99985) ft

Lower Left Coordinate: (-570, -63.98968) ft

Lower Right Coordinate: (-560, -63.98968) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-600, 10.66667) ft

Right Coordinate: (100, -51.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

--	--	--

	X (ft)	Y (ft)
Coordinate 1	-600	12.49
Coordinate 2	100	12.49

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-600	10
Coordinate 2	-460	10
Coordinate 3	-410	-3.69
Coordinate 4	100	-3.69

Points

	X (ft)	Y (ft)
Point 1	-600	-12.31
Point 2	-600	-29.31
Point 3	-600	-33.31
Point 4	-600	-53.31
Point 5	100	-53.31
Point 6	-600	-63.31
Point 7	100	-63.31
Point 8	-600	-65.31
Point 9	100	-65.31
Point 10	-175	-48.31
Point 11	-600	-7.31
Point 12	-280	-50.5
Point 13	-280	-46.5
Point 14	-319.57	-33.31
Point 15	-331.57	-29.31
Point 16	-382.57	-12.31
Point 17	-397.57	-7.31
Point 18	-453.5	11.33333
Point 19	-600	10.66667
Point 20	-550	11
Point 21	-542	11.33333
Point 22	-532	11.33333
Point 23	-523	10.66667
Point 24	-518	10.66667
Point 25	-512	11
Point 26	-501	11
Point 27	-493	12.33333
Point 28	-491	12.33333
Point 29	-487	11.33333
Point 30	-183	-50.33333
Point 31	-182	-51.33333
Point 32	-180	-51.66667
Point 33	-166	-51.66667
Point 34	-139	-51.66667
Point 35	-111	-51.66667

Point 36	-89	-52
Point 37	-84	-52
Point 38	-77	-51
Point 39	-41	-51
Point 40	-34	-51.33333
Point 41	-20	-51.66667
Point 42	-4	-51.66667
Point 43	9	-52
Point 44	13	-52.33333
Point 45	57	-52.33333
Point 46	59	-52
Point 47	77	-52
Point 48	100	-51.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay	1,2,15,16	4,129.8
Region 2	Lean Clay	2,3,14,15	1,097.7
Region 3	Silty Sand	4,6,7,5	7,000
Region 4	Fat Clay	6,8,9,7	1,400
Region 5	Silt	11,1,16,17	1,049.7
Region 6	Fat Clay	19,20,21,22,23,24,25,26,27,28,29,18,17,11	3,219.9
Region 7	Fat Clay	3,14,13,12,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,5,4	6,867.3

Current Slip Surface

Slip Surface: 28,640

F of S: 1.41

Volume: 5,344.3381 ft³

Weight: 616,770.3 lbs

Resisting Moment: 36,826,127 lbs-ft

Activating Moment: 26,038,413 lbs-ft

Resisting Force: 134,215.87 lbs

Activating Force: 95,039.544 lbs

F of S Rank (Analysis): 1 of 31,616 slip surfaces

F of S Rank (Query): 1 of 31,616 slip surfaces

Exit: (-280, -48.427194) ft

Entry: (-496.92013, 11.679977) ft

Radius: 258.20778 ft

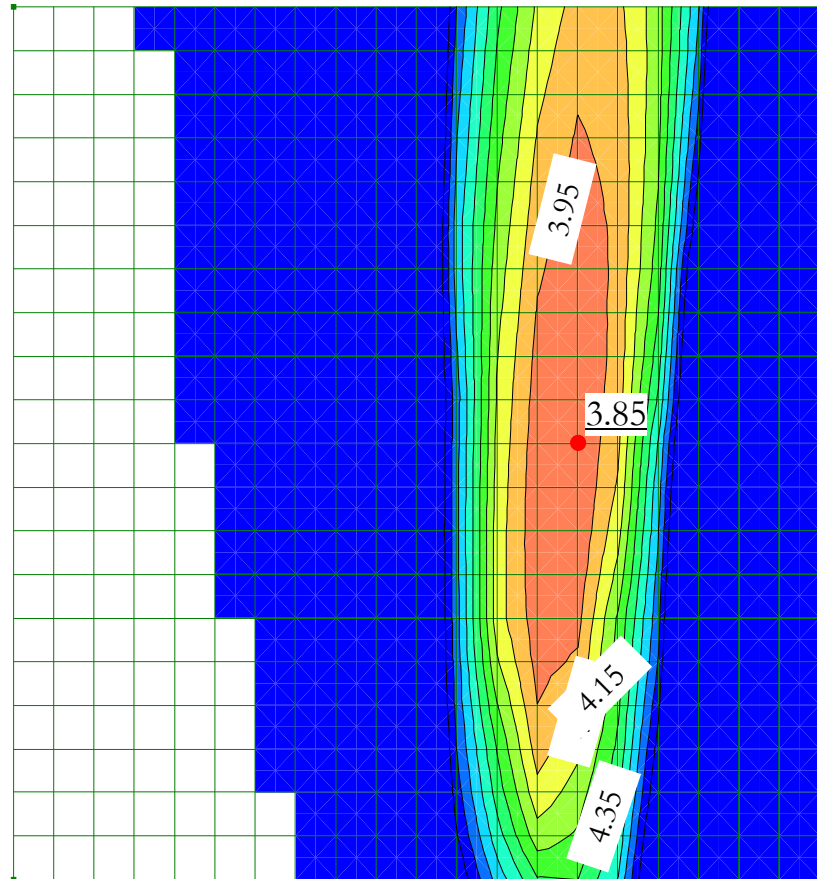
Center: (-326.40495, 205.57643) ft

Slip Slices

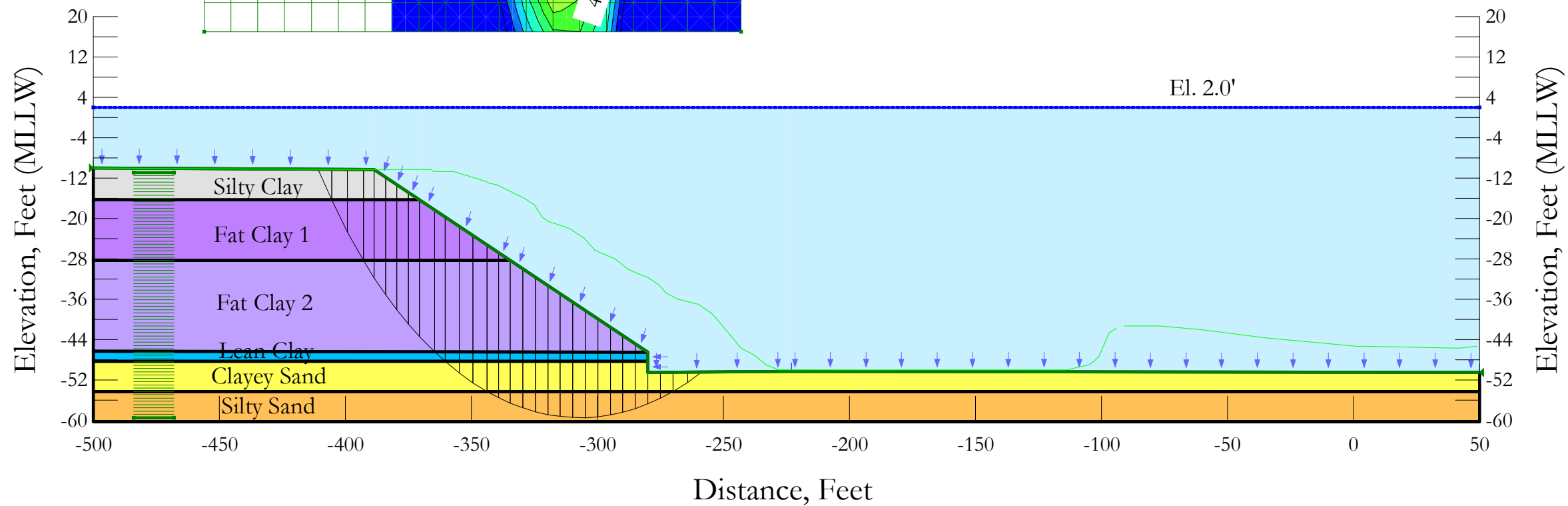
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-495.95536	10.839988	-52.415274	-0.62951182	0	188.92659
Slice 2	-493.9953	9.1508105	52.989425	214.94095	0	219.37385
Slice 3	-492	7.4657496	158.13722	412.01036	0	247.32738
Slice 4	-489	5.0085315	311.46763	608.8149	96.613985	200
Slice 5	-483.38087	0.61536221	585.6014	1,025.2774	142.85939	200
Slice 6	-476.14262	-4.7332302	919.35357	1,586.2914	216.70122	200

Slice 7	-468.74042	-9.81	1,236.144	2,078.8274	547.24503	0
Slice 8	-462.47867	-13.847127	1,488.0607	2,516.2134	334.06706	200
Slice 9	-456.75	-17.285081	1,532.1989	2,859.2729	431.19246	200
Slice 10	-450.19021	-20.99419	1,643.2476	3,132.4471	483.87026	200
Slice 11	-443.57063	-24.488058	1,740.8516	3,278.4285	499.58901	200
Slice 12	-436.95105	-27.741823	1,824.518	3,404.402	513.33542	200
Slice 13	-429.02447	-31.31	1,905.6626	3,514.6236	682.96344	200
Slice 14	-420.80576	-34.72499	1,973.2718	3,670.4117	551.43417	200
Slice 15	-413.60192	-37.432428	2,015.939	3,739.0261	559.86493	200
Slice 16	-409.215	-38.990676	2,202.7622	3,780.5278	512.64712	200
Slice 17	-405.715	-40.132823	2,274.0322	3,854.6555	513.57563	200
Slice 18	-400.285	-41.819953	2,379.309	3,987.2437	522.44965	200
Slice 19	-393.82	-43.645118	2,493.1994	4,134.6346	533.33462	200
Slice 20	-386.32	-45.554182	2,612.325	4,291.448	545.58015	200
Slice 21	-378.92714	-47.205762	2,715.3835	4,417.1208	552.92798	200
Slice 22	-371.64143	-48.610963	2,803.0681	4,510.426	554.75422	200
Slice 23	-364.35571	-49.800618	2,877.3025	4,577.527	552.43643	200
Slice 24	-357.07	-50.777729	2,938.2743	4,616.4869	545.28432	200
Slice 25	-349.78429	-51.544722	2,986.1347	4,625.3755	532.62161	200
Slice 26	-342.49857	-52.103475	3,021.0009	4,602.3772	513.8203	200
Slice 27	-335.21286	-52.455342	3,042.9573	4,545.8961	488.33442	200
Slice 28	-328.57	-52.604848	3,052.2865	4,455.04	455.78225	200
Slice 29	-322.57	-52.585441	3,051.0755	4,335.2877	417.26583	200
Slice 30	-315.613	-52.375327	3,037.9644	4,177.5726	370.28116	200
Slice 31	-307.699	-51.922322	3,009.6969	3,971.8936	312.63666	200
Slice 32	-299.785	-51.224684	2,966.1643	3,724.3524	246.35023	200
Slice 33	-291.871	-50.280412	2,907.2417	3,436.2009	171.86925	200
Slice 34	-283.957	-49.086757	2,832.7576	3,109.2849	89.849177	200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 166+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Clayey Sand	115	0	32	
Orange	Silty Sand	120	0	34	
Grey	Silty Clay (undrained)	115			1,400
Purple	Fat Clay 1 (undrained)	115			900
Cyan	Lean Clay (undrained)	120			2,000
Light Purple	Fat Clay 2 (undrained)	115			1,500



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 70

Date: 4/27/2018

Time: 11:19:33 AM

Tool Version: 8.16.1.13452

File Name: 166+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\166+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:20:26 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,400 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1 (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 900 psf

Pore Water Pressure
Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)
Unit Weight: 120 pcf
Cohesion: 2,000 psf
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2 (undrained)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 1,500 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-456, 132.3189) ft
Lower Left: (-456, 17.00129) ft
Lower Right: (-243, 17.00129) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-484.00975, -10.94478) ft
Upper Right Coordinate: (-468.00472, -10.94478) ft
Lower Left Coordinate: (-484.00975, -59.46821) ft
Lower Right Coordinate: (-468.00472, -59.46821) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, -10) ft
Right Coordinate: (50, -50.5) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	2

Coordinate 2	50	2
--------------	----	---

Points

	X (ft)	Y (ft)
Point 1	-500	-16.31
Point 2	-500	-46.31
Point 3	-500	-48.31
Point 4	-280	-48.31
Point 5	-500	-54.31
Point 6	50	-54.31
Point 7	-500	-60.31
Point 8	50	-60.31
Point 9	-500	-28.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-334.57	-28.31
Point 13	-370.57	-16.31
Point 14	-388.5	-10.33333
Point 15	-225	-50.33333
Point 16	50	-50.5
Point 17	-500	-10

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (undrained)	2,3,4,11	419.1
Region 2	Silty Sand	5,7,8,6	3,300
Region 3	Fat Clay 1 (undrained)	1,13,12,9	1,769.2
Region 4	Fat Clay 2 (undrained)	9,2,11,12	3,484.6
Region 5	Clayey Sand	3,4,10,15,16,6,5	2,604.8
Region 6	Silty Clay (undrained)	17,14,13,1	738.56

Current Slip Surface

Slip Surface: 17,100
 F of S: 3.85
 Volume: 2,953.2338 ft³
 Weight: 341,649.47 lbs
 Resisting Moment: 21,073,557 lbs-ft
 Activating Moment: 5,480,182.9 lbs-ft
 Resisting Force: 138,452.71 lbs
 Activating Force: 36,147.8 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-258.5094, -50.434876) ft
 Entry: (-410.71621, -10.266914) ft
 Radius: 134.12831 ft
 Center: (-306.9, 74.660095) ft

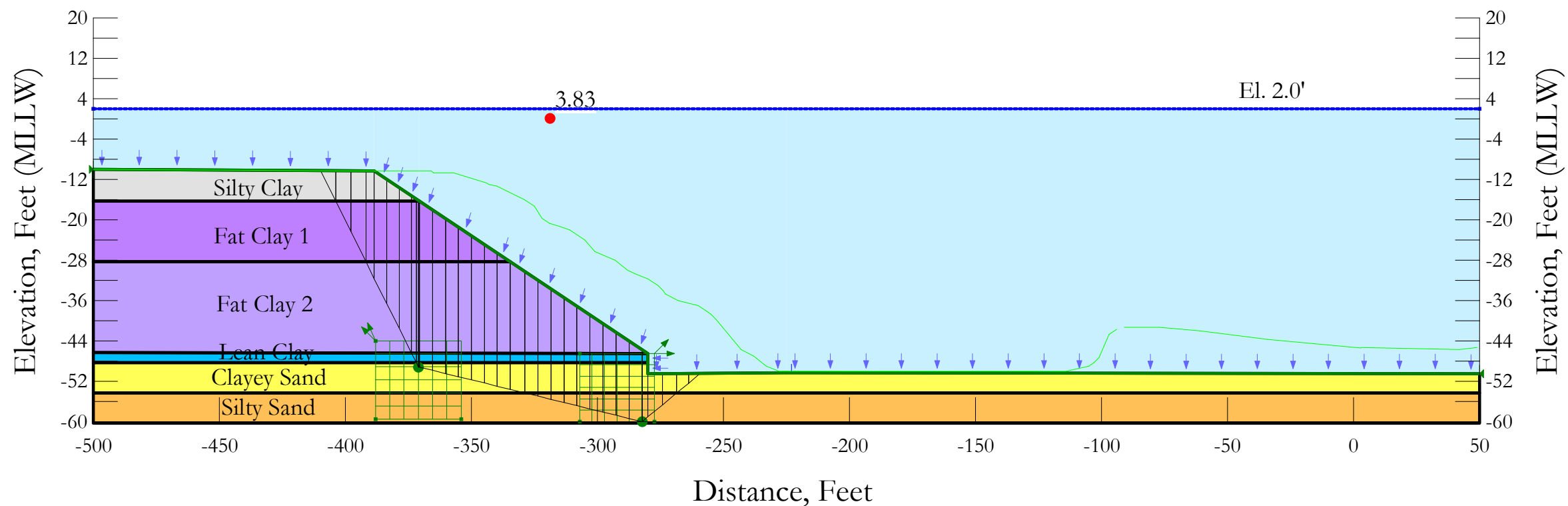
Slip Slices

				Base Normal Stress	Frictional Strength	Cohesive Strength

	X (ft)	Y (ft)	PWP (psf)	(psf)	(psf)	(psf)
Slice 1	-408.09006	-13.288457	953.99973	693.22101	0	1,400
Slice 2	-402.31066	-19.504956	1,341.9093	1,586.0366	0	900
Slice 3	-396.00417	-25.504956	1,716.3093	2,299.502	0	900
Slice 4	-390.67546	-30.050515	1,999.9522	2,714.4325	0	1,500
Slice 5	-386.25875	-33.436438	2,211.2337	3,088.3195	0	1,500
Slice 6	-381.77625	-36.590302	2,408.0348	3,394.387	0	1,500
Slice 7	-377.29375	-39.480995	2,588.4141	3,668.8489	0	1,500
Slice 8	-372.81125	-42.128116	2,753.5944	3,914.3541	0	1,500
Slice 9	-367.58085	-44.909972	2,927.1822	4,164.701	0	1,500
Slice 10	-362.52624	-47.368472	3,080.5926	4,326.3152	0	2,000
Slice 11	-357.67383	-49.45015	3,210.4894	4,626.9823	885.12301	0
Slice 12	-352.09993	-51.588098	3,343.8973	4,787.6669	902.16739	0
Slice 13	-346.52602	-53.447947	3,459.9519	4,917.6689	910.88267	0
Slice 14	-341.4468	-54.921126	3,551.8783	5,009.6849	983.30297	0
Slice 15	-336.86227	-56.057671	3,622.7986	5,078.6101	981.95723	0
Slice 16	-332.08955	-57.057449	3,685.1848	5,128.5642	973.5717	0
Slice 17	-327.12864	-57.910296	3,738.4025	5,158.0248	957.54735	0
Slice 18	-322.16773	-58.573029	3,779.757	5,164.2504	933.85261	0
Slice 19	-317.20682	-59.048478	3,809.425	5,147.2548	902.3776	0
Slice 20	-312.24591	-59.33864	3,827.5311	5,106.958	862.98435	0
Slice 21	-307.285	-59.444719	3,834.1505	5,043.1933	815.50965	0
Slice 22	-302.32409	-59.367154	3,829.3104	4,955.7113	759.76697	0
Slice 23	-297.36318	-59.105623	3,812.9909	4,844.1821	695.54724	0
Slice 24	-292.40227	-58.659044	3,785.1243	4,708.1941	622.61841	0
Slice 25	-287.44136	-58.025544	3,745.5939	4,547.2492	540.72336	0
Slice 26	-282.48045	-57.202426	3,694.2314	4,370.9469	456.45038	0
Slice 27	-277.51523	-56.185051	3,630.7472	3,959.3768	221.66344	0
Slice 28	-272.5457	-54.968515	3,554.8354	3,811.9083	173.39784	0
Slice 29	-267.17305	-53.414217	3,457.8471	3,625.3545	104.67024	0
Slice 30	-261.39728	-51.476654	3,336.9432	3,396.0612	36.941046	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 166+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Clayey Sand	115	0	32	
Orange	Silty Sand	120	0	34	
Grey	Silty Clay (undrained)	115			1,400
Purple	Fat Clay 1 (undrained)	115			900
Cyan	Lean Clay (undrained)	120			2,000
Light Purple	Fat Clay 2 (undrained)	115			1,500



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 70

Date: 4/27/2018

Time: 11:19:33 AM

Tool Version: 8.16.1.13452

File Name: 166+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\166+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:20:58 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Clay (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,400 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1 (undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 900 psf
Pore Water Pressure
Piezometric Line: 1

Lean Clay (undrained)

Model: Undrained (Phi=0)
Unit Weight: 120 pcf
Cohesion: 2,000 psf
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2 (undrained)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 1,500 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-500, -10) ft
Right Coordinate: (50, -50.5) ft

Slip Surface Block

Left Grid

Upper Left: (-388, -43.97595) ft
Lower Left: (-388, -59.50986) ft
Lower Right: (-354, -59.50986) ft
X Increments: 6
Y Increments: 6
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2

Right Grid

Upper Left: (-307.00784, -46.48459) ft
Lower Left: (-307.00784, -59.99428) ft
Lower Right: (-277.3425, -59.99428) ft
X Increments: 6
Y Increments: 6
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	2
Coordinate 2	50	2

Points

	X (ft)	Y (ft)
Point 1	-500	-16.31
Point 2	-500	-46.31
Point 3	-500	-48.31
Point 4	-280	-48.31
Point 5	-500	-54.31
Point 6	50	-54.31
Point 7	-500	-60.31
Point 8	50	-60.31
Point 9	-500	-28.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-334.57	-28.31
Point 13	-370.57	-16.31
Point 14	-388.5	-10.33333
Point 15	-225	-50.33333
Point 16	50	-50.5
Point 17	-500	-10

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (undrained)	2,3,4,11	419.1
Region 2	Silty Sand	5,7,8,6	3,300
Region 3	Fat Clay 1 (undrained)	1,13,12,9	1,769.2
Region 4	Fat Clay 2 (undrained)	9,2,11,12	3,484.6
Region 5	Clayey Sand	3,4,10,15,16,6,5	2,604.8
Region 6	Silty Clay (undrained)	17,14,13,1	738.56

Current Slip Surface

Slip Surface: 13,982
 F of S: 3.83
 Volume: 2,918.2125 ft³
 Weight: 337,308.83 lbs
 Resisting Moment: 9,002,171.2 lbs-ft
 Activating Moment: 2,360,999.7 lbs-ft
 Resisting Force: 126,854.69 lbs
 Activating Force: 33,302.045 lbs
 F of S Rank (Analysis): 1 of 21,609 slip surfaces
 F of S Rank (Query): 1 of 21,609 slip surfaces
 Exit: (-259.21343, -50.437009) ft
 Entry: (-409.88452, -10.269401) ft
 Radius: 73.973394 ft
 Center: (-326.51772, -0.22749876) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-406.86422	-13.2897	954.07731	744.78777	0	1,400

Slice 2	-400.84392	-19.31	1,329.744	1,563.3067	0	900
Slice 3	-394.84392	-25.31	1,704.144	2,245.5232	0	900
Slice 4	-390.17196	-29.98196	1,995.6743	2,619.3439	0	1,500
Slice 5	-386.03915	-34.114775	2,253.5619	3,046.3565	0	1,500
Slice 6	-381.11744	-39.036484	2,560.6766	3,518.3592	0	1,500
Slice 7	-376.19573	-43.958193	2,867.7912	3,989.737	0	1,500
Slice 8	-372.7894	-47.364524	3,080.3463	4,191.6022	0	2,000
Slice 9	-371.42196	-48.73196	3,165.6743	4,610.031	902.53426	0
Slice 10	-370.785	-49.180192	3,193.644	4,888.4069	1,059.0054	0
Slice 11	-367.99857	-49.520681	3,214.8905	4,880.3804	1,040.7136	0
Slice 12	-362.85571	-50.149115	3,254.1048	4,865.6945	1,007.033	0
Slice 13	-357.71286	-50.777549	3,293.319	4,851.1608	973.44758	0
Slice 14	-352.57	-51.405982	3,332.5333	4,836.7349	939.9295	0
Slice 15	-347.42714	-52.034416	3,371.7476	4,822.37	906.44951	0
Slice 16	-342.28429	-52.66285	3,410.9618	4,808.0179	872.97754	0
Slice 17	-337.14143	-53.291284	3,450.1761	4,793.6302	839.48331	0
Slice 18	-331.68733	-53.95775	3,491.7636	4,778.2781	803.90348	0
Slice 19	-326.22032	-54.625793	3,533.4495	4,762.5596	829.04525	0
Slice 20	-321.05166	-55.25738	3,572.8605	4,750.8443	794.56014	0
Slice 21	-315.88301	-55.888967	3,612.2715	4,738.9029	759.92251	0
Slice 22	-310.71435	-56.520553	3,651.6825	4,726.7002	725.10862	0
Slice 23	-305.54569	-57.15214	3,691.0935	4,714.2063	690.09831	0
Slice 24	-300.37703	-57.783727	3,730.5045	4,701.3972	654.8754	0
Slice 25	-295.20837	-58.415313	3,769.9156	4,688.2555	619.4281	0
Slice 26	-290.03971	-59.0469	3,809.3266	4,674.7705	583.74928	0
Slice 27	-284.87105	-59.678487	3,848.7376	4,660.9388	547.83666	0
Slice 28	-281.14336	-59.520684	3,838.8907	4,697.7521	579.30933	0
Slice 29	-277.14091	-57.862816	3,735.4397	4,188.7865	305.78627	0
Slice 30	-271.42274	-55.494272	3,587.6426	3,889.2652	203.44703	0
Slice 31	-266.2261	-53.341752	3,453.3253	3,621.6242	105.16483	0
Slice 32	-261.55099	-51.405257	3,332.488	3,388.5023	35.001619	0

Project Name: HSC-ECIP Preliminary Slope Evaluation

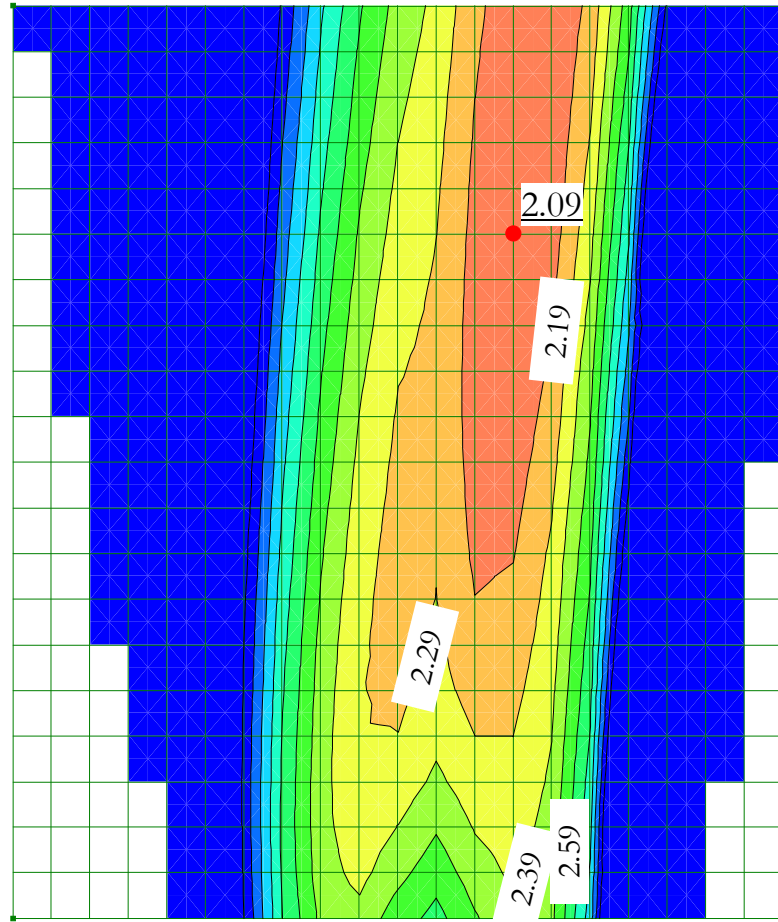
Location: Bayport Ship Channel

Station Analyzed: 166+00

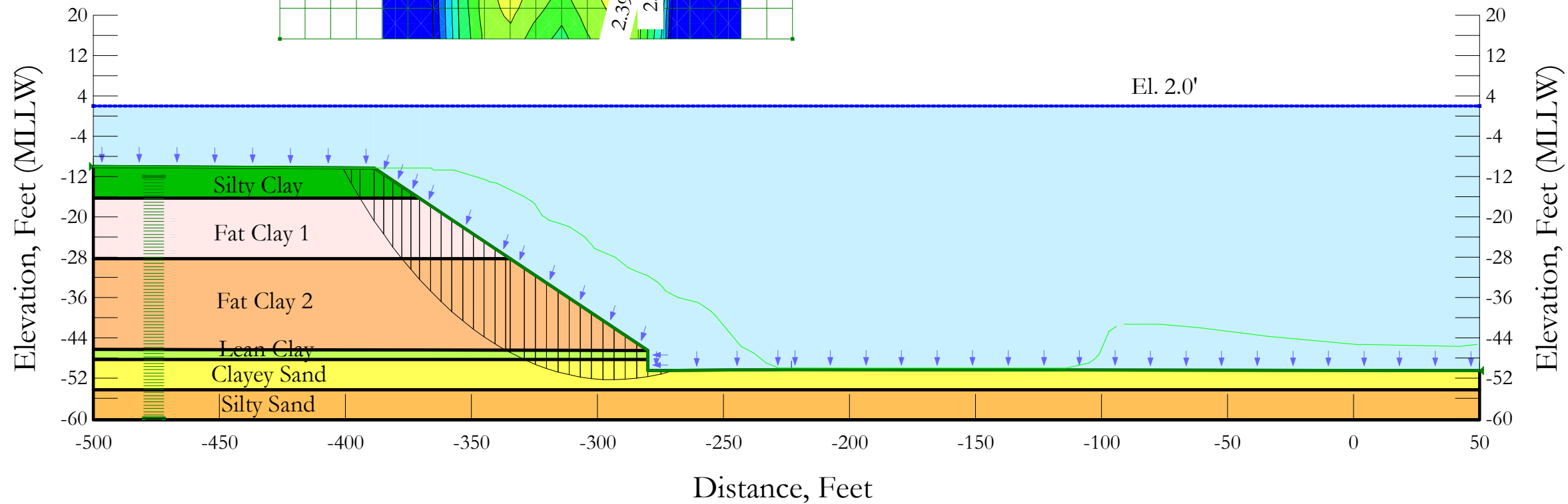
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Green	Silty Clay	115	100	30
Pink	Fat Clay 1	115	200	17
Light Green	Lean Clay	120	200	23
Yellow	Clayey Sand	115	0	32
Orange	Silty Sand	120	0	34
Light Orange	Fat Clay 2	115	200	17



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 70

Date: 4/27/2018

Time: 11:19:33 AM

Tool Version: 8.16.1.13452

File Name: 166+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\166+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:19:52 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silty Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 100 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 17 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 17 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-425.96668, 135.91451) ft

Lower Left: (-425.96668, 15.34286) ft

Lower Right: (-222.60373, 15.34286) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-480, -11.99991) ft

Upper Right Coordinate: (-472, -11.99991) ft

Lower Left Coordinate: (-480, -59.97942) ft

Lower Right Coordinate: (-472, -59.97942) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, -10) ft

Right Coordinate: (50, -50.5) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	2
Coordinate 2	50	2

Points

	X (ft)	Y (ft)
Point 1	-500	-16.31
Point 2	-500	-46.31
Point 3	-500	-48.31
Point 4	-280	-48.31
Point 5	-500	-54.31
Point 6	50	-54.31
Point 7	-500	-60.31
Point 8	50	-60.31
Point 9	-500	-28.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-334.57	-28.31
Point 13	-370.57	-16.31
Point 14	-388.5	-10.33333
Point 15	-225	-50.33333
Point 16	50	-50.5
Point 17	-500	-10

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	2,3,4,11	419.1
Region 2	Silty Sand	5,7,8,6	3,300
Region 3	Fat Clay 1	1,13,12,9	1,769.2
Region 4	Fat Clay 2	9,2,11,12	3,484.6
Region 5	Clayey Sand	3,4,10,15,16,6,5	2,604.8
Region 6	Silty Clay	17,14,13,1	738.56

Current Slip Surface

Slip Surface: 24,992

F of S: 2.09

Volume: 1,710.2003 ft³

Weight: 197,156.93 lbs

Resisting Moment: 8,676,907.6 lbs-ft

Activating Moment: 4,152,687.7 lbs-ft

Resisting Force: 51,225.628 lbs

Activating Force: 24,681.732 lbs

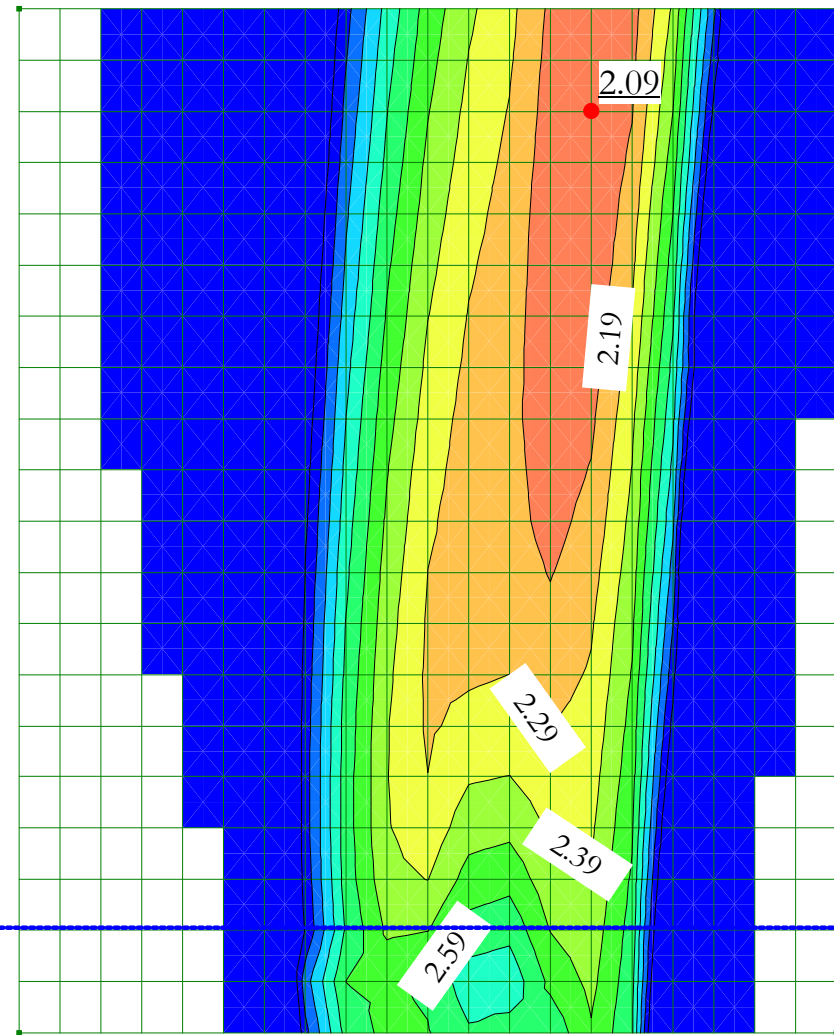
F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-269.77335, -50.46901) ft
 Entry: (-401.09278, -10.295684) ft
 Radius: 158.0743 ft
 Center: (-293.78076, 105.7716) ft

Slip Slices

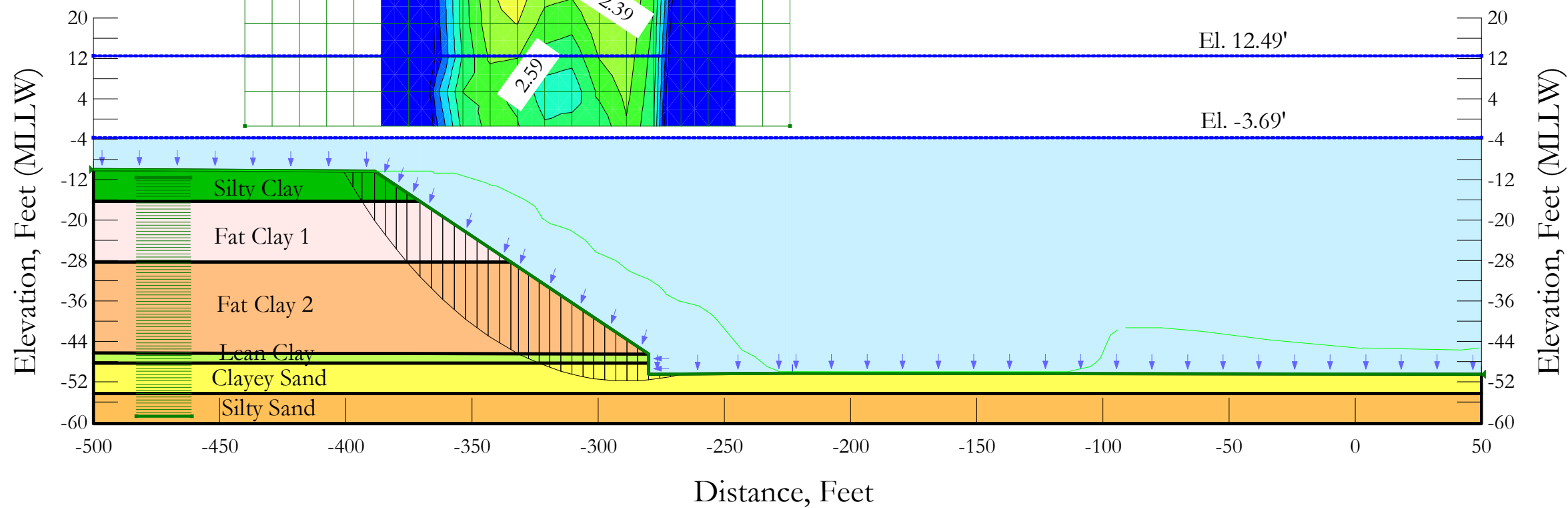
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-399.36902	-11.843186	863.81484	892.66872	16.658793	100
Slice 2	-395.92149	-14.850345	1,051.4615	1,206.0031	89.224621	100
Slice 3	-391.34886	-18.545874	1,282.0625	1,587.919	93.509728	200
Slice 4	-386.66736	-22.112852	1,504.642	1,952.1729	136.82393	200
Slice 5	-383.00208	-24.69721	1,665.9059	2,179.5022	157.02214	200
Slice 6	-379.3368	-27.130232	1,817.7265	2,390.9933	175.26525	200
Slice 7	-375.77062	-29.361796	1,956.9761	2,582.7597	191.32124	200
Slice 8	-372.30354	-31.405902	2,084.5283	2,756.3707	205.40283	200
Slice 9	-368.43384	-33.542893	2,217.8765	2,935.4717	219.39087	200
Slice 10	-364.16153	-35.749918	2,355.5949	3,117.9761	233.08333	200
Slice 11	-359.88921	-37.795896	2,483.2639	3,284.3638	244.92082	200
Slice 12	-355.6169	-39.687633	2,601.3083	3,435.3013	254.97726	200
Slice 13	-351.34458	-41.431082	2,710.0995	3,571.2914	263.29279	200
Slice 14	-347.07227	-43.031461	2,809.9632	3,692.6909	269.87694	200
Slice 15	-342.79995	-44.493347	2,901.1848	3,799.7268	274.71185	200
Slice 16	-338.52764	-45.820749	2,984.0148	3,892.5131	277.75581	200
Slice 17	-335.48074	-46.700379	3,038.9036	3,940.9954	382.91524	200
Slice 18	-331.82718	-47.62973	3,096.8951	4,003.2987	384.74551	200
Slice 19	-326.85326	-48.787412	3,169.1345	4,074.5865	565.78922	0
Slice 20	-322.39104	-49.675462	3,224.5489	4,116.5361	557.37544	0
Slice 21	-317.92883	-50.431018	3,271.6955	4,142.3592	544.05105	0
Slice 22	-313.46661	-51.055996	3,310.6941	4,151.7232	525.53332	0
Slice 23	-309.0044	-51.551953	3,341.6419	4,144.2856	501.54743	0
Slice 24	-304.54218	-51.920108	3,364.6147	4,119.7097	471.83573	0
Slice 25	-300.07997	-52.161354	3,379.6685	4,077.6803	436.1662	0
Slice 26	-295.61775	-52.276275	3,386.8396	4,017.9147	394.33951	0
Slice 27	-291.15554	-52.265145	3,386.1451	3,940.1722	346.19456	0

Slice 28	-286.69332	-52.127938	3,377.5833	3,844.2599	291.61193	0
Slice 29	-282.23111	-51.864325	3,361.1339	3,754.9687	246.09532	0
Slice 30	-277.44334	-51.43516	3,334.354	3,390.7192	35.220889	0
Slice 31	-272.33001	-50.819236	3,295.9203	3,316.741	13.010195	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 166+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Green	Silty Clay	115	100	30	200	25	2
Pink	Fat Clay 1	115	200	17	300	14	2
Light Green	Lean Clay	120	200	23	300	19	2
Yellow	Clayey Sand	115	0	32	0.1	31.9	2
Orange	Silty Sand	120	0	34	0.1	33.9	2
Light Orange	Fat Clay 2	115	200	17	300	14	2



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 70

Date: 4/27/2018

Time: 11:19:33 AM

Tool Version: 8.16.1.13452

File Name: 166+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\166+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:20:56 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Silty Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 100 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 200 psf

Phi R: 25 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 17 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 31.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 34 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 33.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 17 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (-440, 133.92534) ft

Lower Left: (-440, -1.35231) ft

Lower Right: (-224, -1.35231) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-483.03894, -11.6018) ft
Upper Right Coordinate: (-461.6528, -11.6018) ft
Lower Left Coordinate: (-483.03894, -58.75541) ft
Lower Right Coordinate: (-460.98448, -58.75541) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, -10) ft
Right Coordinate: (50, -50.5) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	12.49
Coordinate 2	50	12.49

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	-3.69
Coordinate 2	50	-3.69

Points

	X (ft)	Y (ft)
Point 1	-500	-16.31
Point 2	-500	-46.31
Point 3	-500	-48.31
Point 4	-280	-48.31
Point 5	-500	-54.31
Point 6	50	-54.31
Point 7	-500	-60.31
Point 8	50	-60.31
Point 9	-500	-28.31
Point 10	-280	-50.5
Point 11	-280	-46.5
Point 12	-334.57	-28.31
Point 13	-370.57	-16.31
Point 14	-388.5	-10.33333

Point 15	-225	-50.33333
Point 16	50	-50.5
Point 17	-500	-10

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	2,3,4,11	419.1
Region 2	Silty Sand	5,7,8,6	3,300
Region 3	Fat Clay 1	1,13,12,9	1,769.2
Region 4	Fat Clay 2	9,2,11,12	3,484.6
Region 5	Clayey Sand	3,4,10,15,16,6,5	2,604.8
Region 6	Silty Clay	17,14,13,1	738.56

Current Slip Surface

Slip Surface: 29,857

F of S: 2.09

Volume: 1,595.8925 ft³

Weight: 183,963.45 lbs

Resisting Moment: 8,901,738.8 lbs-ft

Activating Moment: 4,265,422.3 lbs-ft

Resisting Force: 48,328.25 lbs

Activating Force: 23,257.761 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (-267.05014, -50.460757) ft

Entry: (-400.98205, -10.296015) ft

Radius: 172.23712 ft

Center: (-288.8, 120.39757) ft

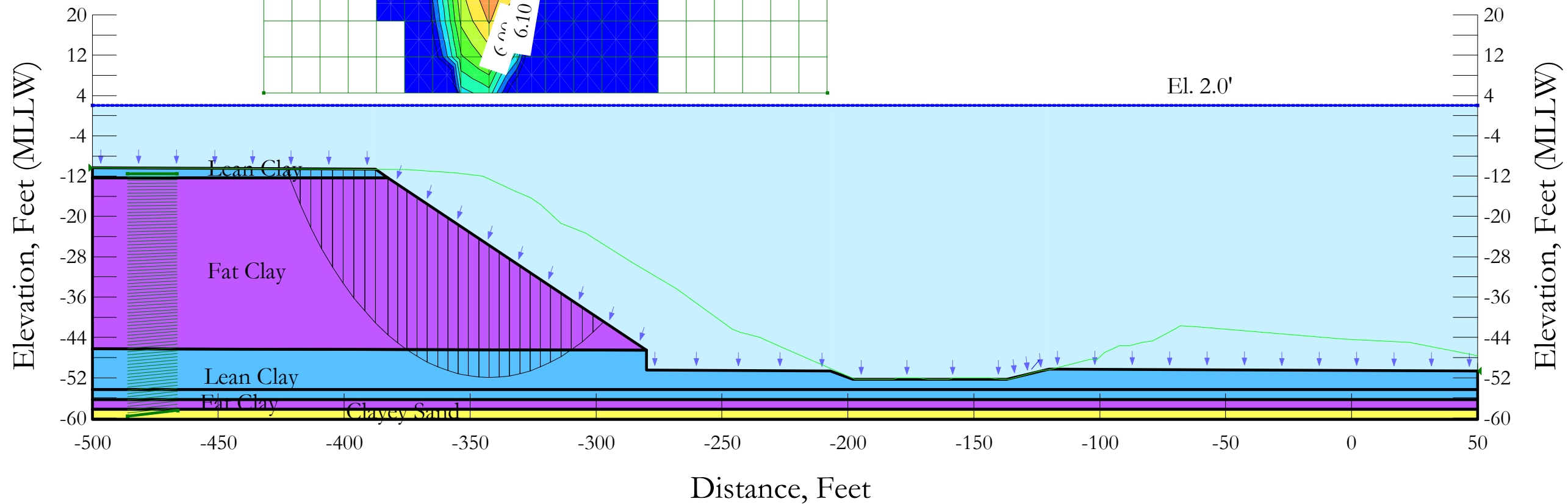
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-399.12893	-11.842089	508.69037	541.23161	0	117.98704
Slice 2	-395.4227	-14.849082	696.32671	856.89385	92.703481	100
Slice 3	-391.03479	-18.180027	904.17766	1,202.695	91.265899	200
Slice 4	-386.36674	-21.516682	1,112.3849	1,536.9966	129.81683	200
Slice 5	-382.10021	-24.358273	1,289.7002	1,783.2399	150.89022	200
Slice 6	-377.83369	-27.021618	1,455.893	2,010.6369	169.60224	200
Slice 7	-373.13521	-29.750825	1,626.1955	2,239.8248	187.60529	200
Slice 8	-368.32	-32.362896	1,789.1887	2,455.8722	203.8256	200
Slice 9	-363.82	-34.622997	1,930.219	2,639.4063	216.82032	200
Slice 10	-359.32	-36.721722	2,061.1795	2,806.7113	227.93196	200
Slice 11	-354.82	-38.665467	2,182.4691	2,958.4476	237.24043	200
Slice 12	-350.32	-40.459855	2,294.439	3,095.1105	244.78985	200
Slice 13	-345.82	-42.109841	2,397.398	3,217.0459	250.5915	200
Slice 14	-341.32	-43.619785	2,491.6186	3,324.4667	254.62722	200

Slice 15	-336.82	-44.993527	2,577.3401	3,417.4685	256.85302	200
Slice 16	-333.04898	-46.051148	2,643.3356	3,485.2915	257.41176	200
Slice 17	-329.51841	-46.94447	2,699.0789	3,531.0564	353.15349	200
Slice 18	-325.49932	-47.871721	2,756.9394	3,586.384	352.07832	200
Slice 19	-321.31529	-48.728057	2,810.3747	3,631.2557	512.94341	0
Slice 20	-316.96631	-49.506595	2,858.9555	3,659.4471	500.20268	0
Slice 21	-312.61733	-50.170712	2,900.3964	3,673.3823	483.0152	0
Slice 22	-308.26835	-50.72174	2,934.7806	3,672.7821	461.1545	0
Slice 23	-303.91938	-51.16077	2,962.176	3,657.3729	434.40722	0
Slice 24	-299.5704	-51.48866	2,982.6364	3,626.8991	402.57998	0
Slice 25	-295.22142	-51.706047	2,996.2013	3,581.1323	365.50548	0
Slice 26	-290.87244	-51.813348	3,002.8969	3,519.8807	323.04734	0
Slice 27	-286.52347	-51.810771	3,002.7361	3,442.9941	275.1037	0
Slice 28	-282.17449	-51.698309	2,995.7185	3,381.0776	240.79908	0
Slice 29	-277.84169	-51.476985	2,981.9079	3,039.4404	35.9503	0
Slice 30	-273.52507	-51.147193	2,961.3289	3,000.9042	24.729422	0
Slice 31	-269.20845	-50.707884	2,933.9159	2,948.3901	9.0444628	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 186+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Clayey Sand	115	0	32	
Purple	Fat Clay (Undrained)	115			1,200
Blue	Lean Clay (Undrained)	120			1,200



Short Term

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 97

Date: 4/27/2018

Time: 11:25:35 AM

Tool Version: 8.16.1.13452

File Name: 186+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\186+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:26:38 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion: 0 psf

Phi: 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Lean Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 120 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-432, 147) ft

Lower Left: (-432, 4.5) ft

Lower Right: (-208, 4.5) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-485.98367, -11.54301) ft
Upper Right Coordinate: (-466.3438, -11.54301) ft
Lower Left Coordinate: (-485.98367, -59.63908) ft
Lower Right Coordinate: (-466.05067, -58.59349) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, -10.31) ft
Right Coordinate: (50, -50.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	2
Coordinate 2	50	2

Points

	X (ft)	Y (ft)
Point 1	-500	-12.31
Point 2	-500	-10.31
Point 3	-500	-46.31
Point 4	-500	-54.31
Point 5	50	-54.31
Point 6	-500	-56.31
Point 7	50	-56.31
Point 8	-500	-58.31
Point 9	50	-58.31
Point 10	-500	-60.31
Point 11	50	-60.31
Point 12	-125	-48.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-382.57	-12.31
Point 16	-387.57	-10.59428
Point 17	-207	-50.66667

Point 18	-198	-52.33333
Point 19	-137	-52.33333
Point 20	-120	-50.33333
Point 21	50	-50.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (Undrained)	1,15,16,2	213.17
Region 2	Fat Clay (Undrained)	14,3,1,15	5,747.5
Region 3	Lean Clay (Undrained)	4,6,7,5	1,100
Region 4	Fat Clay (Undrained)	6,8,9,7	1,100
Region 5	Clayey Sand	8,10,11,9	1,100
Region 6	Lean Clay (Undrained)	3,14,13,17,18,19,20,21,5,4	2,855.3

Current Slip Surface

Slip Surface: 10,260
 F of S: 5.60
 Volume: 2,680.1856 ft³
 Weight: 309,753.92 lbs
 Resisting Moment: 16,847,613 lbs-ft
 Activating Moment: 3,009,452.8 lbs-ft
 Resisting Force: 151,495.76 lbs
 Activating Force: 27,469.279 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-296.83325, -40.888918) ft
 Entry: (-423.07971, -10.504493) ft
 Radius: 99.220954 ft
 Center: (-342.4, 47.25) ft

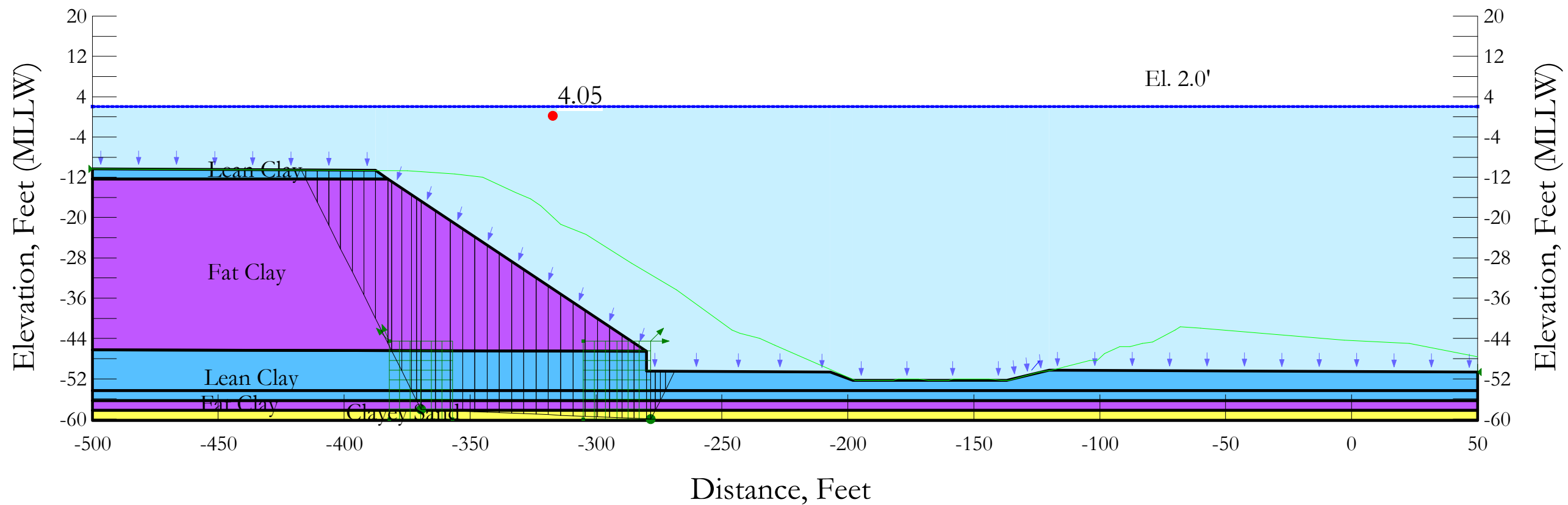
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-422.41795	-11.407247	836.6122	595.7491	0	1,200
Slice 2	-419.61955	-14.96206	1,058.4325	1,032.3344	0	1,200
Slice 3	-415.34628	-19.934012	1,368.6824	1,630.6185	0	1,200
Slice 4	-411.073	-24.304499	1,641.4007	2,152.087	0	1,200
Slice 5	-406.79973	-28.179303	1,883.1885	2,612.0742	0	1,200
Slice 6	-402.52646	-31.632124	2,098.6445	3,021.0663	0	1,200
Slice 7	-398.25318	-34.716669	2,291.1201	3,386.5828	0	1,200
Slice 8	-393.97991	-37.473394	2,463.1398	3,714.1942	0	1,200
Slice 9	-389.70664	-39.933545	2,616.6532	4,008.117	0	1,200
Slice 10	-385.07	-42.284347	2,763.3433	4,247.0477	0	1,200
Slice 11	-380.70954	-44.254693	2,886.2928	4,406.9423	0	1,200
Slice 12	-376.98862	-45.72572	2,978.0849	4,524.8702	0	1,200
Slice 13	-373.08771	-47.081638	3,062.6942	4,631.121	0	1,200
Slice						

14	-369.00681	-48.313536	3,139.5647	4,724.1521	0	1,200
Slice 15	-364.9259	-49.35741	3,204.7024	4,795.1234	0	1,200
Slice 16	-360.845	-50.219315	3,258.4853	4,844.5231	0	1,200
Slice 17	-356.76409	-50.904053	3,301.2129	4,872.6632	0	1,200
Slice 18	-352.68318	-51.415319	3,333.1159	4,879.71	0	1,200
Slice 19	-348.60228	-51.755807	3,354.3623	4,865.709	0	1,200
Slice 20	-344.52137	-51.927277	3,365.0621	4,830.606	0	1,200
Slice 21	-340.44047	-51.930608	3,365.2699	4,774.2633	0	1,200
Slice 22	-336.35956	-51.765817	3,354.987	4,696.475	0	1,200
Slice 23	-332.27865	-51.43206	3,334.1605	4,596.9758	0	1,200
Slice 24	-328.19775	-50.927611	3,302.6829	4,475.4491	0	1,200
Slice 25	-324.11684	-50.249816	3,260.3885	4,331.5294	0	1,200
Slice 26	-320.03594	-49.395021	3,207.0493	4,164.8009	0	1,200
Slice 27	-315.95503	-48.35847	3,142.3685	3,974.7921	0	1,200
Slice 28	-311.87413	-47.134161	3,065.9716	3,760.9637	0	1,200
Slice 29	-307.66694	-45.664268	2,974.2503	3,518.5902	0	1,200
Slice 30	-303.33346	-43.92591	2,865.7768	3,245.8325	0	1,200
Slice 31	-298.99998	-41.943218	2,742.0568	2,944.7682	0	1,200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 186+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Yellow	Clayey Sand	115	0	32	
Purple	Fat Clay (Undrained)	115			1,200
Blue	Lean Clay (Undrained)	120			1,200



Short Term - Block

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 97

Date: 4/27/2018

Time: 11:25:35 AM

Tool Version: 8.16.1.13452

File Name: 186+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\186+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:26:58 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term - Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Lean Clay (Undrained)

Model: Undrained (Phi=0)

Unit Weight: 120 pcf

Cohesion: 1,200 psf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-500, -10.31) ft

Right Coordinate: (50, -50.66667) ft

Slip Surface Block

Left Grid

Upper Left: (-382, -44.48617) ft

Lower Left: (-382, -60.00077) ft

Lower Right: (-357, -60.00077) ft

X Increments: 6

Y Increments: 8

Starting Angle: 115 °

Ending Angle: 135 °

Angle Increments: 2

Right Grid

Upper Left: (-304.99555, -44.50305) ft

Lower Left: (-304.99555, -60.00736) ft

Lower Right: (-278.2181, -60.00736) ft

X Increments: 6

Y Increments: 8

Starting Angle: 0 °

Ending Angle: 45 °

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	2
Coordinate 2	50	2

Points

	X (ft)	Y (ft)
Point 1	-500	-12.31
Point 2	-500	-10.31
Point 3	-500	-46.31
Point 4	-500	-54.31
Point 5	50	-54.31
Point 6	-500	-56.31
Point 7	50	-56.31
Point 8	-500	-58.31
Point 9	50	-58.31
Point 10	-500	-60.31
Point 11	50	-60.31
Point 12	-125	-48.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-382.57	-12.31
Point 16	-387.57	-10.59428
Point 17	-207	-50.66667
Point 18	-198	-52.33333

Point 19	-137	-52.33333
Point 20	-120	-50.33333
Point 21	50	-50.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay (Undrained)	1,15,16,2	213.17
Region 2	Fat Clay (Undrained)	14,3,1,15	5,747.5
Region 3	Lean Clay (Undrained)	4,6,7,5	1,100
Region 4	Fat Clay (Undrained)	6,8,9,7	1,100
Region 5	Clayey Sand	8,10,11,9	1,100
Region 6	Lean Clay (Undrained)	3,14,13,17,18,19,20,21,5,4	2,855.3

Current Slip Surface

Slip Surface: 6,069

F of S: 4.05

Volume: 3,589.6046 ft³

Weight: 418,057.66 lbs

Resisting Moment: 11,296,526 lbs-ft

Activating Moment: 2,801,926.1 lbs-ft

Resisting Force: 150,669.02 lbs

Activating Force: 38,046.553 lbs

F of S Rank (Analysis): 1 of 35,721 slip surfaces

F of S Rank (Query): 1 of 35,721 slip surfaces

Exit: (-268.73646, -50.525716) ft

Entry: (-417.04168, -10.519761) ft

Radius: 74.792021 ft

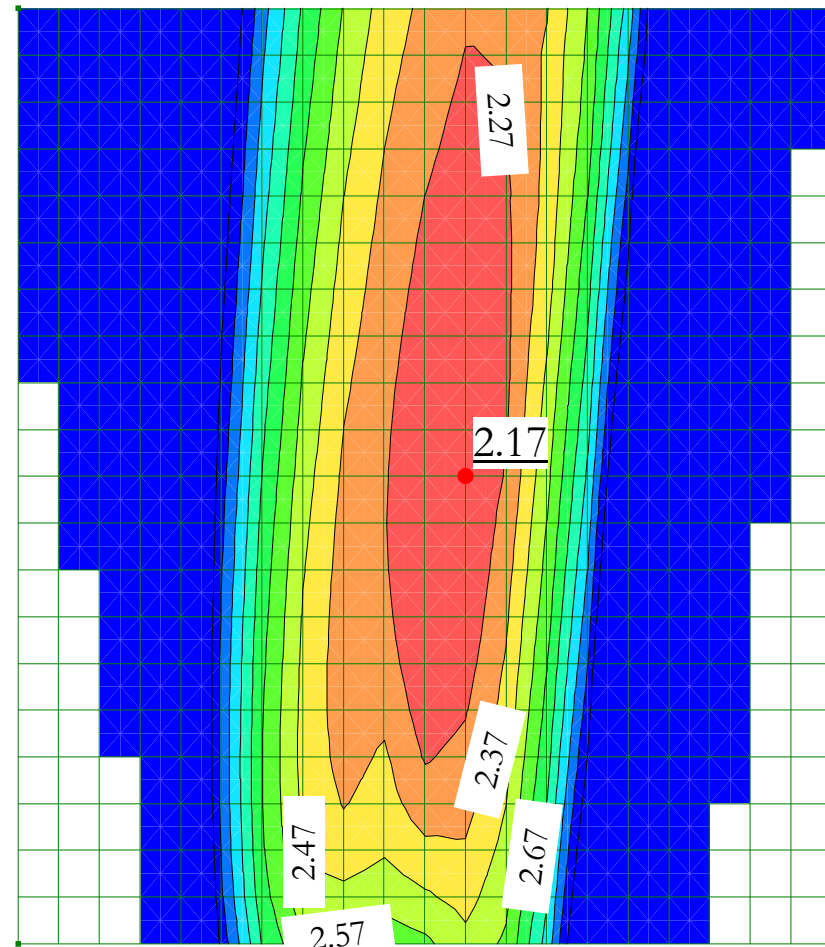
Center: (-334.79524, -0.51827172) ft

Slip Slices

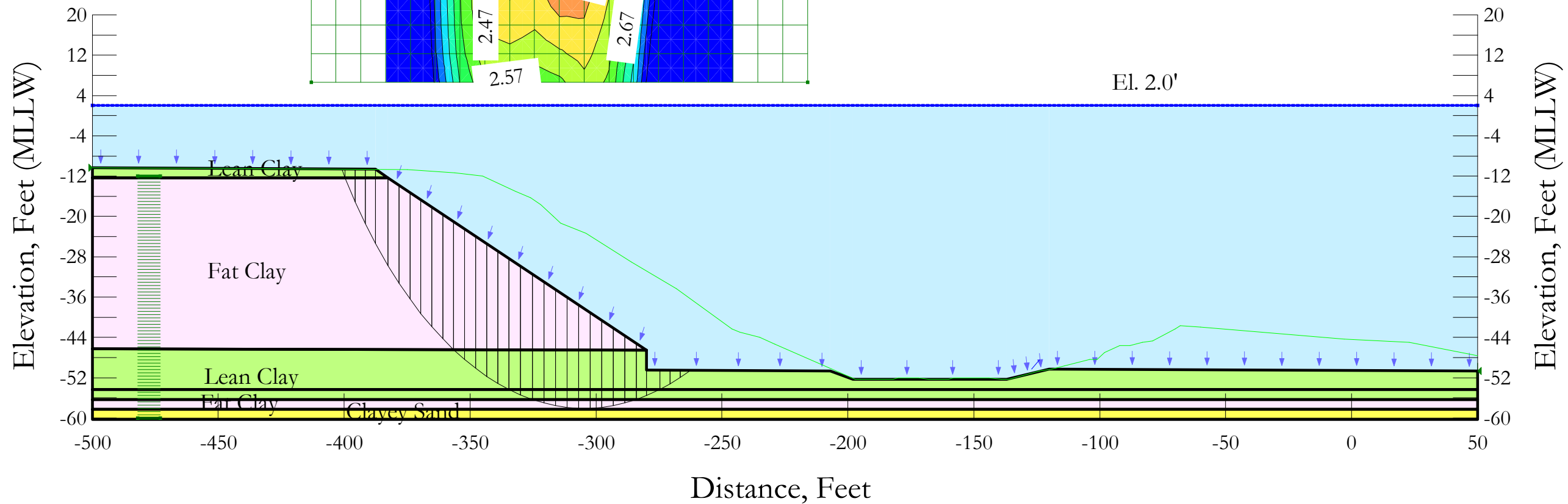
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-416.14656	-11.41488	837.08853	590.67064	0	1,200
Slice 2	-412.94466	-14.616787	1,036.8875	961.10157	0	1,200
Slice 3	-408.33108	-19.230361	1,324.7745	1,485.9587	0	1,200
Slice 4	-403.71751	-23.843935	1,612.6616	2,007.9062	0	1,200
Slice 5	-399.10394	-28.45751	1,900.5486	2,527.2104	0	1,200
Slice 6	-394.49036	-33.071084	2,188.4356	3,044.2234	0	1,200
Slice 7	-389.87679	-37.684658	2,476.3227	3,559.3741	0	1,200
Slice 8	-385.07	-42.491445	2,776.2662	4,050.1068	0	1,200
Slice 9	-381.8594	-45.702045	2,976.6076	4,347.4567	0	1,200
Slice 10	-379.17446	-48.386983	3,144.1477	4,610.4844	0	1,200
Slice 11	-375.22578	-52.335661	3,390.5452	5,002.5896	0	1,200
Slice 12	-372.25144	-55.31	3,576.144	5,298.1975	0	1,200
Slice 13	-370.37572	-57.185722	3,693.1891	5,480.518	0	1,200
Slice 14	-366.5851	-58.123584	3,751.7116	5,908.5663	0	1,200

Slice 15	-360.75531	-58.247861	3,759.4665	5,828.694	0	1,200
Slice 16	-355.4079	-58.361855	3,766.5798	5,755.3159	1,242.7002	0
Slice 17	-350.54287	-58.465566	3,773.0513	5,688.3567	1,196.8156	0
Slice 18	-345.67785	-58.569277	3,779.5229	5,621.058	1,150.7189	0
Slice 19	-340.81282	-58.672988	3,785.9945	5,553.329	1,104.3532	0
Slice 20	-335.94779	-58.776699	3,792.466	5,485.0865	1,057.6667	0
Slice 21	-331.08277	-58.88041	3,798.9376	5,416.2568	1,010.6132	0
Slice 22	-326.21774	-58.984121	3,805.4091	5,346.7762	963.15306	0
Slice 23	-321.35272	-59.087832	3,811.8807	5,276.5931	915.25388	0
Slice 24	-316.48769	-59.191542	3,818.3523	5,205.6679	866.89099	0
Slice 25	-311.62267	-59.295253	3,824.8238	5,133.9742	818.04797	0
Slice 26	-306.75764	-59.398964	3,831.2954	5,061.4996	768.71687	0
Slice 27	-301.89262	-59.502675	3,837.7669	4,988.2449	718.89846	0
Slice 28	-297.02759	-59.606386	3,844.2385	4,914.2256	668.60214	0
Slice 29	-292.16256	-59.710097	3,850.71	4,839.4701	617.84591	0
Slice 30	-287.29754	-59.813808	3,857.1816	4,764.0208	566.65603	0
Slice 31	-282.43251	-59.917519	3,863.6532	4,700.413	522.86555	0
Slice 32	-279.10905	-59.988367	3,868.0741	4,411.9246	339.8355	0
Slice 33	-277.36942	-59.15868	3,816.3016	4,428.2724	382.40178	0
Slice 34	-275.52074	-57.31	3,700.944	4,411.6288	0	1,200
Slice 35	-273.52074	-55.31	3,576.144	4,167.8996	0	1,200
Slice 36	-270.6286	-52.417858	3,395.6744	3,809.2906	0	1,200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 186+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Light Pink	Fat Clay	115	200	17
Light Green	Lean Clay	120	200	23
Yellow	Clayey Sand	115	0	32



Long Term

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 97

Date: 4/27/2018

Time: 11:25:35 AM

Tool Version: 8.16.1.13452

File Name: 186+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\186+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:25:56 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 17 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Slip Surface Grid

Upper Left: (-412.98645, 119.90044) ft
Lower Left: (-412.98645, 6.65529) ft
Lower Right: (-215.99872, 6.65529) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-482, -12) ft
Upper Right Coordinate: (-473, -12) ft
Lower Left Coordinate: (-482, -60) ft
Lower Right Coordinate: (-473, -60) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, -10.31) ft
Right Coordinate: (50, -50.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	2
Coordinate 2	50	2

Points

	X (ft)	Y (ft)
Point 1	-500	-12.31
Point 2	-500	-10.31
Point 3	-500	-46.31
Point 4	-500	-54.31
Point 5	50	-54.31
Point 6	-500	-56.31
Point 7	50	-56.31
Point 8	-500	-58.31
Point 9	50	-58.31
Point 10	-500	-60.31
Point 11	50	-60.31
Point 12	-125	-48.31
Point 13	-280	-50.5

Point 14	-280	-46.5
Point 15	-382.57	-12.31
Point 16	-387.57	-10.59428
Point 17	-207	-50.66667
Point 18	-198	-52.33333
Point 19	-137	-52.33333
Point 20	-120	-50.33333
Point 21	50	-50.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	1,15,16,2	213.17
Region 2	Fat Clay	14,3,1,15	5,747.5
Region 3	Lean Clay	4,6,7,5	1,100
Region 4	Fat Clay	6,8,9,7	1,100
Region 5	Clayey Sand	8,10,11,9	1,100
Region 6	Lean Clay	3,14,13,17,18,19,20,21,5,4	2,855.3

Current Slip Surface

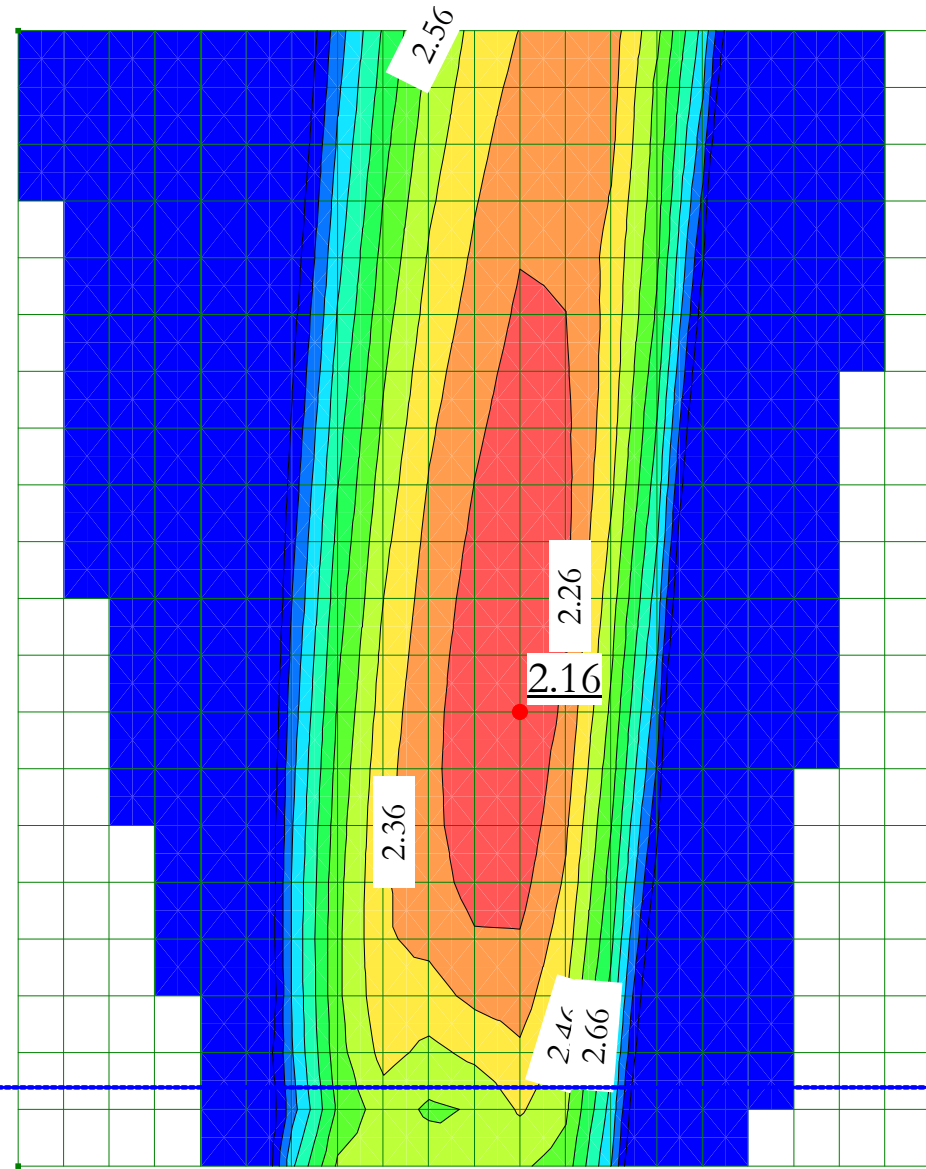
Slip Surface: 16,869
 F of S: 2.17
 Volume: 2,453.2345 ft³
 Weight: 285,599.39 lbs
 Resisting Moment: 9,369,437.1 lbs-ft
 Activating Moment: 4,318,706.4 lbs-ft
 Resisting Force: 70,855.949 lbs
 Activating Force: 33,144.04 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (-262.53319, -50.539879) ft
 Entry: (-400.9533, -10.56044) ft
 Radius: 121.35787 ft
 Center: (-304.6432, 63.277865) ft

Slip Slices

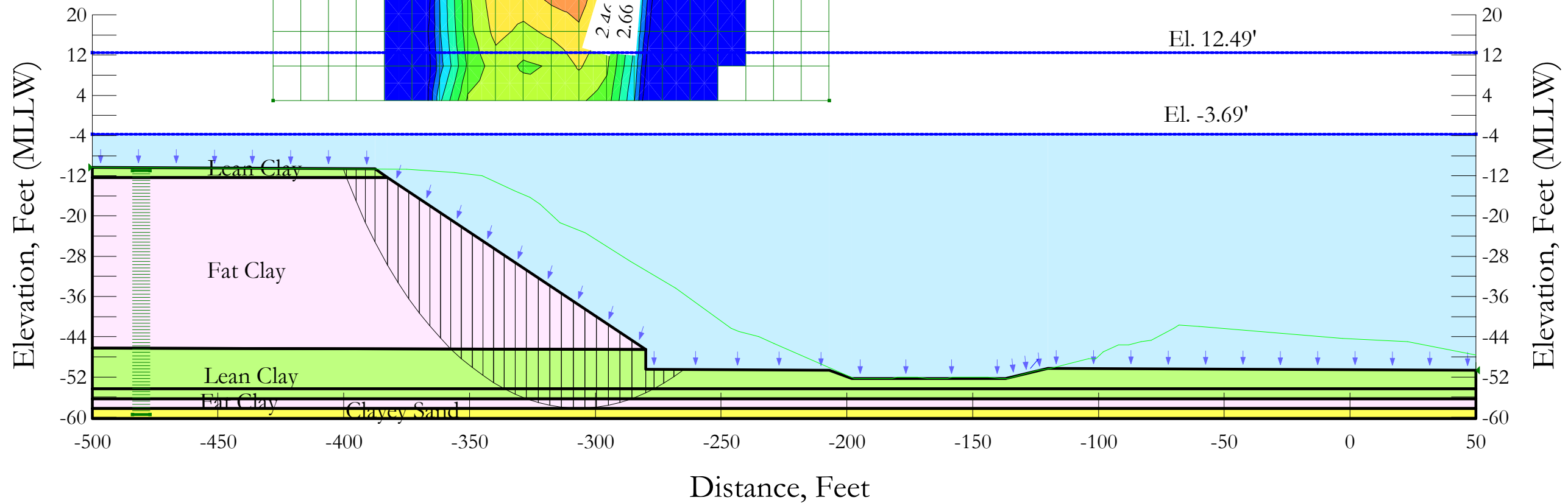
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-400.26984	-11.43522	838.35774	783.29147	-23.374243	200
Slice 2	-397.58364	-14.697105	1,041.8994	1,134.8635	28.42198	200
Slice 3	-393.57819	-19.242616	1,325.5393	1,625.2358	91.626406	200
Slice 4	-389.57273	-23.364166	1,582.7239	2,070.9935	149.279	200
Slice 5	-385.07	-27.541238	1,843.3733	2,485.6258	196.3563	200
Slice 6	-380.39905	-31.490578	2,089.8121	2,842.3243	230.06608	200
Slice 7	-376.05715	-34.806628	2,296.7336	3,142.0423	258.43679	200
Slice 8	-371.71525	-37.827449	2,485.2328	3,411.9904	283.33823	200
Slice 9	-367.37335	-40.5789	2,656.9233	3,655.1542	305.1898	200
Slice 10	-363.03144	-43.081952	2,813.1138	3,873.8741	324.30698	200
Slice 11	-358.68954	-45.353826	2,954.8788	4,069.969	340.91729	200
Slice						

12	-354.33243	-47.415267	3,083.5126	4,225.9872	484.95169	200
Slice 13	-349.9601	-49.276814	3,199.6732	4,392.1279	506.16698	200
Slice 14	-345.58777	-50.940696	3,303.4995	4,537.8946	523.96964	200
Slice 15	-341.21544	-52.415459	3,395.5247	4,663.7219	538.31776	200
Slice 16	-336.84312	-53.708268	3,476.1959	4,769.8148	549.10863	200
Slice 17	-332.31633	-54.858287	3,547.9571	4,858.5057	556.29488	200
Slice 18	-327.63507	-55.858287	3,610.3571	4,928.1826	559.38372	200
Slice 19	-322.99986	-56.661186	3,660.458	4,980.6573	403.62542	200
Slice 20	-318.4107	-57.274421	3,698.7239	4,997.9158	397.20283	200
Slice 21	-313.82153	-57.71054	3,725.9377	4,992.843	387.33181	200
Slice 22	-309.23236	-57.971458	3,742.219	4,964.8809	373.80525	200
Slice 23	-304.6432	-58.058306	3,747.6383	4,913.4471	356.42353	200
Slice 24	-300.05403	-57.971458	3,742.219	4,837.9608	335.00189	200
Slice 25	-295.46487	-57.71054	3,725.9377	4,737.8643	309.37701	200
Slice 26	-290.8757	-57.274421	3,698.7239	4,612.6402	279.41226	200
Slice 27	-286.28654	-56.661186	3,660.458	4,461.822	245.00155	200
Slice 28	-281.99598	-55.930805	3,614.8822	4,356.7215	314.89211	200
Slice 29	-277.31472	-54.930805	3,552.4822	3,873.3934	136.21873	200
Slice 30	-272.6134	-53.758261	3,479.3155	3,727.0402	105.15289	200
Slice 31	-268.58132	-52.579004	3,405.7298	3,577.4207	72.878455	200
Slice 32	-264.54924	-51.245683	3,322.5306	3,406.4102	35.604764	200

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Bayport Ship Channel
Station Analyzed: 186+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Light Pink	Fat Clay	115	200	17	300	14	2
Light Green	Lean Clay	120	200	23	300	19	2
Yellow	Clayey Sand	115	0	32	0.1	31.9	2



Rapid Drawdown

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File Information

File Version: 8.16

Title: Bayport Channel Widening

Created By: Nishant Dayal

Last Edited By: Anil Raavi

Revision Number: 97

Date: 4/27/2018

Time: 11:25:35 AM

Tool Version: 8.16.1.13452

File Name: 186+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BSC\186+00\

Last Solved Date: 4/27/2018

Last Solved Time: 11:26:30 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Rapid Drawdown

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 200 psf

Phi': 17 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 23 °

Phi-B: 0 °

Cohesion R: 300 psf

Phi R: 19 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Cohesion R: 0.1 psf

Phi R: 31.9 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Grid

Upper Left: (-428, 140.5) ft

Lower Left: (-428, 3) ft

Lower Right: (-207, 3) ft

Grid Horizontal Increment: 20

Grid Vertical Increment: 20

Left Projection Angle: 0 °

Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-484, -11) ft

Upper Right Coordinate: (-477, -11) ft

Lower Left Coordinate: (-484, -59.5) ft

Lower Right Coordinate: (-477, -59.5) ft

Number of Increments: 75

Left Projection: No

Left Projection Angle: 135 °

Right Projection: No

Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, -10.31) ft

Right Coordinate: (50, -50.66667) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	12.49
Coordinate 2	50	12.49

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	-3.69
Coordinate 2	50	-3.69

Points

	X (ft)	Y (ft)
Point 1	-500	-12.31
Point 2	-500	-10.31
Point 3	-500	-46.31
Point 4	-500	-54.31
Point 5	50	-54.31
Point 6	-500	-56.31
Point 7	50	-56.31
Point 8	-500	-58.31
Point 9	50	-58.31
Point 10	-500	-60.31
Point 11	50	-60.31
Point 12	-125	-48.31
Point 13	-280	-50.5
Point 14	-280	-46.5
Point 15	-382.57	-12.31
Point 16	-387.57	-10.59428
Point 17	-207	-50.66667
Point 18	-198	-52.33333
Point 19	-137	-52.33333
Point 20	-120	-50.33333
Point 21	50	-50.66667

Regions

	Material	Points	Area (ft ²)
Region 1	Lean Clay	1,15,16,2	213.17
Region 2	Fat Clay	14,3,1,15	5,747.5
Region 3	Lean Clay	4,6,7,5	1,100
Region 4	Fat Clay	6,8,9,7	1,100
Region 5	Clayey Sand	8,10,11,9	1,100
Region 6	Lean Clay	3,14,13,17,18,19,20,21,5,4	2,855.3

Current Slip Surface

Slip Surface: 13,678

F of S: 2.16

Volume: 2,460.0105 ft³

Weight: 286,379.6 lbs

Resisting Moment: 8,925,167 lbs-ft

Activating Moment: 4,128,673.2 lbs-ft

Resisting Force: 70,267.638 lbs

Activating Force: 32,955.184 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (-264.92567, -50.534417) ft

Entry: (-400.27548, -10.562154) ft

Radius: 116.20667 ft

Center: (-306.45, 58) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-399.62421	-11.436077	483.35521	424.31206	-25.062329	200
Slice 2	-397.07244	-14.679672	685.75551	774.62514	0	225.99975
Slice 3	-393.27147	-19.18705	967.01589	1,260.5211	89.733544	200
Slice 4	-389.47049	-23.266269	1,221.5592	1,701.2649	146.66074	200
Slice 5	-385.07	-27.506439	1,486.1458	2,120.5726	193.96374	200
Slice 6	-380.47398	-31.537948	1,737.712	2,485.9597	228.76227	200
Slice 7	-376.28193	-34.847253	1,944.2126	2,785.8092	257.30189	200
Slice 8	-372.08988	-37.858967	2,132.1436	3,055.7171	282.36476	200
Slice 9	-367.89784	-40.600471	2,303.2134	3,298.934	304.42235	200
Slice 10	-363.70579	-43.093823	2,458.7986	3,517.9975	323.82961	200
Slice 11	-359.51375	-45.357036	2,600.023	3,714.873	340.84384	200
Slice 12	-355.305	-47.412315	2,728.2725	3,871.7935	485.39587	200
Slice 13	-351.07955	-49.270484	2,844.2222	4,040.026	507.58861	200
Slice 14	-346.85409	-50.933103	2,947.9696	4,188.5496	526.59496	200
Slice 15	-342.62864	-52.409023	3,040.067	4,317.8351	542.38039	200
Slice 16	-338.40319	-53.705659	3,120.9771	4,428.1046	554.84268	200
Slice 17	-334.05776	-54.856182	3,192.7697	4,521.3935	563.96735	200
Slice 18	-329.59235	-55.856182	3,255.1697	4,596.4154	569.32501	200
Slice 19	-325.03635	-56.686518	3,306.9827	4,656.6241	412.62679	200
Slice 20	-320.38976	-57.343816	3,347.9981	4,681.7945	407.78249	200
Slice 21	-315.74318	-57.811026	3,377.152	4,683.0812	399.26261	200
Slice 22	-311.09659	-58.090449	3,394.588	4,659.7633	386.80289	200
Slice 23	-306.45	-58.18344	3,400.3906	4,611.0903	370.14805	200
Slice 24	-301.80341	-58.090449	3,394.588	4,536.3198	349.06245	200
Slice 25	-297.15682	-57.811026	3,377.152	4,434.7485	323.3397	200
Slice 26	-292.51024	-57.343816	3,347.9981	4,305.7381	292.81052	200
Slice 27	-287.86365	-56.686518	3,306.9827	4,148.7318	257.34853	200
Slice 28	-282.77018	-55.733235	3,247.4979	3,984.0852	312.66277	200
Slice 29	-278.30477	-54.733235	3,185.0979	3,499.2977	133.36992	200
Slice 30	-274.66223	-53.756109	3,124.1252	3,376.2076	107.00264	200
Slice						

31	-270.7676	-52.573818	3,050.3502	3,225.1865	74.213588	200
Slice 32	-266.87298	-51.239917	2,967.1148	3,053.0235	36.466071	200

APPENDIX C

SLOPE STABILITY ANALYSIS: RECOMMENDED AT
BARBOURS CUT CHANNEL

Project Name: HSC - ECIP Preliminary Slope Evaluation

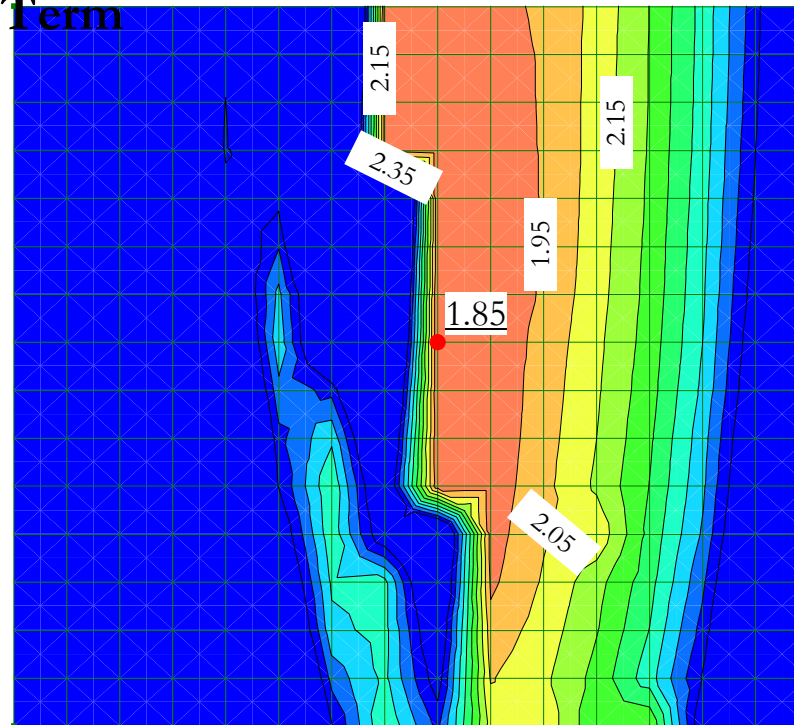
Location: Barbours Cut Ship Channel

Station Analyzed: 34+00

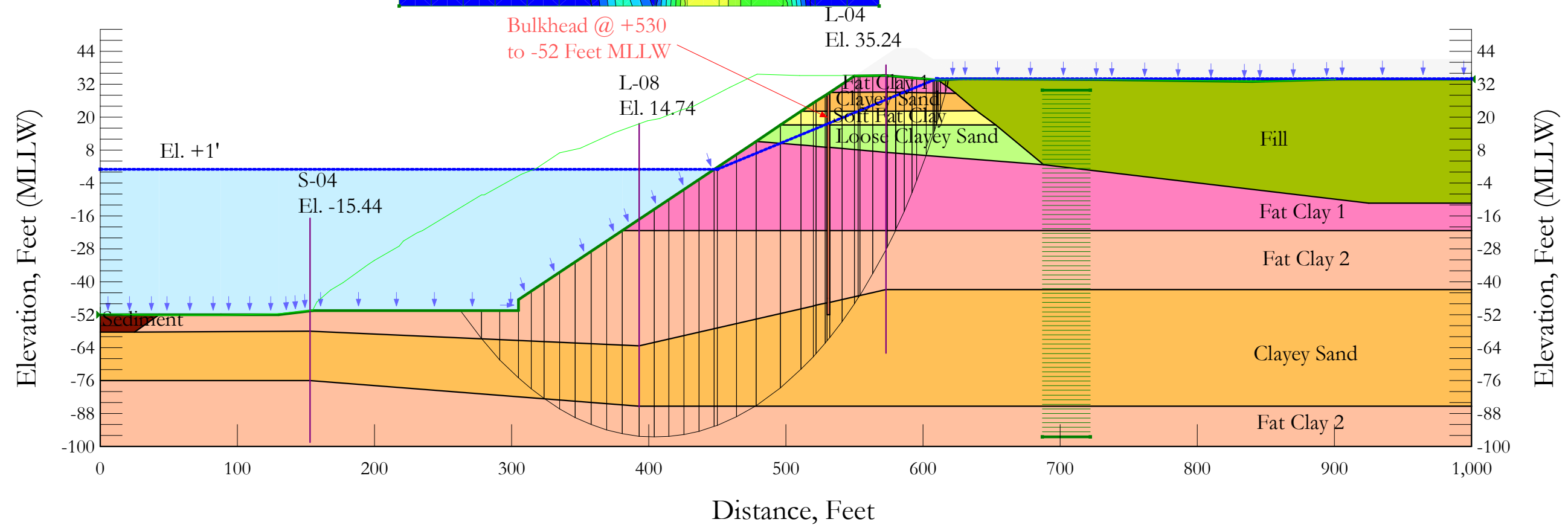
HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)	C-Top of Layer (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)
Orange	Clayey Sand	120	0	30				
Pink	Fat Clay 1(U)	125			1,000			
Green	Fill	110				50	10	150
Dark Red	Sediment (U)	90			50			
Light Orange	Fat Clay 2 (U)	125			2,200			
Yellow	Soft Fat Clay (U)	115			300			
Light Green	Loose Clayey Sand	110	0	28				
Red	Bulkhead	150						



Short Term 34+00

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 222

Date: [4/26/2018](#)

Time: [4:51:35 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00 with Bulkhead.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\Rec\](#)

Last Solved Date: [4/26/2018](#)

Last Solved Time: [4:51:46 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

Short Term 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 0 psf

Phi: 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fill

Model: S=f(depth)

Unit Weight: 110 pcf

C-Top of Layer: 50 psf

C-Rate of Change: 10 (lbs/ft²)/ft

C-Maximum: 150 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: Undrained (Phi=0)

Unit Weight: 90 pcf

Cohesion: 50 psf

Pore Water Pressure
Piezometric Line: 1

Fat Clay 2 (U)

Model: [Undrained \(Phi=0\)](#)
Unit Weight: 125 pcf
Cohesion: 2,200 psf
Pore Water Pressure
Piezometric Line: 1

Soft Fat Clay (U)

Model: [Undrained \(Phi=0\)](#)
Unit Weight: 115 pcf
Cohesion: 300 psf
Pore Water Pressure
Piezometric Line: 1

Loose Clayey Sand

Model: [Mohr-Coulomb](#)
Unit Weight: 110 pcf
Cohesion: 0 psf
Phi': 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Bulkhead

Model: [High Strength](#)
Unit Weight: 150 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (217.8737, 219.00031) ft
Lower Left: (217.8737, 60.51432) ft
Lower Right: (568.0477, 60.51432) ft
Grid Horizontal Increment: 15
Grid Vertical Increment: 15
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (687.0189, 29.85921) ft
Upper Right Coordinate: (722.1145, 29.85921) ft
Lower Left Coordinate: (687.0189, -96.57772) ft
Lower Right Coordinate: (722.1145, -96.57772) ft
Number of Increments: 75
Left Projection: [No](#)
Left Projection Angle: 135 °
Right Projection: [No](#)
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, -52) ft

Right Coordinate: (1,000, 33.75) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	610	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76
Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74

Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5
Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
Point 50	550	35
Point 51	580.42	45.14
Point 52	595.42	45.14
Point 53	607.42	41.14
Point 54	704	41.14
Point 55	732	33.7
Point 56	1,000	41.14
Point 57	900	33.75
Point 58	530	28.40251
Point 59	530	22.15041
Point 60	530	17.21409
Point 61	530	9.05473
Point 62	530	-21.26
Point 63	530	-46
Point 64	532	-46
Point 65	532	-21.26
Point 66	532	8.97032
Point 67	532	17.2153
Point 68	532	22.15458
Point 69	532	-47.42944
Point 70	530	-47.65722
Point 71	530	-52
Point 72	532	-52
Point 73	520	25.0911
Point 74	522	25.75338
Point 75	520	22.12958
Point 76	522	22.13375
Point 77	520	17.19
Point 78	522	17.19482
Point 79	520	9.47676
Point 80	522	9.39235
Point 81	520	-21.26
Point 82	522	-21.26
Point 83	520	-48.79611

Point 84	522	-48.56833
Point 85	520	-50

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1(U)	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2 (U)	26,3,9,27,28,29	17,271
Region 3	Fill	20,19,18,33,32,31,23,41,17,57,22,55,30	13,515
Region 4	Loose Clayey Sand	14,31,32,13,67,66	1,523.3
Region 5	Soft Fat Clay (U)	67,13,32,33,12,68	576.06
Region 6	Clayey Sand	33,18,11,49,68,12	675.61
Region 7	Clayey Sand	25,38,1,6,83,84,70,71,72,69,15,24,27,9,3,26	31,479
Region 8	Fat Clay 2 (U)	39,38,1,6,83,84,70,63,62,82,81,36,45,44,37,43,42	9,470.6
Region 9	Fat Clay 1(U)	66,14,31,23,41,34,35,65	9,001.7
Region 10	Sediment (U)	39,40,25,38	212.84
Region 11		51,50,10,21,20,30,53,52	502.37
Region 12		53,54,55,30	724.35
Region 13		54,55,22,57,17,56	2,150.4
Region 14	Clayey Sand	58,74,73,48,75,76,59	59.395
Region 15	Soft Fat Clay (U)	59,76,75,48,47,77,78,60	130.64
Region 16	Loose Clayey Sand	60,78,77,47,46,79,80,61	311.97
Region 17	Fat Clay 1(U)	61,80,79,46,36,81,82,62	3,210.6
Region 18	Bulkhead	49,58,59,60,61,62,63,70,71,72,69,64,65,66,67,68	161.47
Region 19	Fat Clay 2 (U)	65,35,34,24,15,69,64	10,158

Current Slip Surface

Slip Surface: 10,412
 F of S: 1.85
 Volume: 23,160.602 ft³
 Weight: 2,846,552.4 lbs
 Resisting Moment: 1.9716479e+008 lbs-ft
 Activating Moment: 1.0671048e+008 lbs-ft
 Resisting Force: 730,114.69 lbs
 Activating Force: 397,334.76 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (262.70626, -50.5) ft
 Entry: (619.09392, 33.7487) ft
 Radius: 241.6179 ft
 Center: (404.63317, 145.04018) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	270.3412	-55.609945	3,532.4606	4,736.9221	0	2,200
Slice 2	284.7321	-64.584171	4,092.4523	5,408.8371	760.01511	0
Slice 3	298.24403	-71.763713	4,540.4557	6,462.0739	1,109.4468	0
Slice 4	309.63944	-77.063265	4,871.1478	7,828.9939	1,707.7132	0
Slice 5	318.91833	-80.808335	5,104.8401	8,510.0385	1,965.9922	0
Slice 6	329.274	-84.446218	5,331.844	9,251.0481	0	2,200

Slice 7	340.70644	-87.892101	5,546.8671	9,911.2659	0	2,200
Slice 8	352.13889	-90.733579	5,724.1753	10,459.32	0	2,200
Slice 9	363.57133	-92.992355	5,865.123	10,897.241	0	2,200
Slice 10	375.00378	-94.684943	5,970.7404	11,228.554	0	2,200
Slice 11	386.86	-95.84448	6,043.0955	11,463.169	0	2,200
Slice 12	398.45	-96.437057	6,080.0724	11,593.91	0	2,200
Slice 13	409.35	-96.470166	6,082.1384	11,627.87	0	2,200
Slice 14	420.25	-96.010638	6,053.4638	11,586.298	0	2,200
Slice 15	431.15	-95.055639	5,993.8719	11,474.829	0	2,200
Slice 16	442.05	-93.599208	5,902.9906	11,298.744	0	2,200
Slice 17	448.75	-92.512547	5,835.183	11,194.421	0	2,200
Slice 18	456.92889	-90.74361	5,576.7465	11,156.854	0	2,200
Slice 19	471.03889	-87.153065	5,536.0245	11,036.039	0	2,200
Slice 20	487.11	-81.867969	5,418.0866	10,649.641	3,020.4394	0
Slice 21	503.5	-75.27092	5,225.56	10,209.06	2,877.2248	0
Slice 22	515.5	-69.580652	5,033.1137	9,835.4252	2,772.6158	0
Slice 23	521	-66.706527	4,928.9829	9,650.3348	2,725.8738	0
Slice 24	525.29869	-64.255166	4,835.3263	9,488.1277	2,686.2961	0
Slice 25	529.29869	-61.930943	4,745.592	9,335.4553	2,649.9588	0
Slice 26	531	-60.894899	4,704.5831	11,103.203	3,694.2449	0
Slice 27	536.5	-57.3493	4,560.262	9,032.9561	2,582.3111	0
Slice 28	545.5	-51.18688	4,302.5211	8,624.8035	2,495.4709	0
Slice 29	551.38877	-46.894564	4,118.3054	8,294.4894	2,411.121	0
Slice 30	553.35434	-45.382211	4,052.0499	8,130.6921	2,354.8051	0
Slice 31	558.69835	-40.983512	3,854.7418	7,643.9517	0	2,200
Slice 32	568.23278	-32.646012	3,473.4114	6,614.7086	0	2,200
Slice 33	573.5	-27.768135	3,246.4746	6,007.4619	0	2,200
Slice 34	576.95713	-24.269769	3,079.7617	5,548.046	0	2,200
Slice 35	580.16713	-20.992657	2,923.2408	5,736.909	0	1,000

Slice 36	583.35475	-17.498364	2,753.4446	5,308.8879	0	1,000
Slice 37	589.14475	-10.892874	2,429.5572	4,494.3948	0	1,000
Slice 38	593.71	-5.3646595	2,155.0295	3,806.315	0	1,000
Slice 39	598.86104	1.4392056	1,811.3807	2,947.7199	0	1,000
Slice 40	604.86104	9.8843894	1,379.973	2,309.2452	494.10279	0
Slice 41	607.86868	14.373239	1,148.4268	1,893.291	396.05129	0
Slice 42	608.98698	16.132637	1,101.8858	1,751.2119	345.25282	0
Slice 43	609.8283	17.470354	1,029.2402	1,653.2044	0	300
Slice 44	610.5	18.560361	963.43345	1,531.3836	0	300
Slice 45	611.8768	20.837213	821.35788	1,269.682	0	300
Slice 46	614.60687	25.557076	526.83843	823.74738	171.42046	0
Slice 47	617.10084	29.997192	249.77521	-547.27684	0	1,000
Slice 48	618.41773	32.464582	95.810086	91.453579	0	62.666823

Project Name: HSC - ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

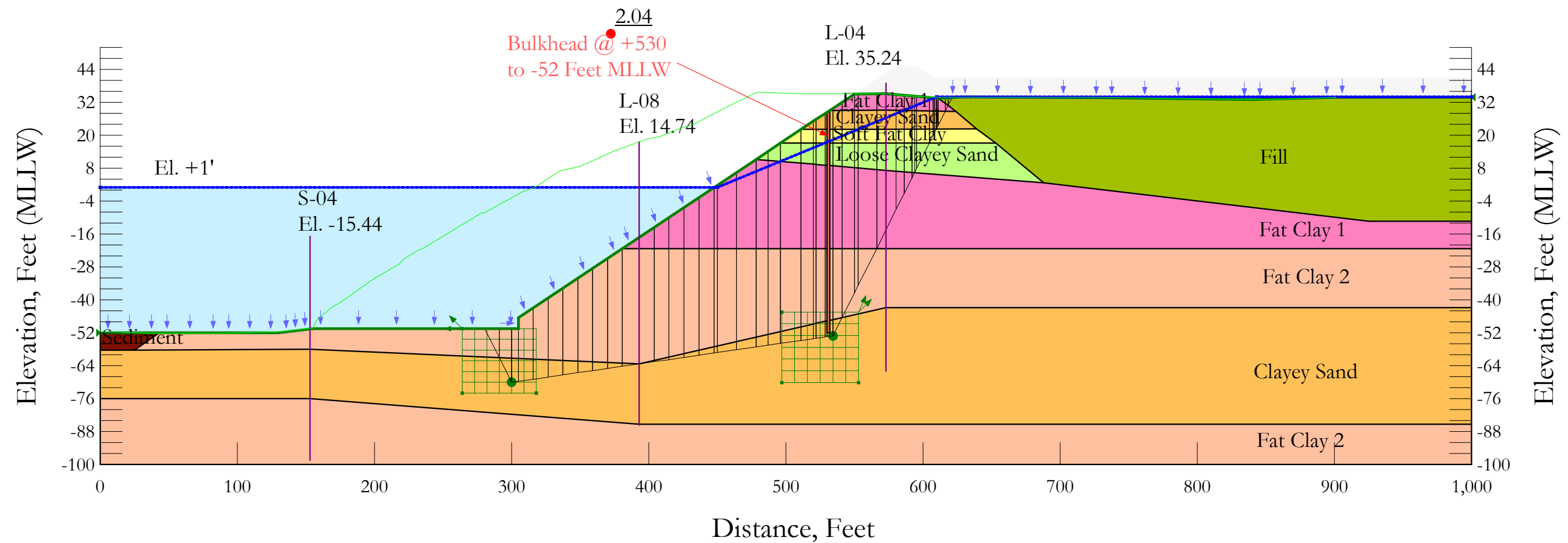
Station Analyzed: 34+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)	C-Top of Layer (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)
Orange	Clayey Sand	120	0	30				
Pink	Fat Clay 1(U)	125			1,000			
Green	Fill	110				50	10	150
Dark Red	Sediment (U)	90			50			
Light Orange	Fat Clay 2 (U)	125			2,200			
Yellow	Soft Fat Clay (U)	115			300			
Light Green	Loose Clayey Sand	110	0	28				
Red	Bulkhead	150						



Short Term - 34+00 Block

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 222

Date: [4/26/2018](#)

Time: [4:51:35 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00 with Bulkhead.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\Rec\](#)

Last Solved Date: [4/26/2018](#)

Last Solved Time: [4:52:34 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: [1](#)

Analysis Settings

Short Term - 34+00 Block

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Block](#)

Critical slip surfaces saved: [1](#)

Resisting Side Maximum Convex Angle: [1 °](#)

Driving Side Maximum Convex Angle: [5 °](#)

Restrict Block Crossing: [No](#)

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fill

Model: S=f(depth)

Unit Weight: 110 pcf

C-Top of Layer: 50 psf

C-Rate of Change: 10 (lbs/ft²)/ft

C-Maximum: 150 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: Undrained (Phi=0)

Unit Weight: 90 pcf

Cohesion: 50 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Soft Fat Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 115 pcf

Cohesion: 300 psf

Pore Water Pressure

Piezometric Line: 1

Loose Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: High Strength

Unit Weight: 150 pcf

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (0, -52) ft

Right Coordinate: (1,000, 33.75) ft

Slip Surface Block

Left Grid

Upper Left: (263.9875, -50.50385) ft

Lower Left: (263.9875, -73.9829) ft

Lower Right: (318.0132, -73.9829) ft

X Increments: 6

Y Increments: 6

Starting Angle: 135 °

Ending Angle: 180 °

Angle Increments: 2

Right Grid

Upper Left: (497.0051, -44.5153) ft

Lower Left: (497.0051, -70.2344) ft

Lower Right: (553.0725, -70.2344) ft

X Increments: 6

Y Increments: 6
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	610	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76
Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74

Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5
Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
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Point 56	1,000	41.14
Point 57	900	33.75
Point 58	530	28.40251
Point 59	530	22.15041
Point 60	530	17.21409
Point 61	530	9.05473
Point 62	530	-21.26
Point 63	530	-46
Point 64	532	-46
Point 65	532	-21.26
Point 66	532	8.97032
Point 67	532	17.2153
Point 68	532	22.15458
Point 69	532	-47.42944
Point 70	530	-47.65722
Point 71	530	-52
Point 72	532	-52
Point 73	520	25.0911
Point 74	522	25.75338
Point 75	520	22.12958
Point 76	522	22.13375
Point 77	520	17.19
Point 78	522	17.19482
Point 79	520	9.47676
Point 80	522	9.39235
Point 81	520	-21.26
Point 82	522	-21.26
Point 83	520	-48.79611

Point 84	522	-48.56833
Point 85	520	-50

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1(U)	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2 (U)	26,3,9,27,28,29	17,271
Region 3	Fill	20,19,18,33,32,31,23,41,17,57,22,55,30	13,515
Region 4	Loose Clayey Sand	14,31,32,13,67,66	1,523.3
Region 5	Soft Fat Clay (U)	67,13,32,33,12,68	576.06
Region 6	Clayey Sand	33,18,11,49,68,12	675.61
Region 7	Clayey Sand	25,38,1,6,83,84,70,71,72,69,15,24,27,9,3,26	31,479
Region 8	Fat Clay 2 (U)	39,38,1,6,83,84,70,63,62,82,81,36,45,44,37,43,42	9,470.6
Region 9	Fat Clay 1(U)	66,14,31,23,41,34,35,65	9,001.7
Region 10	Sediment (U)	39,40,25,38	212.84
Region 11		51,50,10,21,20,30,53,52	502.37
Region 12		53,54,55,30	724.35
Region 13		54,55,22,57,17,56	2,150.4
Region 14	Clayey Sand	58,74,73,48,75,76,59	59.395
Region 15	Soft Fat Clay (U)	59,76,75,48,47,77,78,60	130.64
Region 16	Loose Clayey Sand	60,78,77,47,46,79,80,61	311.97
Region 17	Fat Clay 1(U)	61,80,79,46,36,81,82,62	3,210.6
Region 18	Bulkhead	49,58,59,60,61,62,63,70,71,72,69,64,65,66,67,68	161.47
Region 19	Fat Clay 2 (U)	65,35,34,24,15,69,64	10,158

Current Slip Surface

Slip Surface: 4,948
 F of S: 2.04
 Volume: 16,277.121 ft³
 Weight: 2,011,437.3 lbs
 Resisting Moment: 85,852,988 lbs-ft
 Activating Moment: 42,165,818 lbs-ft
 Resisting Force: 618,971.02 lbs
 Activating Force: 303,803.14 lbs
 F of S Rank (Analysis): 1 of 21,609 slip surfaces
 F of S Rank (Query): 1 of 21,609 slip surfaces
 Exit: (280.43491, -50.5) ft
 Entry: (621.27668, 33.804982) ft
 Radius: 163.19631 ft
 Center: (435.21658, 54.881227) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	285.68801	-55.7531	3,541.3934	5,063.0146	0	2,200
Slice 2	295.47287	-65.537962	4,151.9688	5,892.9709	1,005.168	0
Slice 3	302.50232	-69.888761	4,423.4587	5,773.8371	779.64135	0
Slice 4	310.40857	-69.315931	4,387.7141	6,188.0412	1,039.4193	0
Slice 5	321.22571	-68.532199	4,338.8092	6,294.2091	1,128.9507	0
Slice 6	332.04286	-67.748467	4,289.9043	6,442.3939	1,242.7405	0

Slice 7	342.86	-66.964734	4,240.9994	6,584.1489	1,352.818	0
Slice 8	353.67714	-66.181002	4,192.0945	6,719.1031	1,458.9691	0
Slice 9	364.49429	-65.39727	4,143.1897	6,847.0161	1,561.0549	0
Slice 10	375.31143	-64.613538	4,094.2848	6,967.7868	1,659.0171	0
Slice 11	386.86	-63.776812	4,042.0731	7,088.8107	1,759.0347	0
Slice 12	398.45	-62.937084	3,989.6741	7,198.7765	1,852.7761	0
Slice 13	409.35	-62.147349	3,940.3946	7,291.2843	1,934.6371	0
Slice 14	420.25	-61.357613	3,891.1151	7,377.6738	2,012.9656	0
Slice 15	431.15	-60.567878	3,841.8356	7,458.609	2,088.1451	0
Slice 16	442.05	-59.778143	3,792.5561	7,534.875	2,160.6288	0
Slice 17	448.75	-59.292709	3,762.265	7,608.1296	2,220.411	0
Slice 18	457.055	-58.690989	3,659.8298	7,851.2586	2,419.9226	0
Slice 19	471.165	-57.66868	3,772.8267	8,250.4281	2,585.1444	0
Slice 20	482.665	-56.835473	3,864.9219	8,546.9607	2,703.1764	0
Slice 21	491.555	-56.191368	3,936.1155	8,743.3946	2,775.4839	0
Slice 22	503.5	-55.325919	4,031.7745	9,011.0208	2,874.7692	0
Slice 23	515.5	-54.456486	4,127.8738	9,290.5965	2,980.6994	0
Slice 24	521	-54.057995	4,171.9194	9,424.9939	3,032.864	0
Slice 25	525.29869	-53.746543	4,206.3445	9,529.6445	3,073.4087	0
Slice 26	529.29869	-53.456732	4,238.3777	9,626.8669	3,111.0457	0
Slice 27	531	-53.333468	4,252.0022	11,933.885	4,435.1368	0
Slice 28	533.19168	-53.174674	4,269.5538	9,721.9382	3,147.9356	0
Slice 29	537.72964	-49.742065	4,120.1192	7,629.6988	2,026.2567	0
Slice 30	545.53795	-41.933748	3,749.1538	7,084.6718	0	2,200
Slice 31	551.38877	-36.082929	3,471.1872	6,664.3858	0	2,200
Slice 32	559.49462	-27.977079	3,086.0863	5,848.6075	0	2,200
Slice 33	569.60585	-17.86585	2,605.7118	5,309.7655	0	1,000
Slice 34	576.71	-10.7617	2,268.2007	4,555.3418	0	1,000
Slice 35	583.35475	-4.1169467	1,952.515	3,810.9393	0	1,000
Slice						

36	589.14475	1.6730533	1,677.4378	3,145.3878	0	1,000
Slice 37	592.94705	5.4753523	1,496.7944	2,700.3291	0	1,000
Slice 38	594.65705	7.1853523	1,415.5539	2,661.2675	662.35767	0
Slice 39	600.04605	12.574355	1,159.5278	2,159.6008	531.74826	0
Slice 40	606.04605	18.574355	874.47369	1,624.2652	0	300
Slice 41	607.86868	20.396976	787.88279	1,419.0485	0	300
Slice 42	609.04238	21.57068	763.26502	1,296.7778	0	300
Slice 43	609.8837	22.412004	721.59422	1,219.0999	287.23505	0
Slice 44	610.5	23.0283	684.63408	1,155.8124	272.03493	0
Slice 45	613.64366	26.171957	488.46987	820.10823	191.47149	0
Slice 46	617.35169	29.879994	257.08835	-26.472	0	1,000
Slice 47	619.84638	32.374678	101.4201	135.82933	0	63.934238

Project Name: HSC - ECIP Preliminary Slope Evaluation

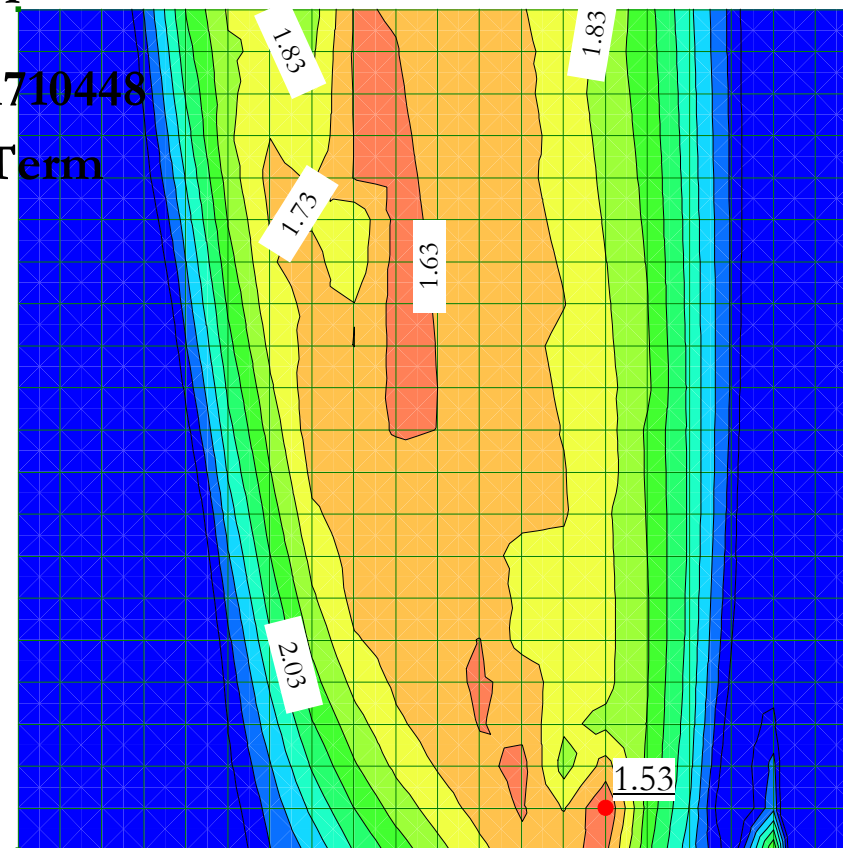
Location: Barbours Cut Ship Channel

Station Analyzed: 34+00

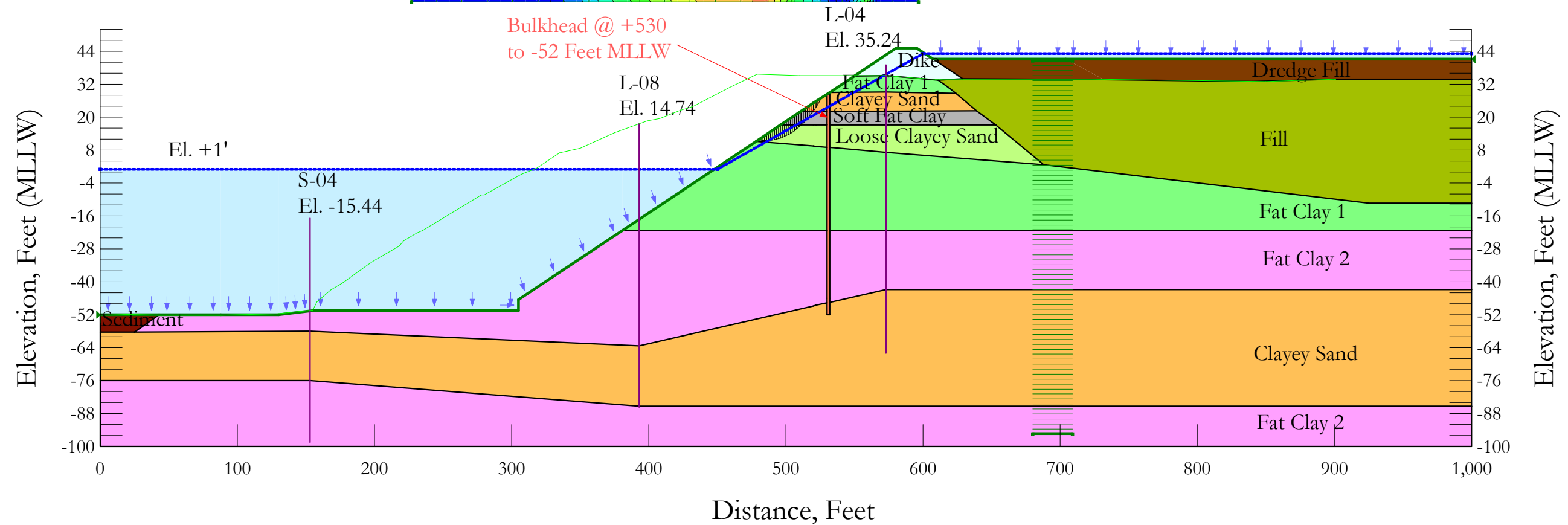
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	C-Top of Layer (psf)	C-Rate of Change ((lbs/ft ²)/ft)	C-Maximum (psf)
Light Green	Fat Clay 1	125	300	22			
Orange	Clayey Sand	120	0	30			
Brown	Dredge Fill	90	16	15			
Light Blue	Dike	125	100	25			
Olive Green	Fill	110			50	10	150
Pink	Fat Clay 2	125	300	22			
Light Green	Loose Clayey Sand	110	0	28			
Grey	Soft Fat Clay	115	100	15			
Dark Red	Sediment	90	16	15			
Red	Bulkhead	150					



Long Term 34+00

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Last Edited By: [Anil Raavi](#)

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Time: [4:51:35 PM](#)

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Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\Rec\](#)

Last Solved Date: [4/26/2018](#)

Last Solved Time: [4:51:56 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

Long Term 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fill

Model: $S=f(\text{depth})$

Unit Weight: 110 pcf

C-Top of Layer: 50 psf

C-Rate of Change: 10 (lbs/ft²)/ft

C-Maximum: 150 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Loose Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Soft Fat Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 100 psf

Phi': 15 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: High Strength

Unit Weight: 150 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (227.0672, 247.0971) ft
Lower Left: (227.0672, 62.00415) ft
Lower Right: (596.7231, 62.00415) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (680, 40.48201) ft
Upper Right Coordinate: (709, 40.48201) ft
Lower Left Coordinate: (680, -95.49981) ft
Lower Right Coordinate: (709, -95.49981) ft
Number of Increments: 75
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, -52) ft
Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74

Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
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Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
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Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74
Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
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Point 43	130	-52
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Point 73	520	25.0911
Point 74	522	25.75338
Point 75	520	22.12958
Point 76	522	22.13375
Point 77	520	17.19
Point 78	522	17.19482
Point 79	520	9.47676
Point 80	522	9.39235
Point 81	520	-21.26
Point 82	522	-21.26
Point 83	520	-48.79611
Point 84	522	-48.56833
Point 85	520	-50

Regions

	Material	Points	Area (ft ²)
Region 1	Fat Clay 1	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2	26,3,9,27,28,29	17,271
Region 3	Fill	20,19,18,33,32,31,23,41,17,57,22,55,30	13,515
Region 4	Loose Clayey Sand	14,31,32,13,67,66	1,523.3
Region 5	Soft Fat Clay	67,13,32,33,12,68	576.06
Region 6	Clayey Sand	33,18,11,49,68,12	675.61
Region 7	Clayey Sand	25,38,1,6,83,84,70,71,72,69,15,24,27,9,3,26	31,479
Region 8	Fat Clay 2	39,38,1,6,83,84,70,63,62,82,81,36,45,44,37,43,42	9,470.6
Region 9	Fat Clay 1	66,14,31,23,41,34,35,65	9,001.7
Region 10	Sediment	39,40,25,38	212.84
Region 11	Dike	51,50,10,21,20,30,53,52	502.37
Region 12	Dredge Fill	53,54,55,30	724.35
Region 13	Dredge Fill	54,55,22,57,17,56	2,150.4
Region 14	Clayey Sand	58,74,73,48,75,76,59	59.395
Region 15	Soft Fat Clay	59,76,75,48,47,77,78,60	130.64
Region 16	Loose Clayey Sand	60,78,77,47,46,79,80,61	311.97
Region 17	Fat Clay 1	61,80,79,46,36,81,82,62	3,210.6
Region 18	Bulkhead	49,58,59,60,61,62,63,70,71,72,69,64,65,66,67,68	161.47
Region 19	Fat Clay 2	65,35,34,24,15,69,64	10,158

Current Slip Surface

Slip Surface: 2,677
 F of S: 1.53
 Volume: 171.91782 ft³
 Weight: 19,444.326 lbs
 Resisting Moment: 536,476.72 lbs-ft
 Activating Moment: 351,010.55 lbs-ft
 Resisting Force: 8,385.9081 lbs
 Activating Force: 5,487.1604 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (479.81833, 11.775197) ft
 Entry: (526.16624, 27.132993) ft
 Radius: 59.786242 ft
 Center: (485.82633, 71.258798) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	480.57115	11.708762	-122.62893	36.764221	19.547883	0
Slice 2	482.07679	11.595017	-91.586894	109.32624	58.129793	0
Slice 3	483.58243	11.519429	-62.751744	178.94486	95.146669	0
Slice 4	485.08807	11.481854	-36.115099	244.81061	130.16811	0
Slice 5	486.59371	11.482221	-11.672811	306.09936	162.75592	0
Slice 6	488.06765	11.518941	10.15198	360.31975	186.18751	0
Slice 7	489.5099	11.590514	29.445974	407.01307	200.75599	0
Slice 8	490.95214	11.69709	46.715505	447.66654	213.18944	0
Slice 9	492.39439	11.83886	61.949673	482.09446	223.39495	0
Slice 10	493.83663	12.016074	75.133857	510.26216	231.36182	0
Slice 11	495.27888	12.229053	86.249583	532.27664	237.15679	0
Slice 12	496.72725	12.479399	95.303668	549.03838	241.25502	0
Slice 13	498.18174	12.767891	102.25105	560.79375	243.81148	0
Slice 14	499.63623	13.094181	107.01241	567.21651	244.69486	0
Slice 15	501.09073	13.458909	109.5507	568.73799	244.15421	0
Slice 16	502.54522	13.862808	109.82351	565.79365	242.44363	0
Slice 17	503.99972	14.306712	107.78259	558.79424	239.80715	0
Slice 18	505.45421	14.791565	103.37335	548.10129	236.46604	0
Slice 19	506.9087	15.318434	96.53415	534.0073	232.6086	0
Slice 20	508.47696	15.936851	86.248631	515.06732	228.00694	0
Slice 21	510.15899	16.65597	71.987471	490.95518	222.76908	0
Slice 22	511.1715	17.111026	62.120337	475.42506	219.75802	0

Slice 23	512.06136	17.542142	51.644812	460.04459	109.43039	100
Slice 24	513.49806	18.268105	33.001842	431.35523	106.73847	100
Slice 25	514.93476	19.043687	11.48908	398.78725	103.77623	100
Slice 26	516.36014	19.864196	-12.806007	362.90989	97.241412	100
Slice 27	517.77419	20.73129	-39.979301	323.70994	86.737816	100
Slice 28	519.18825	21.653848	-70.36039	279.86298	74.98906	100
Slice 29	519.94764	22.165754	-87.6282	260.54288	150.4245	0
Slice 30	521	22.929945	-114.72685	222.28311	128.33521	0
Slice 31	522.69437	24.201768	-160.75327	158.28338	91.384954	0
Slice 32	524.08312	25.324102	-203.09974	99.342249	57.355274	0
Slice 33	525.47187	26.517702	-249.56794	34.19737	19.743861	0

Project Name: HSC - ECIP Preliminary Slope Evaluation

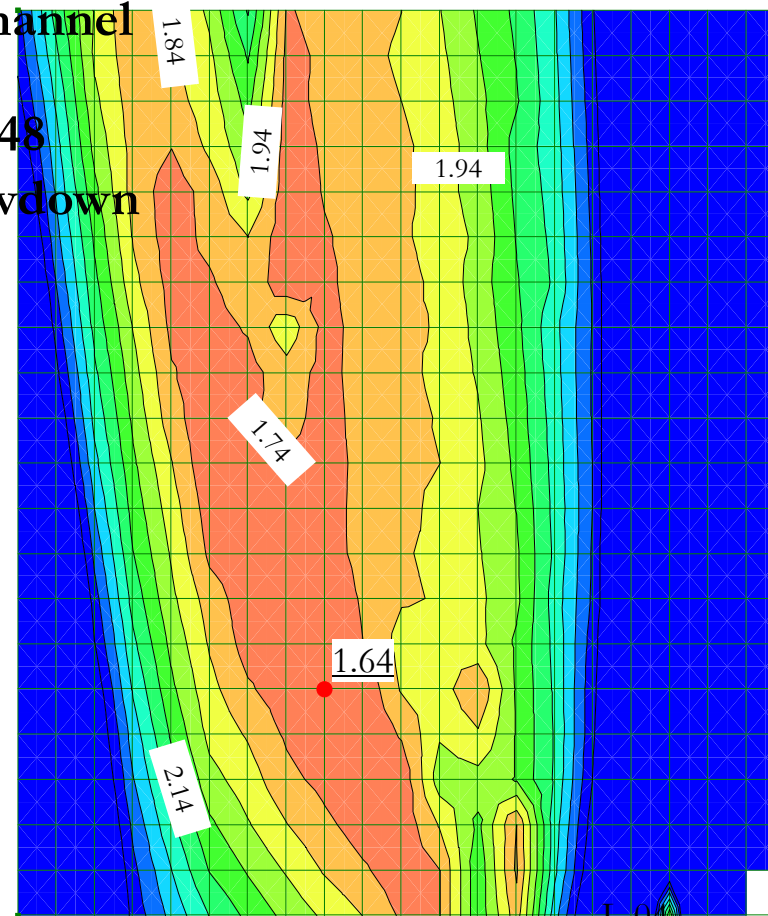
Location: Barbours Cut Ship Channel

Station Analyzed: 34+00

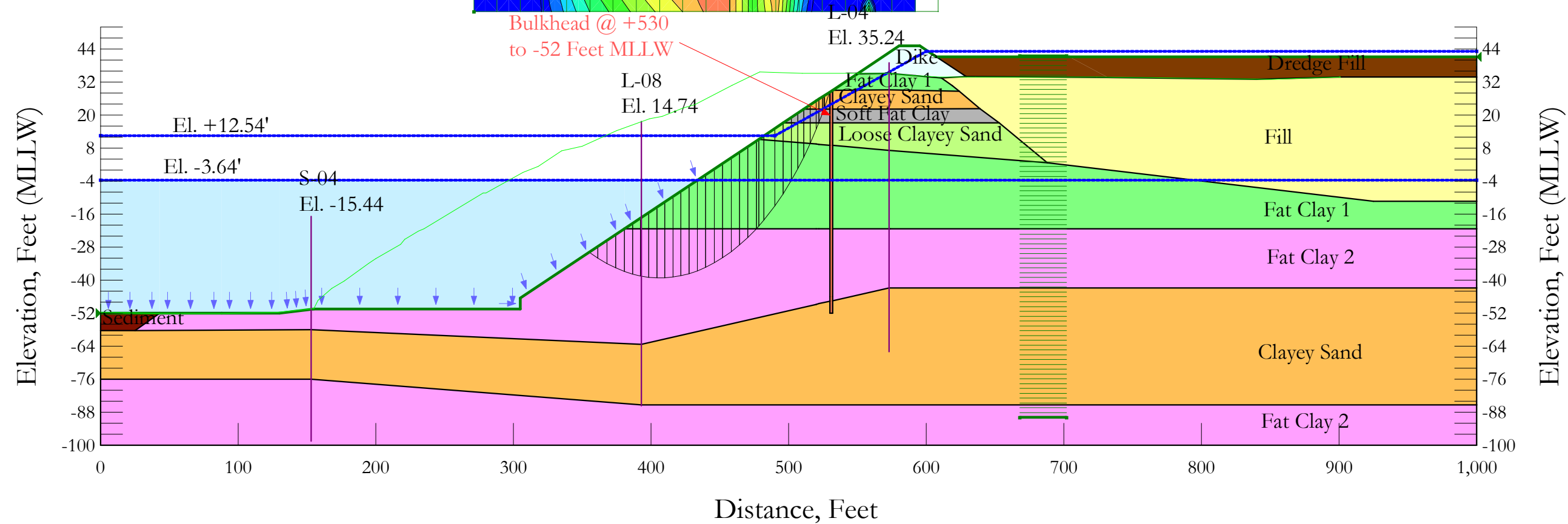
HVJ Project Number: HG1710448

Loading Condition: Rapid Drawdown

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Light Green	Fat Clay 1	125	300	22	500	15	2
Orange	Clayey Sand	120	0	30	0	30	2
Brown	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Yellow	Fill (RDD)	110	50	25	100	20	2
Pink	Fat Clay 2	125	300	22	500	15	2
Light Green	Loose Clayey Sand	110	0	28	0	28	2
Grey	Soft Fat Clay	115	100	15	150	10	2
Dark Brown	Sediment	90	16	15	50	0	2
Red	Bulkhead	150					2



RDD 34+00

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File Information

File Version: 8.16

Title: [Barbours Cut Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 222

Date: [4/26/2018](#)

Time: [4:51:35 PM](#)

Tool Version: 8.16.1.13452

File Name: [34+00 with Bulkhead.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\34+00\Rec\](#)

Last Solved Date: [4/26/2018](#)

Last Solved Time: [4:52:28 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

RDD 34+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [Yes](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fill (RDD)

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 50 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 100 psf

Phi R: 20 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Loose Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 28 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Soft Fat Clay

Model: [Mohr-Coulomb](#)

Unit Weight: [115 pcf](#)

Cohesion': [100 psf](#)

Phi': [15 °](#)

Phi-B: [0 °](#)

Cohesion R: [150 psf](#)

Phi R: [10 °](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Sediment

Model: [Mohr-Coulomb](#)

Unit Weight: [90 pcf](#)

Cohesion': [16 psf](#)

Phi': [15 °](#)

Phi-B: [0 °](#)

Cohesion R: [50 psf](#)

Phi R: [0 °](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Slip Surface Grid

Upper Left: [\(609.064, 256.88125\) ft](#)

Lower Left: [\(271.3642, 256.88125\) ft](#)

Lower Right: [\(271.3642, 57.51914\) ft](#)

Grid Horizontal Increment: [20](#)

Grid Vertical Increment: [20](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(668, 41.5\) ft](#)

Upper Right Coordinate: [\(702, 41.5\) ft](#)

Lower Left Coordinate: [\(668, -90\) ft](#)

Lower Right Coordinate: [\(702, -90\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: (0, -52) ft

Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	490	12.54
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64
Coordinate 2	1,000	-3.64

Points

	X (ft)	Y (ft)
Point 1	153	-57.96
Point 2	228	-64.7
Point 3	153	-75.96
Point 4	228	-96.7
Point 5	393	14.74
Point 6	393	-63.26
Point 7	468	-67
Point 8	468	-82
Point 9	393	-85.26
Point 10	573	35.24
Point 11	573	29.24
Point 12	573	22.24
Point 13	573	17.24
Point 14	573	7.24
Point 15	573	-42.76
Point 16	648	-63.5
Point 17	1,000	33.75
Point 18	624	28.74
Point 19	619	30.74
Point 20	611	33.54
Point 21	592	34.34
Point 22	840	33
Point 23	925	-11.26
Point 24	1,000	-42.76

Point 25	0	-58.26
Point 26	0	-76.06
Point 27	1,000	-85.26
Point 28	1,000	-100
Point 29	0	-100
Point 30	628.84	34
Point 31	688	2.74
Point 32	653	17.14
Point 33	639	22.34
Point 34	1,000	-21.26
Point 35	574	-21.26
Point 36	380.72	-21.26
Point 37	155	-50.5
Point 38	25	-58.26
Point 39	43	-52
Point 40	0	-52
Point 41	1,000	-11.26
Point 42	88	-52
Point 43	130	-52
Point 44	305	-50.5
Point 45	305	-46.5
Point 46	478.22	11.24
Point 47	496	17.19361
Point 48	511	22.11083
Point 49	532	29.06479
Point 50	550	35
Point 51	580.42	45.14
Point 52	595.42	45.14
Point 53	607.42	41.14
Point 54	704	41.14
Point 55	732	33.7
Point 56	1,000	41.14
Point 57	900	33.75
Point 58	530	28.40251
Point 59	530	22.15041
Point 60	530	17.21409
Point 61	530	9.05473
Point 62	530	-21.26
Point 63	530	-46
Point 64	532	-46
Point 65	532	-21.26
Point 66	532	8.97032
Point 67	532	17.2153
Point 68	532	22.15458
Point 69	532	-47.42944
Point 70	530	-47.65722
Point 71	530	-52
Point 72	532	-52
Point 73	520	25.0911
Point 74	522	25.75338
Point 75	520	22.12958
Point 76	522	22.13375

Point 77	520	17.19
Point 78	522	17.19482
Point 79	520	9.47676
Point 80	522	9.39235
Point 81	520	-21.26
Point 82	522	-21.26
Point 83	520	-48.79611
Point 84	522	-48.56833
Point 85	520	-50

Regions

	Material	Points	Area (ft²)
Region 1	Fat Clay 1	18,19,20,21,10,50,49,11	422.29
Region 2	Fat Clay 2	26,3,9,27,28,29	17,271
Region 3	Fill (RDD)	20,19,18,33,32,31,23,41,17,57,22,55,30	13,515
Region 4	Loose Clayey Sand	14,31,32,13,67,66	1,523.3
Region 5	Soft Fat Clay	67,13,32,33,12,68	576.06
Region 6	Clayey Sand	33,18,11,49,68,12	675.61
Region 7	Clayey Sand	25,38,1,6,83,84,70,71,72,69,15,24,27,9,3,26	31,479
Region 8	Fat Clay 2	39,38,1,6,83,84,70,63,62,82,81,36,45,44,37,43,42	9,470.6
Region 9	Fat Clay 1	66,14,31,23,41,34,35,65	9,001.7
Region 10	Sediment	39,40,25,38	212.84
Region 11	Dike	51,50,10,21,20,30,53,52	502.37
Region 12	Dredge Fill	53,54,55,30	724.35
Region 13	Dredge Fill	54,55,22,57,17,56	2,150.4
Region 14	Clayey Sand	58,74,73,48,75,76,59	59.395
Region 15	Soft Fat Clay	59,76,75,48,47,77,78,60	130.64
Region 16	Loose Clayey Sand	60,78,77,47,46,79,80,61	311.97
Region 17	Fat Clay 1	61,80,79,46,36,81,82,62	3,210.6
Region 18	Bulkhead	49,58,59,60,61,62,63,70,71,72,69,64,65,66,67,68	161.47
Region 19	Fat Clay 2	65,35,34,24,15,69,64	10,158

Current Slip Surface

Slip Surface: 13,955
 F of S: 1.64
 Volume: 4,102.6339 ft³
 Weight: 508,252.1 lbs
 Resisting Moment: 25,791,857 lbs-ft
 Activating Moment: 15,764,925 lbs-ft
 Resisting Force: 159,603.68 lbs
 Activating Force: 97,696.375 lbs
 F of S Rank (Analysis): 1 of 33,516 slip surfaces
 F of S Rank (Query): 1 of 33,516 slip surfaces
 Exit: (355.01213, -29.82929) ft
 Entry: (529.82413, 28.344272) ft
 Radius: 146.513 ft
 Center: (406.44412, 107.35967) ft

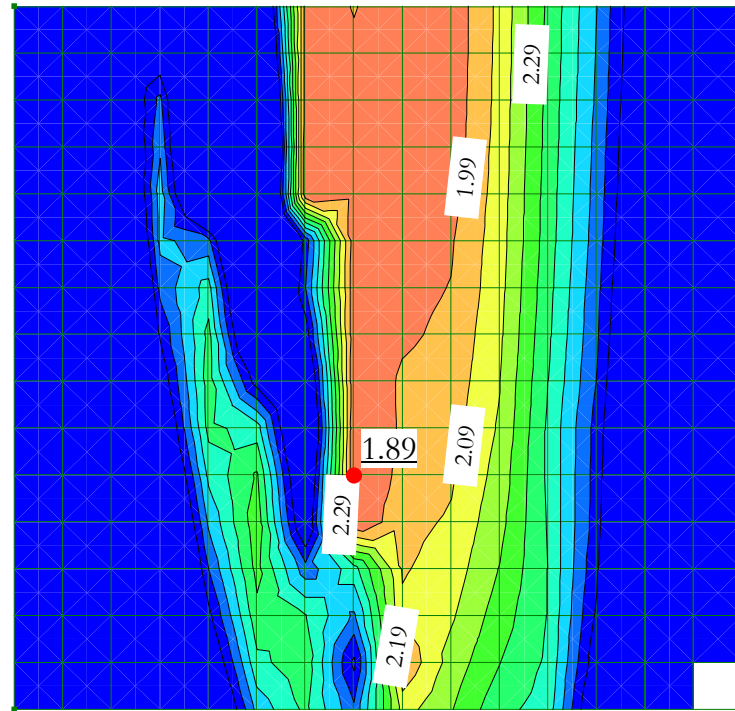
Slip Slices

				Base Normal Stress	Frictional Strength	Cohesive Strength
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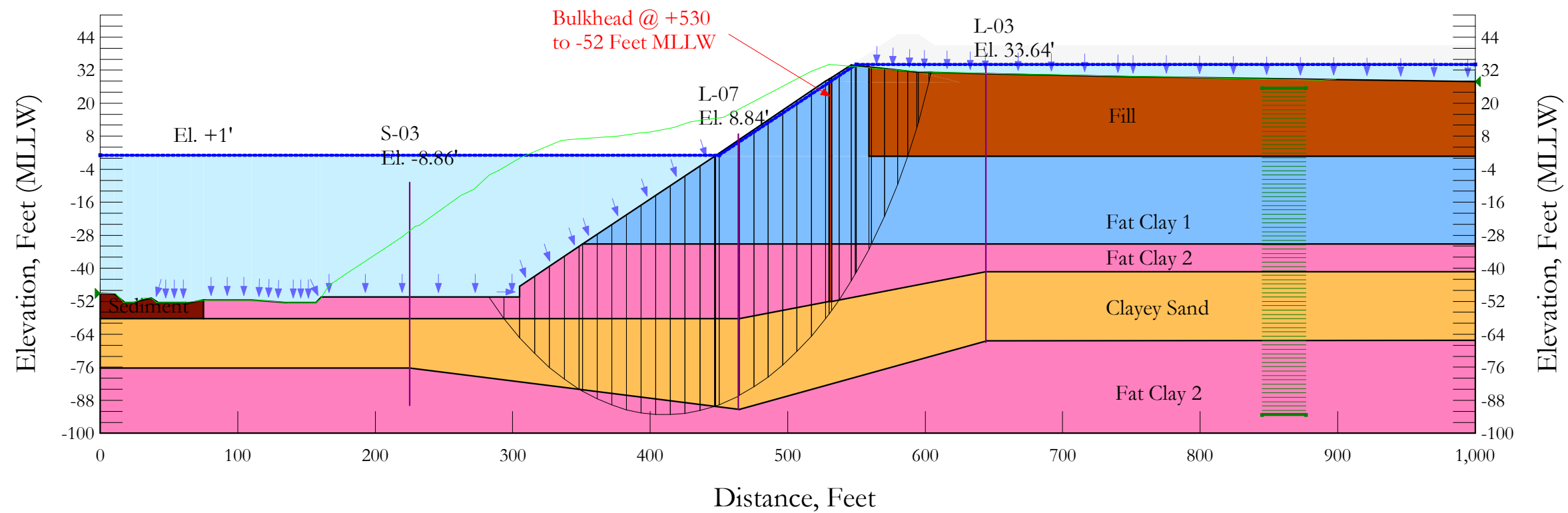
	X (ft)	Y (ft)	PWP (psf)	(psf)	(psf)	(psf)
Slice 1	358.22561	-30.9496	1,704.1191	1,966.89	106.16634	300
Slice 2	364.65258	-33.026533	1,833.7196	2,456.2319	251.51131	300
Slice 3	371.07955	-34.782659	1,943.3019	2,894.1155	384.15365	300
Slice 4	377.50652	-36.229777	2,033.6021	3,274.8362	501.49114	300
Slice 5	383.65667	-37.339861	2,102.8713	3,582.5158	597.81519	300
Slice 6	389.53	-38.143705	2,153.0312	3,820.7345	673.79588	300
Slice 7	395.40333	-38.707054	2,188.1842	4,004.7847	733.95424	300
Slice 8	401.27667	-39.032689	2,208.5038	4,135.3623	778.50136	300
Slice 9	407.15	-39.122198	2,214.0892	4,214.3959	808.17639	300
Slice 10	413.02333	-38.976015	2,204.9673	4,244.8417	824.16276	300
Slice 11	418.89667	-38.59343	2,181.094	4,230.4154	827.97959	300
Slice 12	424.77	-37.972574	2,142.3526	4,175.2914	821.36059	300
Slice 13	430.64333	-37.110369	2,088.551	4,083.7986	806.13234	300
Slice 14	436.65346	-35.970682	2,017.4346	4,022.5394	810.11494	300
Slice 15	442.80039	-34.535415	1,927.8739	3,990.1084	833.19683	300
Slice 16	448.94732	-32.816017	1,820.5835	3,924.6683	0	1,147.5716
Slice 17	455.09425	-30.801857	1,694.8998	3,831.2478	0	1,121.7644
Slice 18	461.24118	-28.47979	1,550.0029	3,711.3287	0	1,093.2166
Slice 19	467.38811	-25.833672	1,384.8852	3,565.9253	0	1,062.4052
Slice 20	473.53504	-22.843688	1,198.3102	3,394.9407	0	1,029.5251
Slice 21	477.41425	-20.813854	1,071.6485	3,277.9283	0	1,008.3809
Slice 22	480.16118	-19.237368	973.27575	3,174.5571	0	988.88832
Slice 23	486.05118	-15.549411	743.14724	2,914.2761	0	966.9569
Slice 24	493	-10.794085	446.41488	2,564.7772	0	969.09866
Slice 25	499.03715	-6.1181875	154.6389	2,228.3632	0	913.82216
Slice 26	504.39859	-1.5495115	-130.44648	1,891.5272	0	860.65604
Slice 27	508.86143	2.6323737	-391.39612	1,518.3815	613.46593	300
Slice 28	513.31392	7.1925243	-675.94952	1,193.0501	482.02353	300
Slice 29	517.81392	12.220297	-989.68253	954.68525	507.61515	0
Slice 30	521	16.033678	-1,227.6375	745.42814	396.35117	0
Slice 31	523.25305	18.943476	-1,409.2089	611.10787	163.74586	100

Slice 32	525.06514	21.370104	-1,560.6305	444.81384	119.18751	100
Slice 33	525.76138	22.333812	-1,620.7659	367.70868	212.2967	0
Slice 34	527.86135	25.4353	-1,814.2987	175.85632	101.53069	0

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Fat Clay 1 (U)	125			1,000
Pink	Fat Clay 2 (U)	125			2,200
Brown	Fill (U)	110			300
Dark Brown	Sediment (U)	90			50
Red	Bulkhead	150			



Short Term 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Nitharsan Kanapathippillai

Revision Number: 193

Date: 4/27/2018

Time: 8:23:07 AM

Tool Version: 8.16.1.13452

File Name: 44+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\Rec\

Last Solved Date: 4/27/2018

Last Solved Time: 8:23:30 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Fill (U)

Model: Undrained (Phi=0)

Unit Weight: 110 pcf

Cohesion: 300 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Slip Surface Grid

Upper Left: [\(245.9759, 233.47631\) ft](#)

Lower Left: [\(245.9759, 63.16979\) ft](#)

Lower Right: [\(598.7619, 63.16979\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(845.056, 25.44217\) ft](#)

Upper Right Coordinate: [\(877.0413, 25.44217\) ft](#)

Lower Left Coordinate: [\(845.056, -93.25256\) ft](#)

Lower Right Coordinate: [\(877.0413, -93.25256\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -49.2\) ft](#)

Right Coordinate: [\(1,000, 27.94\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	550	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26
Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74
Point 24	644	0.74
Point 25	559	27.72993
Point 26	559	0.74
Point 27	559	33.14
Point 28	110	-51.6
Point 29	75	-51.6
Point 30	75	-58.26
Point 31	0	-49.2
Point 32	305	-50.5
Point 33	305	-46.5
Point 34	350.72	-31.26
Point 35	446.72	0.74
Point 36	546.2	33.9
Point 37	161	-50.5
Point 38	157	-52.4
Point 39	42	-52.4
Point 40	66	-52.4
Point 41	37	-50.8
Point 42	24	-52.4
Point 43	18	-52.5
Point 44	10	-49.29
Point 45	527.69	28
Point 46	579.92	45.14
Point 47	594.92	45.14
Point 48	745.7421	29.59999
Point 49	638.12	30.74

Point 50	606.92	41.14
Point 51	696.5	41.14
Point 52	530	28.7363
Point 53	530	27.98007
Point 54	532	29.37379
Point 55	532	27.96282
Point 56	530	0.74
Point 57	532	0.74
Point 58	530	-31.26
Point 59	532	-31.26
Point 60	530	-52
Point 61	532	-52

Regions

	Points	Area (ft ²)	Material
Region 1	51,48,6,10	3,429.3	
Region 2	12,5,4,2,13,14,15	25,013	Fat Clay 2 (U)
Region 3	12,16,17,61,60,3,1,30,18,13,2,4,5	24,297	Clayey Sand
Region 4	58,21,34,33,32,37,38,22,28,29,30,1,3,60	7,186.4	Fat Clay 2 (U)
Region 5	59,20,19,23,24,26,57	14,976	Fat Clay 1 (U)
Region 6	25,55,57,26	731.87	Fat Clay 1 (U)
Region 7	25,7,8,9,27	219.6	Fill (U)
Region 8	25,55,54,36,27	126.45	Fat Clay 1 (U)
Region 9	30,29,40,39,41,42,43,44,31,18	500.79	Sediment (U)
Region 10	9,8,7,25,26,24,23,6,48,49	12,517	Fill (U)
Region 11	46,36,27,9,49,50,47	719.15	
Region 12	50,51,48,49	1,058.7	
Region 13	54,52,53,56,58,60,61,59,57,55	162.11	Bulkhead
Region 14	52,45,53	0.87345	Fat Clay 1 (U)
Region 15	45,35,56,53	1,166.6	Fat Clay 1 (U)
Region 16	56,35,34,21,58	4,201	Fat Clay 1 (U)
Region 17	19,20,59,61,17,16	5,281.4	Fat Clay 2 (U)

Current Slip Surface

Slip Surface: 6,688
 F of S: 1.89
 Volume: 20,714.609 ft³
 Weight: 2,548,799.3 lbs
 Resisting Moment: 1.5970862e+008 lbs-ft
 Activating Moment: 84,689,386 lbs-ft
 Resisting Force: 672,578.33 lbs
 Activating Force: 358,543.5 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (282.54237, -50.5) ft
 Entry: (604.47745, 31.250124) ft
 Radius: 213.19119 ft
 Center: (410.60937, 119.93863) ft

Slip Slices

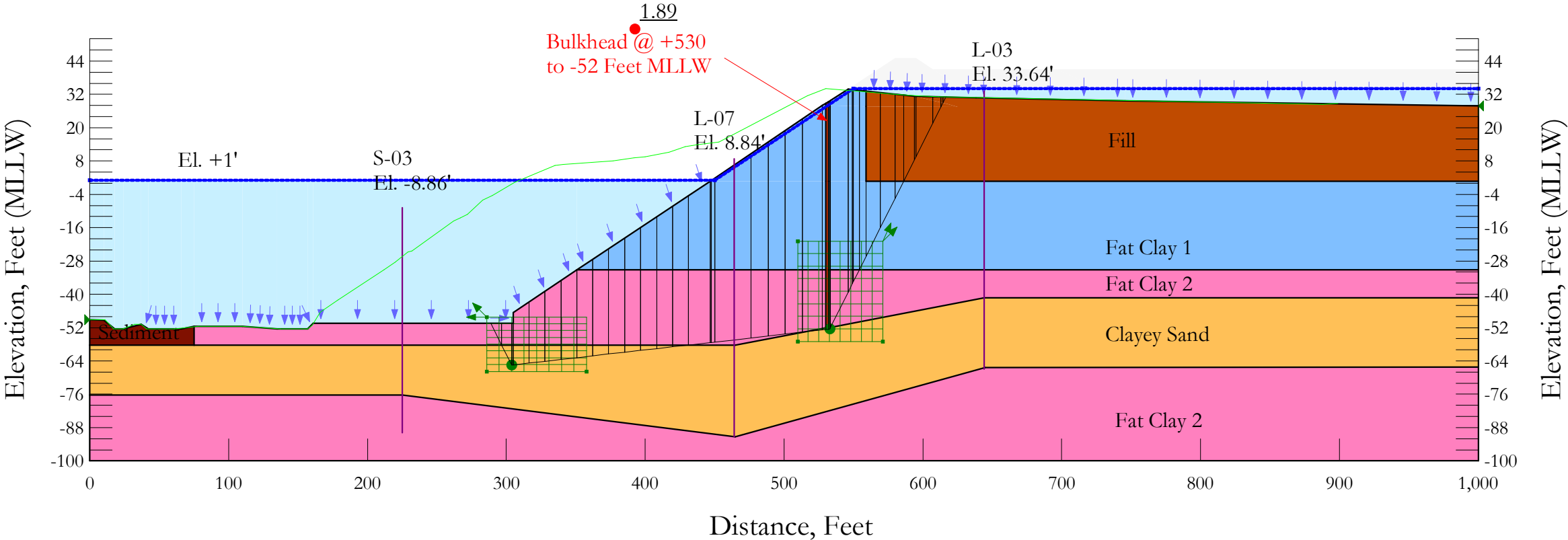
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	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	288.06148	-54.38	3,455.712	4,596.6033	0	2,200
Slice 2	299.2903	-61.758127	3,916.1071	5,006.5538	629.56968	0
Slice 3	310.42408	-68.145456	4,314.6765	6,565.4308	1,299.4736	0
Slice 4	321.27224	-73.539191	4,651.2455	7,624.1261	1,716.3934	0
Slice 5	332.12039	-78.192455	4,941.6092	8,583.8722	2,102.8615	0
Slice 6	342.96855	-82.156613	5,188.9726	9,395.0779	2,428.396	0
Slice 7	349.55631	-84.319866	5,323.9596	9,741.0255	0	2,200
Slice 8	356.05333	-86.080019	5,433.7932	10,075.377	0	2,200
Slice 9	366.72	-88.614727	5,591.959	10,547.226	0	2,200
Slice 10	377.38667	-90.578787	5,714.5163	10,904.467	0	2,200
Slice 11	388.05333	-91.988108	5,802.4579	11,152.051	0	2,200
Slice 12	398.72	-92.853741	5,856.4734	11,296.34	0	2,200
Slice 13	409.38667	-93.182329	5,876.9773	11,344.68	0	2,200
Slice 14	420.05333	-92.976364	5,864.1251	11,304.937	0	2,200
Slice 15	430.72	-92.234285	5,817.8194	11,185.048	0	2,200
Slice 16	441.38667	-90.950419	5,737.7062	10,992.582	0	2,200
Slice 17	446.83614	-90.152043	5,687.8875	10,876.941	0	2,200
Slice 18	447.22227	-90.084948	5,683.7008	10,864.098	2,990.904	0
Slice 19	448.74614	-89.809901	5,666.5378	10,851.551	2,993.5686	0
Slice 20	457	-88.020391	5,139.342	10,772.941	3,252.5599	0
Slice 21	464.5	-86.328226	5,183.3938	10,700.88	3,185.5221	0
Slice 22	470.22417	-84.67552	5,196.6891	10,607.498	3,123.9318	0
Slice 23	480.6725	-81.33492	5,202.7298	10,413.638	3,008.5193	0
Slice 24	491.12083	-77.38484	5,174.474	10,174.056	2,886.5099	0
Slice 25	501.56917	-72.787671	5,109.8052	9,889.6532	2,759.6465	0
Slice 26	512.0175	-67.495607	5,006.0332	9,559.1989	2,628.7714	0
Slice 27	522.46583	-61.447543	4,859.7196	9,178.9843	2,493.7286	0
Slice 28	528.845	-57.456105	4,753.5731	8,928.0427	2,410.1311	0
Slice 29	531	-56.002015	4,711.7664	10,453.825	3,315.1792	0
Slice 30	534.67626	-53.402239	4,633.7391	8,660.7335	2,324.9863	0
Slice 31	541.77626	-48.032277	4,463.406	8,292.5762	0	2,200

Slice 32	547.68186	-43.333753	4,308.6762	7,861.6915	0	2,200
Slice 33	549.58186	-41.730245	4,716.957	7,659.7028	0	2,200
Slice 34	554.5	-37.251544	4,446.0963	7,097.7834	0	2,200
Slice 35	559.95363	-32.19614	4,130.6391	6,000.3344	0	2,200
Slice 36	565.66045	-26.217542	3,757.5746	5,844.8152	0	1,000
Slice 37	575.16682	-15.395524	3,082.2807	4,569.8427	0	1,000
Slice 38	583.64196	-4.4379822	2,398.5301	3,245.5693	0	1,000
Slice 39	590.59931	5.8439925	1,756.9349	2,594.7148	0	300
Slice 40	594.37735	11.870754	1,380.865	1,963.0394	0	300
Slice 41	598.84381	20.198751	861.19794	1,063.0677	0	300
Slice 42	603.373	28.885592	319.13904	95.92716	0	300
Slice 43	604.22791	30.708665	205.37932	-113.51644	0	300

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Fat Clay 1 (U)	125			1,000
Pink	Fat Clay 2 (U)	125			2,200
Brown	Fill (U)	110			300
Dark Brown	Sediment (U)	90			50
Red	Bulkhead	150			



Short Term 44+00 Block

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 199

Date: 4/27/2018

Time: 3:09:52 PM

Tool Version: 8.16.1.13452

File Name: 44+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\Rec\

Last Solved Date: 4/27/2018

Last Solved Time: 3:10:08 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 44+00 Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Fill (U)

Model: Undrained (Phi=0)

Unit Weight: 110 pcf

Cohesion: 300 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: [\(0, -49.2\) ft](#)

Right Coordinate: [\(1,000, 27.94\) ft](#)

Slip Surface Block

Left Grid

Upper Left: [\(285.8115, -48.22191\) ft](#)

Lower Left: [\(285.8115, -67.92193\) ft](#)

Lower Right: [\(357.9455, -67.92193\) ft](#)

X Increments: 8

Y Increments: 8

Starting Angle: [135 °](#)

Ending Angle: [180 °](#)

Angle Increments: 2

Right Grid

Upper Left: [\(509.9823, -20.98882\) ft](#)

Lower Left: [\(509.9823, -57.01488\) ft](#)

Lower Right: [\(571.0258, -57.01488\) ft](#)

X Increments: 8

Y Increments: 8

Starting Angle: [45 °](#)

Ending Angle: [65 °](#)

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	550	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26
Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74
Point 24	644	0.74
Point 25	559	27.72993
Point 26	559	0.74
Point 27	559	33.14
Point 28	110	-51.6
Point 29	75	-51.6
Point 30	75	-58.26
Point 31	0	-49.2
Point 32	305	-50.5
Point 33	305	-46.5
Point 34	350.72	-31.26
Point 35	446.72	0.74
Point 36	546.2	33.9
Point 37	161	-50.5
Point 38	157	-52.4
Point 39	42	-52.4
Point 40	66	-52.4
Point 41	37	-50.8
Point 42	24	-52.4
Point 43	18	-52.5
Point 44	10	-49.29
Point 45	527.69	28
Point 46	579.92	45.14
Point 47	594.92	45.14
Point 48	745.7421	29.59999
Point 49	638.12	30.74

Point 50	606.92	41.14
Point 51	696.5	41.14
Point 52	530	28.7363
Point 53	530	27.98007
Point 54	532	29.37379
Point 55	532	27.96282
Point 56	530	0.74
Point 57	532	0.74
Point 58	530	-31.26
Point 59	532	-31.26
Point 60	530	-52
Point 61	532	-52

Regions

	Points	Area (ft ²)	Material
Region 1	51,48,6,10	3,429.3	
Region 2	12,5,4,2,13,14,15	25,013	Fat Clay 2 (U)
Region 3	12,16,17,61,60,3,1,30,18,13,2,4,5	24,297	Clayey Sand
Region 4	58,21,34,33,32,37,38,22,28,29,30,1,3,60	7,186.4	Fat Clay 2 (U)
Region 5	59,20,19,23,24,26,57	14,976	Fat Clay 1 (U)
Region 6	25,55,57,26	731.87	Fat Clay 1 (U)
Region 7	25,7,8,9,27	219.6	Fill (U)
Region 8	25,55,54,36,27	126.45	Fat Clay 1 (U)
Region 9	30,29,40,39,41,42,43,44,31,18	500.79	Sediment (U)
Region 10	9,8,7,25,26,24,23,6,48,49	12,517	Fill (U)
Region 11	46,36,27,9,49,50,47	719.15	
Region 12	50,51,48,49	1,058.7	
Region 13	54,52,53,56,58,60,61,59,57,55	162.11	Bulkhead
Region 14	52,45,53	0.87345	Fat Clay 1 (U)
Region 15	45,35,56,53	1,166.6	Fat Clay 1 (U)
Region 16	56,35,34,21,58	4,201	Fat Clay 1 (U)
Region 17	19,20,59,61,17,16	5,281.4	Fat Clay 2 (U)

Current Slip Surface

Slip Surface: 8,056
 F of S: 1.89
 Volume: 15,212.908 ft³
 Weight: 1,883,278.7 lbs
 Resisting Moment: 69,868,848 lbs-ft
 Activating Moment: 36,982,326 lbs-ft
 Resisting Force: 537,418.04 lbs
 Activating Force: 284,288.43 lbs
 F of S Rank (Analysis): 1 of 59,049 slip surfaces
 F of S Rank (Query): 1 of 59,049 slip surfaces
 Exit: (288.88557, -50.5) ft
 Entry: (616.45376, 31.068526) ft
 Radius: 156.64053 ft
 Center: (437.43599, 51.460658) ft

Slip Slices

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	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	292.76557	-54.38	3,455.712	4,949.2429	0	2,200
Slice 2	300.24529	-61.859714	3,922.4461	5,265.7393	775.55069	0
Slice 3	304.4225	-65.426779	4,145.031	5,185.2029	600.54353	0
Slice 4	310.715	-65.071042	4,122.833	5,609.2849	858.20343	0
Slice 5	322.145	-64.424863	4,082.5115	5,770.9548	974.82319	0
Slice 6	333.575	-63.778684	4,042.1899	5,957.9998	1,106.0933	0
Slice 7	345.005	-63.132506	4,001.8684	6,138.2859	1,233.4612	0
Slice 8	356.46806	-62.484458	3,961.4302	6,311.5498	1,356.8422	0
Slice 9	367.96418	-61.834541	3,920.8754	6,477.1395	1,475.8598	0
Slice 10	379.4603	-61.184625	3,880.3206	6,634.1299	1,589.9125	0
Slice 11	390.95642	-60.534708	3,839.7658	6,782.3161	1,698.8822	0
Slice 12	402.45253	-59.884792	3,799.211	6,921.7126	1,802.7771	0
Slice 13	413.94865	-59.234875	3,758.6562	7,052.5592	1,901.7358	0
Slice 14	425.44477	-58.584958	3,718.1014	7,175.3205	1,996.0264	0
Slice 15	438.95642	-57.821097	3,670.4364	7,314.6872	0	2,200
Slice 16	447.10614	-57.360364	3,641.6867	7,385.7627	0	2,200
Slice 17	448.74614	-57.267649	3,635.9013	7,427.5928	0	2,200
Slice 18	457	-56.801029	3,382.5667	7,679.2556	0	2,200
Slice 19	470.13154	-56.058656	3,584.6414	8,075.3286	0	2,200
Slice 20	482.39463	-55.36538	3,773.3519	8,440.8161	0	2,200
Slice 21	494.65772	-54.672104	3,962.0624	8,803.3768	0	2,200
Slice 22	506.9208	-53.978827	4,150.7728	9,164.31	0	2,200
Slice 23	520.37117	-53.21843	4,357.7538	9,595.7665	3,024.168	0
Slice 24	528.845	-52.739374	4,488.1533	9,835.1943	3,087.1156	0
Slice 25	531	-52.617545	4,521.3155	11,953.342	4,290.8828	0
Slice 26	532.43681	-52.536317	4,543.4258	9,928.792	3,109.2426	0
Slice 27	533.20289	-52.18235	4,537.7333	7,899.3724	1,940.8433	0
Slice 28	539.86608	-45.519156	4,286.516	7,373.9889	0	2,200
Slice 29	547.68186	-37.703373	3,991.8436	6,815.4885	0	2,200
Slice 30	549.58186	-35.803373	4,347.1202	6,622.6707	0	2,200
Slice 31	552.06262	-33.322618	4,200.9313	6,373.5238	0	2,200

Slice 32	556.56262	-28.822618	3,920.1313	6,424.3315	0	1,000
Slice 33	564.23	-21.155235	3,441.6867	5,192.5661	0	1,000
Slice 34	574.69	-10.695235	2,788.9827	4,084.276	0	1,000
Slice 35	583.02262	-2.3626175	2,269.0273	3,170.0582	0	1,000
Slice 36	589.97997	4.5947325	1,834.8887	2,776.0122	0	300
Slice 37	594.37735	8.992115	1,560.492	2,340.2052	0	300
Slice 38	600.92	15.534765	1,152.2307	1,678.1749	0	300
Slice 39	609.93994	24.554707	589.38631	734.93877	0	300
Slice 40	613.62385	28.238614	359.51051	336.36834	0	300
Slice 41	615.37079	29.985553	250.50151	144.09181	0	300

Project Name: HSC-ECIP Preliminary Slope Evaluation

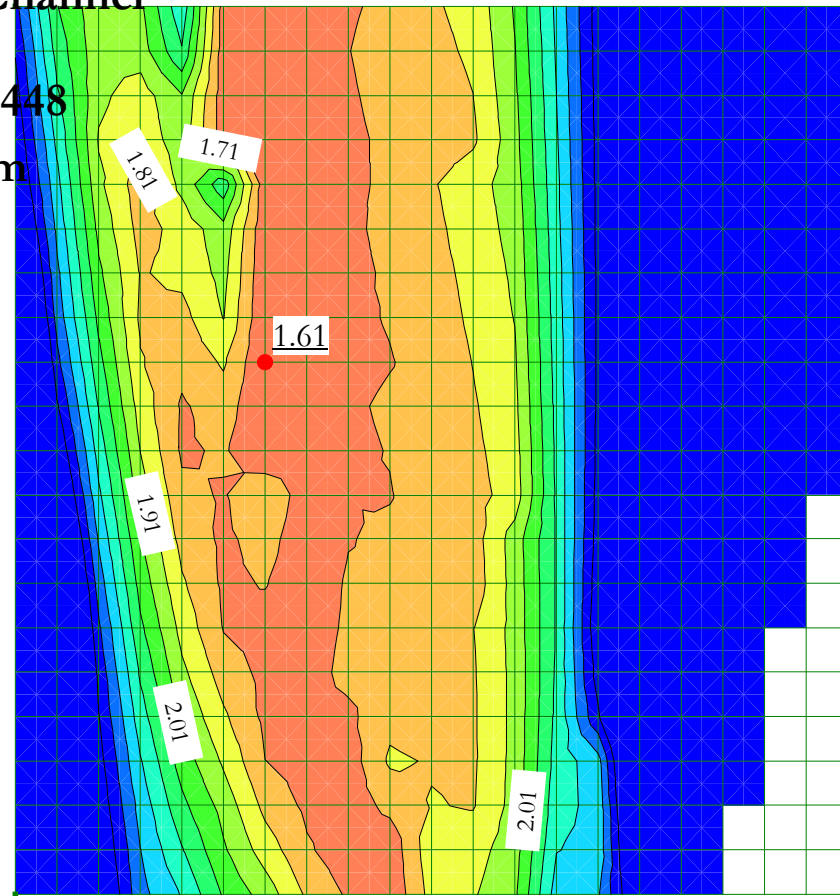
Location: Barbours Cut Ship Channel

Station Analyzed: 44+00

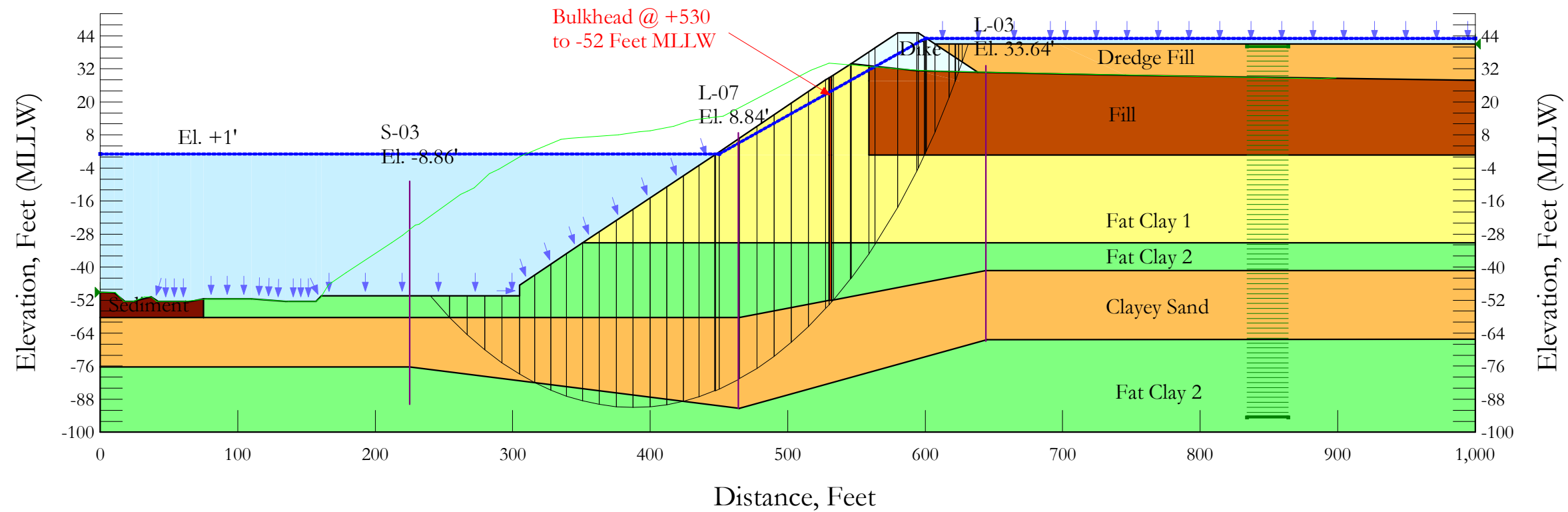
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Fat Clay 1	125	300	22
Light Green	Fat Clay 2	125	300	22
Orange	Clayey Sand	120	0	30
Light Orange	Dredge Fill	90	16	15
Light Blue	Dike	125	100	25
Brown	Fill	110	100	20
Dark Brown	Sediment	90	16	15
Red	Bulkhead	150		



Long Term 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Nitharsan Kanapathippillai

Revision Number: 193

Date: 4/27/2018

Time: 8:23:07 AM

Tool Version: 8.16.1.13452

File Name: 44+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\Rec\

Last Solved Date: 4/27/2018

Last Solved Time: 8:23:25 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dike

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fill

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 100 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Bulkhead

Model: High Strength
Unit Weight: 150 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (267.004, 285.00146) ft
Lower Left: (267.004, 69.97217) ft
Lower Right: (670.0211, 69.97217) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (834.0689, 40.15019) ft
Upper Right Coordinate: (864.0265, 40.15019) ft

Lower Left Coordinate: (834.0689, -94.59981) ft
 Lower Right Coordinate: (864.0265, -94.59981) ft
 Number of Increments: 75
 Left Projection: No
 Left Projection Angle: 135 °
 Right Projection: No
 Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, -49.2) ft
 Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26
Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74

Point 24	644	0.74
Point 25	559	27.72993
Point 26	559	0.74
Point 27	559	33.14
Point 28	110	-51.6
Point 29	75	-51.6
Point 30	75	-58.26
Point 31	0	-49.2
Point 32	305	-50.5
Point 33	305	-46.5
Point 34	350.72	-31.26
Point 35	446.72	0.74
Point 36	546.2	33.9
Point 37	161	-50.5
Point 38	157	-52.4
Point 39	42	-52.4
Point 40	66	-52.4
Point 41	37	-50.8
Point 42	24	-52.4
Point 43	18	-52.5
Point 44	10	-49.29
Point 45	527.69	28
Point 46	579.92	45.14
Point 47	594.92	45.14
Point 48	745.7421	29.59999
Point 49	638.12	30.74
Point 50	606.92	41.14
Point 51	696.5	41.14
Point 52	530	28.7363
Point 53	530	27.98007
Point 54	532	29.37379
Point 55	532	27.96282
Point 56	530	0.74
Point 57	532	0.74
Point 58	530	-31.26
Point 59	532	-31.26
Point 60	530	-52
Point 61	532	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	51,48,6,10	3,429.3
Region 2	Fat Clay 2	12,5,4,2,13,14,15	25,013
Region 3	Clayey Sand	12,16,17,61,60,3,1,30,18,13,2,4,5	24,297
Region 4	Fat Clay 2	58,21,34,33,32,37,38,22,28,29,30,1,3,60	7,186.4
Region 5	Fat Clay 1	59,20,19,23,24,26,57	14,976
Region 6	Fat Clay 1	25,55,57,26	731.87
Region 7	Fill	25,7,8,9,27	219.6
Region 8	Fat Clay 1	25,55,54,36,27	126.45
Region 9	Sediment	30,29,40,39,41,42,43,44,31,18	500.79
Region 10	Fill	9,8,7,25,26,24,23,6,48,49	12,517

Region 11	Dike	46,36,27,9,49,50,47	719.15
Region 12	Dredge Fill	50,51,48,49	1,058.7
Region 13	Bulkhead	54,52,53,56,58,60,61,59,57,55	162.11
Region 14	Fat Clay 1	52,45,53	0.87345
Region 15	Fat Clay 1	45,35,56,53	1,166.6
Region 16	Fat Clay 1	56,35,34,21,58	4,201
Region 17	Fat Clay 2	19,20,59,61,17,16	5,281.4

Current Slip Surface

Slip Surface: 19,682

F of S: 1.61

Volume: 22,874.038 ft³

Weight: 2,806,884.2 lbs

Resisting Moment: 2.2761775e+008 lbs-ft

Activating Moment: 1.4145326e+008 lbs-ft

Resisting Force: 725,764.49 lbs

Activating Force: 451,225.1 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (240.08262, -50.5) ft

Entry: (631.18113, 41.14) ft

Radius: 289.99622 ft

Center: (387.90913, 198.98974) ft

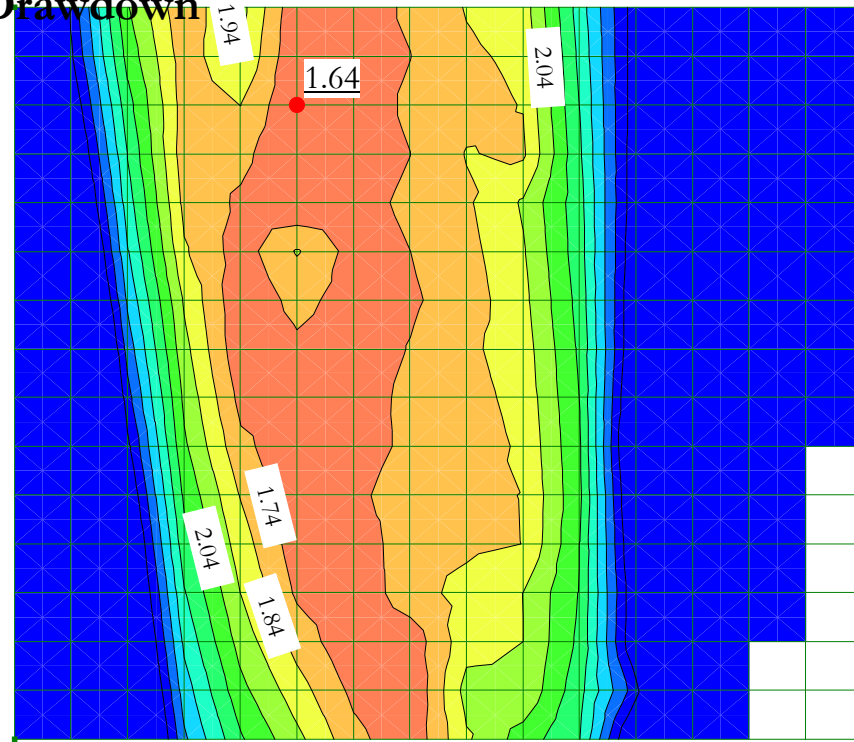
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	247.06237	-54.38	3,455.712	3,921.6582	188.2545	300
Slice 2	260.41185	-61.379128	3,892.4576	4,904.7256	584.4332	0
Slice 3	273.15132	-67.243879	4,258.418	5,790.3943	884.48691	0
Slice 4	285.89079	-72.384093	4,579.1674	6,557.8776	1,142.4089	0
Slice 5	298.63026	-76.840399	4,857.2409	7,204.5162	1,355.2	0
Slice 6	310.49471	-80.424476	5,080.8873	8,420.6007	1,928.1844	0
Slice 7	321.77785	-83.302865	5,260.4988	8,875.3474	1,460.4937	300
Slice 8	333.35471	-85.767851	5,414.3139	9,444.4251	1,628.2706	300
Slice 9	344.93157	-87.744416	5,537.6516	9,904.4104	1,764.2851	300
Slice 10	356.85073	-89.27257	5,633.0083	10,266.284	1,871.9649	300
Slice 11	369.11218	-90.331424	5,699.0809	10,527.993	1,951.007	300
Slice 12	381.37363	-90.867963	5,732.5609	10,683.458	2,000.2921	300
Slice 13	393.63509	-90.885093	5,733.6298	10,740.862	2,023.053	300
Slice 14	405.89654	-90.382905	5,702.2933	10,708.977	2,022.8314	300
Slice 15	418.15799	-89.358682	5,638.3818	10,596.688	2,003.2858	300
Slice 16	429.89654	-87.894804	5,547.0358	10,445.531	2,828.1476	0
Slice 17	441.11218	-86.027273	5,430.5018	10,221.336	2,765.9891	0
Slice						

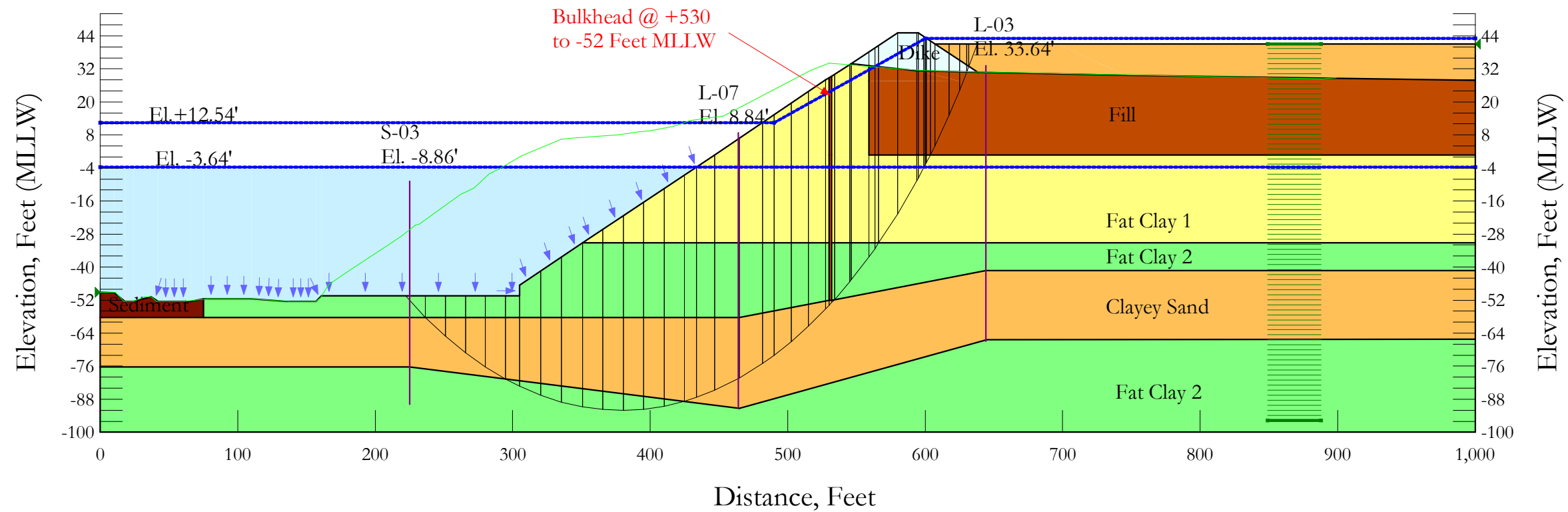
18	447.10614	-84.899965	5,360.1578	10,088.546	2,729.9362	0
Slice 19	448.74614	-84.550415	5,338.3459	10,074.884	2,734.6416	0
Slice 20	457	-82.563642	4,946.6739	10,016.843	2,927.2633	0
Slice 21	464.5	-80.708983	4,961.2682	9,963.9728	2,888.3129	0
Slice 22	471.269	-78.690104	4,954.4875	9,879.1851	2,843.2755	0
Slice 23	483.807	-74.610837	4,922.2775	9,696.765	2,756.5516	0
Slice 24	496.345	-69.885278	4,852.689	9,464.6059	2,662.6915	0
Slice 25	508.883	-64.478555	4,743.705	9,183.8044	2,563.4926	0
Slice 26	521.421	-58.347602	4,592.8348	8,853.4274	2,459.8543	0
Slice 27	528.845	-54.452837	4,488.2039	8,640.7285	2,397.4612	0
Slice 28	531	-53.243262	4,453.2618	10,213.802	3,325.8493	0
Slice 29	532.70357	-52.270515	4,424.6821	8,513.5383	2,360.7022	0
Slice 30	539.48335	-48.138271	4,295.849	8,349.4089	1,637.7445	300
Slice 31	545.87977	-44.203468	4,172.2065	8,108.4333	1,590.3388	300
Slice 32	552.6	-39.577323	4,013.841	7,820.5647	1,538.0162	300
Slice 33	561.29655	-33.446055	3,800.5373	7,052.1698	1,313.7448	300
Slice 34	571.75655	-25.033489	3,483.946	6,512.6876	1,223.691	300
Slice 35	586.87735	-11.765823	2,962.2861	5,409.758	988.84282	300
Slice 36	594.37735	-4.6473964	2,672.4481	4,685.9556	813.50983	300
Slice 37	597.23853	-1.6786011	2,547.2347	4,308.4388	711.57263	300
Slice 38	599.77853	0.9769672	2,434.9185	4,089.2323	602.12099	100
Slice 39	600.46	1.7095411	2,585.2606	4,034.3651	527.4309	100
Slice 40	603.92	5.5552884	2,345.286	3,611.926	461.01926	100
Slice 41	612.11405	15.243133	1,740.7645	2,608.8771	315.96713	100
Slice 42	619.55513	24.565019	1,159.0788	1,661.1673	182.74527	100
Slice 43	621.93698	27.733439	961.36942	1,337.6468	136.95377	100
Slice 44	623.16461	29.433937	855.25833	1,163.4537	112.17395	100
Slice 45	625.50869	32.738442	649.0572	794.12729	67.647295	100

Slice 46	628.97054	37.833343	331.1354	389.16553	15.549127	16
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Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 44+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Fat Clay 1	125	300	22	500	15	2
Light Green	Fat Clay 2	125	300	22	500	15	2
Orange	Clayey Sand	120	0	30	0	30	2
Light Orange	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Brown	Fill	110	100	20	150	15	2
Dark Brown	Sediment	90	16	15	50	0	2
Red	Bulkhead	150					2



RDD 44+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Nitharsan Kanapathippillai

Revision Number: 193

Date: 4/27/2018

Time: 8:23:07 AM

Tool Version: 8.16.1.13452

File Name: 44+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\44+00\Rec\

Last Solved Date: 4/27/2018

Last Solved Time: 8:23:48 AM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

RDD 44+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fill

Model: Mohr-Coulomb

Unit Weight: 110 pcf

Cohesion': 100 psf

Phi': 20 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Slip Surface Grid

Upper Left: [\(242.2658, 249.51717\) ft](#)

Lower Left: [\(242.2658, 72.20246\) ft](#)

Lower Right: [\(653.0031, 72.20246\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(848.9456, 41.02998\) ft](#)

Upper Right Coordinate: [\(888.1061, 41.02998\) ft](#)

Lower Left Coordinate: [\(848.9456, -95.69264\) ft](#)

Lower Right Coordinate: [\(888.1061, -95.69264\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -49.2\) ft](#)

Right Coordinate: [\(1,000, 41.14\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	490	12.54
Coordinate 3	600	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64

Coordinate 2	1,000	-3.64
--------------	-------	-------

Points

	X (ft)	Y (ft)
Point 1	225	-58.26
Point 2	225	-76.26
Point 3	465	-58.26
Point 4	465	-91.26
Point 5	645	-66.36
Point 6	1,000	27.94
Point 7	625	27.54
Point 8	617.3081	28.53209
Point 9	593.8347	31.4115
Point 10	1,000	41.14
Point 11	999.9742	-11.27583
Point 12	1,000	-66.26
Point 13	0	-76.26
Point 14	0	-100
Point 15	1,000	-100
Point 16	1,000	-41.26
Point 17	644	-41.26
Point 18	0	-58.26
Point 19	1,000	-31.26
Point 20	644	-31.26
Point 21	464	-31.26
Point 22	135	-52.4
Point 23	1,000	0.74
Point 24	644	0.74
Point 25	559	27.72993
Point 26	559	0.74
Point 27	559	33.14
Point 28	110	-51.6
Point 29	75	-51.6
Point 30	75	-58.26
Point 31	0	-49.2
Point 32	305	-50.5
Point 33	305	-46.5
Point 34	350.72	-31.26
Point 35	446.72	0.74
Point 36	546.2	33.9
Point 37	161	-50.5
Point 38	157	-52.4
Point 39	42	-52.4
Point 40	66	-52.4
Point 41	37	-50.8
Point 42	24	-52.4
Point 43	18	-52.5
Point 44	10	-49.29
Point 45	527.69	28
Point 46	579.92	45.14
Point 47	594.92	45.14

Point 48	745.7421	29.59999
Point 49	638.12	30.74
Point 50	606.92	41.14
Point 51	696.5	41.14
Point 52	530	28.7363
Point 53	530	27.98007
Point 54	532	29.37379
Point 55	532	27.96282
Point 56	530	0.74
Point 57	532	0.74
Point 58	530	-31.26
Point 59	532	-31.26
Point 60	530	-52
Point 61	532	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	51,48,6,10	3,429.3
Region 2	Fat Clay 2	12,5,4,2,13,14,15	25,013
Region 3	Clayey Sand	12,16,17,61,60,3,1,30,18,13,2,4,5	24,297
Region 4	Fat Clay 2	58,21,34,33,32,37,38,22,28,29,30,1,3,60	7,186.4
Region 5	Fat Clay 1	59,20,19,23,24,26,57	14,976
Region 6	Fat Clay 1	25,55,57,26	731.87
Region 7	Fill	25,7,8,9,27	219.6
Region 8	Fat Clay 1	25,55,54,36,27	126.45
Region 9	Sediment	30,29,40,39,41,42,43,44,31,18	500.79
Region 10	Fill	9,8,7,25,26,24,23,6,48,49	12,517
Region 11	Dike	46,36,27,9,49,50,47	719.15
Region 12	Dredge Fill	50,51,48,49	1,058.7
Region 13	Bulkhead	54,52,53,56,58,60,61,59,57,55	162.11
Region 14	Fat Clay 1	52,45,53	0.87345
Region 15	Fat Clay 1	45,35,56,53	1,166.6
Region 16	Fat Clay 1	56,35,34,21,58	4,201
Region 17	Fat Clay 2	19,20,59,61,17,16	5,281.4

Current Slip Surface

Slip Surface: 16,262
 F of S: 1.64
 Volume: 23,934.395 ft³
 Weight: 2,933,606.9 lbs
 Resisting Moment: 2.7045249e+008 lbs-ft
 Activating Moment: 1.6468314e+008 lbs-ft
 Resisting Force: 788,253.13 lbs
 Activating Force: 480,285.69 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (222.04426, -50.5) ft
 Entry: (637.91989, 41.14) ft
 Radius: 317.92191 ft
 Center: (379.17823, 225.87521) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	229.29939	-54.38	3,166.176	3,612.3262	180.25637	300
Slice 2	243.82198	-61.680886	3,621.7513	4,622.4704	577.76546	0
Slice 3	258.3569	-68.088751	4,021.6021	5,570.4609	894.23403	0
Slice 4	272.89183	-73.654549	4,368.9078	6,385.1339	1,164.0687	0
Slice 5	287.42675	-78.424627	4,666.5607	7,063.0898	1,383.6367	0
Slice 6	299.84711	-81.943892	4,886.1628	7,504.2487	1,057.7754	300
Slice 7	312.62	-84.903838	5,070.8635	8,573.6542	1,415.2193	300
Slice 8	327.86	-87.782507	5,250.4924	9,166.212	1,582.0534	300
Slice 9	343.1	-89.899839	5,382.614	9,688.8622	1,739.8372	300
Slice 10	358.13225	-91.262341	5,467.6341	10,052.539	1,852.422	300
Slice 11	372.95674	-91.899354	5,507.3837	10,271.289	1,924.7426	300
Slice 12	387.78124	-91.843769	5,503.9152	10,362.867	1,963.1438	300
Slice 13	402.60573	-91.09522	5,457.2058	10,339.263	1,972.4793	300
Slice 14	417.43023	-89.648765	5,366.947	10,210.896	0	2,217.076
Slice 15	429.21124	-88.053875	5,267.4258	10,068.685	2,772.0085	0
Slice 16	440.15	-86.07346	5,143.8479	10,002.75	2,805.2882	0
Slice 17	455.36	-82.655956	4,930.5957	9,964.5768	2,906.3703	0
Slice 18	464.5	-80.383292	4,788.7814	9,917.6995	2,961.1823	0
Slice 19	473.38469	-77.641529	4,617.6954	9,811.3562	2,998.5615	0
Slice 20	485.88469	-73.572597	4,363.7941	9,643.0006	3,047.9513	0
Slice 21	496.28167	-69.616706	4,116.9464	9,448.0511	3,077.9147	0
Slice 22	508.845	-64.320474	3,786.4616	9,167.1668	3,106.5516	0
Slice 23	521.40833	-58.370463	3,415.1809	8,829.3236	3,125.8568	0
Slice 24	528.845	-54.610954	3,180.5875	8,608.0026	3,133.5196	0
Slice 25	531	-53.45112	3,108.2139	10,198.719	4,093.7053	0
Slice 26	532.99313	-52.358561	3,040.0382	8,465.2896	3,132.2704	0
Slice 27	539.51177	-48.581618	2,804.357	8,491.0867	0	2,028.5112
Slice 28	545.61863	-44.996477	2,580.6442	8,279.6582	0	1,991.683
Slice 29	552.6	-40.472136	2,298.3253	8,008.9819	0	1,947.3791
Slice 30	561.14376	-34.808615	1,944.9216	7,271.1897	0	1,747.7763
Slice						

31	564.71526	-32.286103	1,787.5168	7,120.2222	0	1,724.6017
Slice 32	573.0315	-25.957441	1,392.6083	6,725.169	0	1,663.967
Slice 33	586.87735	-14.646972	686.83506	5,762.8161	0	1,468.5474
Slice 34	594.37735	-8.1400449	280.8028	5,083.441	0	1,314.0326
Slice 35	597.04583	-5.6405135	124.83204	4,750.0412	0	1,230.3692
Slice 36	599.58583	-3.2415772	-24.861584	4,414.1281	0	1,144.9352
Slice 37	600.46	-2.3972415	-77.548129	4,327.244	0	1,057.3522
Slice 38	602.28601	-0.60566435	-189.34254	4,068.7432	0	1,014.6942
Slice 39	605.28601	2.3931892	-376.47101	3,829.1165	0	645.79561
Slice 40	612.11405	9.6416253	-828.77342	3,034.2664	0	535.14994
Slice 41	621.15405	19.751773	-1,459.6466	1,984.7282	0	387.23235
Slice 42	627.63102	27.562912	-1,947.0617	1,166.7038	0	274.68812
Slice 43	631.02831	31.853811	-2,214.8138	577.87606	269.46803	100
Slice 44	634.85724	36.994236	-2,535.5763	333.398	0	43.60213

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

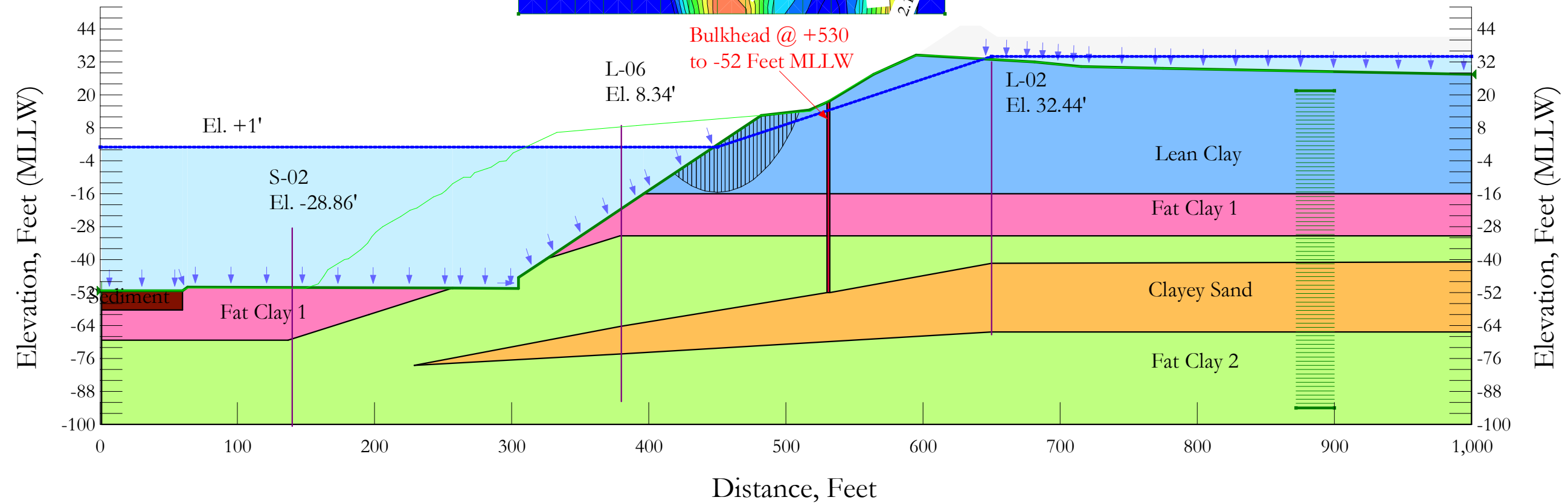
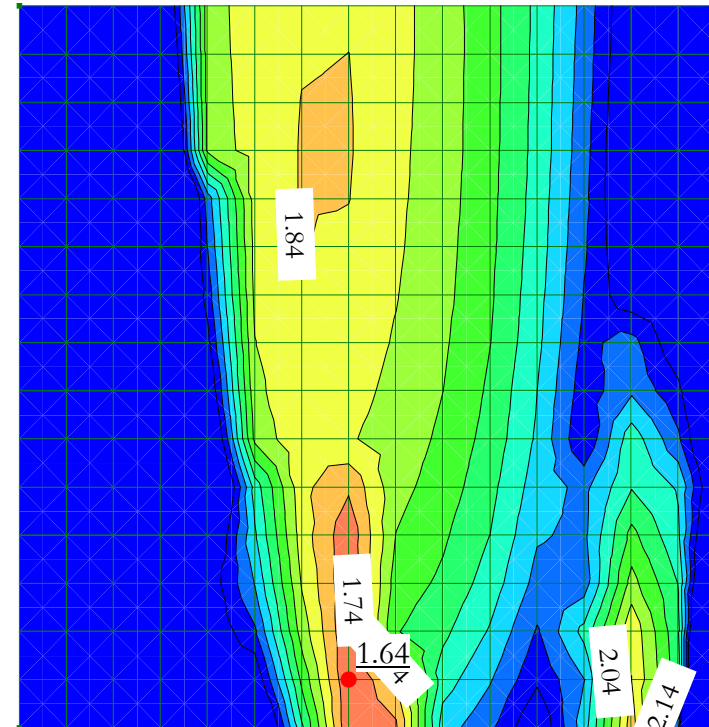
Station Analyzed: 56+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Lean Clay (U)	125			500
Pink	Fat Clay 1(U)	125			1,000
Light Green	Fat Clay 2(U)	125			2,200
Brown	Sediment (U)	90			50
Red	Bulkhead	150			



Short Term 56+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 153

Date: 4/26/2018

Time: 5:15:44 PM

Tool Version: 8.16.1.13452

File Name: 56+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\Rec\

Last Solved Date: 4/26/2018

Last Solved Time: 5:16:02 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 56+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Slip Surface Grid

Upper Left: [\(305, 208.5\) ft](#)

Lower Left: [\(305, 49.5\) ft](#)

Lower Right: [\(616, 49.5\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(872, 21.5\) ft](#)

Upper Right Coordinate: [\(900, 21.5\) ft](#)

Lower Left Coordinate: [\(872, -94\) ft](#)

Lower Right Coordinate: [\(900, -94\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(1, -51.26\) ft](#)

Right Coordinate: [\(1,000, 27.54\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	650	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96
Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.28	32
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	1,000	-16.06
Point 19	1,000	-31.26
Point 20	379	-31.26
Point 21	137	-69.26
Point 22	1	-69.26
Point 23	1	-100
Point 24	1,000	-100
Point 25	1,000	-66.26
Point 26	229	-78.46
Point 27	379	-64.26
Point 28	1,000	-40.86
Point 29	60	-51.26
Point 30	63.6	-50.06
Point 31	60	-58.26
Point 32	1	-58.26
Point 33	1	-51.26
Point 34	325.7	-39.6
Point 35	305	-50.5
Point 36	305	-46.5
Point 37	256.9893	-50.4
Point 38	196	-60
Point 39	396.32	-16.06
Point 40	482	12.5
Point 41	715.3	30.4
Point 42	530	17.26444
Point 43	532	17.86888
Point 44	530	-16.06
Point 45	532	-16.06
Point 46	530	-31.26
Point 47	532	-31.26
Point 48	530	-52
Point 49	532	-52

Point 50	517	14.5
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Regions

	Points	Area (ft ²)	Material
Region 1	10,11,12,41,14	984	
Region 2	11,13,9,12	2,972.5	
Region 3	15,16,17,10,14	597.58	
Region 4	8,43,45,18,9,12,41,14,15	21,354	Lean Clay (U)
Region 5	18,19,47,45	7,113.6	Fat Clay 1(U)
Region 6	48,46,20,34,36,35,37,38,21,22,23,24,25,7,5,26,27	39,169	Fat Clay 2(U)
Region 7	26,5,7,25,28,6,49,48,27	14,233	Clayey Sand
Region 8	29,33,32,31	413	Sediment (U)
Region 9	37,30,29,31,32,22,21,38	3,265.5	Fat Clay 1(U)
Region 10	42,50,40,39,44	2,673.4	Lean Clay (U)
Region 11	44,39,34,20,46	2,496.4	Fat Clay 1(U)
Region 12	43,42,44,46,48,49,47,45	139.13	Bulkhead
Region 13	19,47,49,6,28	5,243.7	Fat Clay 2(U)

Current Slip Surface

Slip Surface: 1,773
 F of S: 1.64
 Volume: 1,302.7902 ft³
 Weight: 162,848.77 lbs
 Resisting Moment: 3,839,842.3 lbs-ft
 Activating Moment: 2,334,982.6 lbs-ft
 Resisting Force: 45,697.792 lbs
 Activating Force: 27,825.793 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (418.68556, -8.6048126) ft
 Entry: (510.08115, 14.104637) ft
 Radius: 75.56 ft
 Center: (450.13333, 60.1) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	420.28636	-9.2933383	642.30431	861.51106	0	500
Slice 2	423.48797	-10.585299	722.92263	1,097.7954	0	500
Slice 3	426.68957	-11.711336	793.18738	1,312.969	0	500
Slice 4	429.89118	-12.679172	853.58034	1,505.9752	0	500
Slice 5	433.09278	-13.495062	904.4919	1,675.9929	0	500
Slice 6	436.29439	-14.164026	946.23522	1,822.4936	0	500
Slice 7	439.49599	-14.690013	979.05684	1,945.2731	0	500
Slice 8	442.69759	-15.076032	1,003.1444	2,044.4555	0	500
Slice 9	445.8992	-15.324234	1,018.6322	2,120.4737	0	500
Slice 10	448.75	-15.436991	1,025.6682	2,197.1419	0	500
Slice 11	451.45455	-15.43444	1,012.9086	2,285.297	0	500
Slice						

12	454.36364	-15.327421	1,035.5658	2,363.7395	0	500
Slice 13	457.27273	-15.107765	1,051.3807	2,425.282	0	500
Slice 14	460.18182	-14.77448	1,060.2931	2,470.6261	0	500
Slice 15	463.09091	-14.326037	1,062.21	2,500.4888	0	500
Slice 16	466	-13.760335	1,057.004	2,515.5564	0	500
Slice 17	468.90909	-13.074651	1,044.5094	2,516.4372	0	500
Slice 18	471.81818	-12.265567	1,024.5188	2,503.616	0	500
Slice 19	474.72727	-11.328882	996.777	2,477.4064	0	500
Slice 20	477.63636	-10.259491	960.97372	2,437.9026	0	500
Slice 21	480.54545	-9.0512225	916.73419	2,384.9277	0	500
Slice 22	483.56629	-7.6384697	861.19303	2,263.1116	0	500
Slice 23	486.69886	-5.998953	792.99683	2,070.1952	0	500
Slice 24	489.83144	-4.1649562	712.9867	1,857.2502	0	500
Slice 25	492.96402	-2.1192133	620.11381	1,620.8475	0	500
Slice 26	496.09659	0.16005719	513.05501	1,356.3143	0	500
Slice 27	499.22917	2.7008304	390.11091	1,057.2917	0	500
Slice 28	502.36174	5.5398902	249.04704	715.00928	0	500
Slice 29	505.49432	8.7271203	86.833159	317.01662	0	500
Slice 30	508.57088	12.259818	-96.928068	-145.29913	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

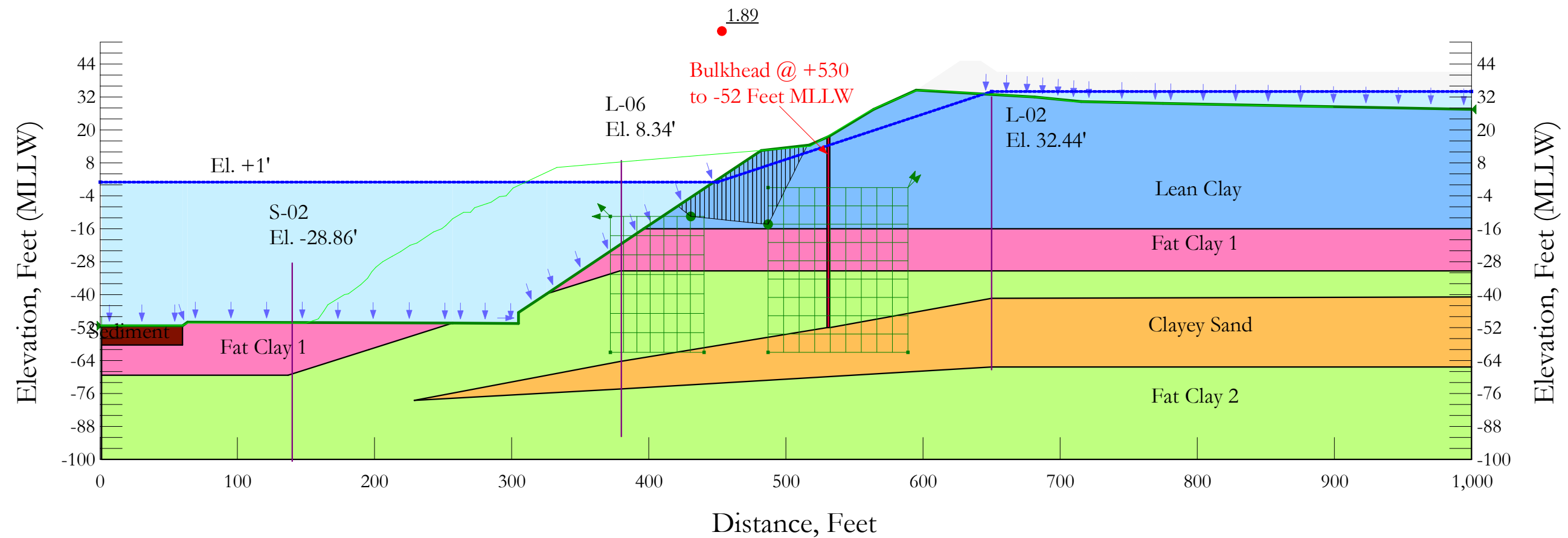
Station Analyzed: 56+00

HVJ Project Number: HG1710448

Loading Condition: Short Term

Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Blue	Lean Clay (U)	125			500
Pink	Fat Clay 1(U)	125			1,000
Light Green	Fat Clay 2(U)	125			2,200
Brown	Sediment (U)	90			50
Red	Bulkhead	150			



Short Term 56+00 Block

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 153

Date: 4/26/2018

Time: 5:15:44 PM

Tool Version: 8.16.1.13452

File Name: 56+00.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\Rec\

Last Solved Date: 4/26/2018

Last Solved Time: 5:16:30 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 56+00 Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2(U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: [\(1, -51.26\) ft](#)

Right Coordinate: [\(1,000, 27.54\) ft](#)

Slip Surface Block

Left Grid

Upper Left: [\(372.0438, -11.5123\) ft](#)

Lower Left: [\(372.0438, -61.07368\) ft](#)

Lower Right: [\(440.2923, -61.07368\) ft](#)

X Increments: 7

Y Increments: 7

Starting Angle: [135 °](#)

Ending Angle: [180 °](#)

Angle Increments: 2

Right Grid

Upper Left: [\(486.9862, -0.99251\) ft](#)

Lower Left: [\(486.9862, -61.04894\) ft](#)

Lower Right: [\(589.0441, -61.04894\) ft](#)

X Increments: 9

Y Increments: 9

Starting Angle: [45 °](#)

Ending Angle: [65 °](#)

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	650	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96
Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.28	32
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	1,000	-16.06
Point 19	1,000	-31.26
Point 20	379	-31.26
Point 21	137	-69.26
Point 22	1	-69.26
Point 23	1	-100
Point 24	1,000	-100
Point 25	1,000	-66.26
Point 26	229	-78.46
Point 27	379	-64.26
Point 28	1,000	-40.86
Point 29	60	-51.26
Point 30	63.6	-50.06
Point 31	60	-58.26
Point 32	1	-58.26
Point 33	1	-51.26
Point 34	325.7	-39.6
Point 35	305	-50.5
Point 36	305	-46.5
Point 37	256.9893	-50.4
Point 38	196	-60
Point 39	396.32	-16.06
Point 40	482	12.5
Point 41	715.3	30.4
Point 42	530	17.26444
Point 43	532	17.86888
Point 44	530	-16.06
Point 45	532	-16.06
Point 46	530	-31.26
Point 47	532	-31.26
Point 48	530	-52
Point 49	532	-52

Point 50	517	14.5
----------	-----	------

Regions

	Points	Area (ft ²)	Material
Region 1	10,11,12,41,14	984	
Region 2	11,13,9,12	2,972.5	
Region 3	15,16,17,10,14	597.58	
Region 4	8,43,45,18,9,12,41,14,15	21,354	Lean Clay (U)
Region 5	18,19,47,45	7,113.6	Fat Clay 1(U)
Region 6	48,46,20,34,36,35,37,38,21,22,23,24,25,7,5,26,27	39,169	Fat Clay 2(U)
Region 7	26,5,7,25,28,6,49,48,27	14,233	Clayey Sand
Region 8	29,33,32,31	413	Sediment (U)
Region 9	37,30,29,31,32,22,21,38	3,265.5	Fat Clay 1(U)
Region 10	42,50,40,39,44	2,673.4	Lean Clay (U)
Region 11	44,39,34,20,46	2,496.4	Fat Clay 1(U)
Region 12	43,42,44,46,48,49,47,45	139.13	Bulkhead
Region 13	19,47,49,6,28	5,243.7	Fat Clay 2(U)

Current Slip Surface

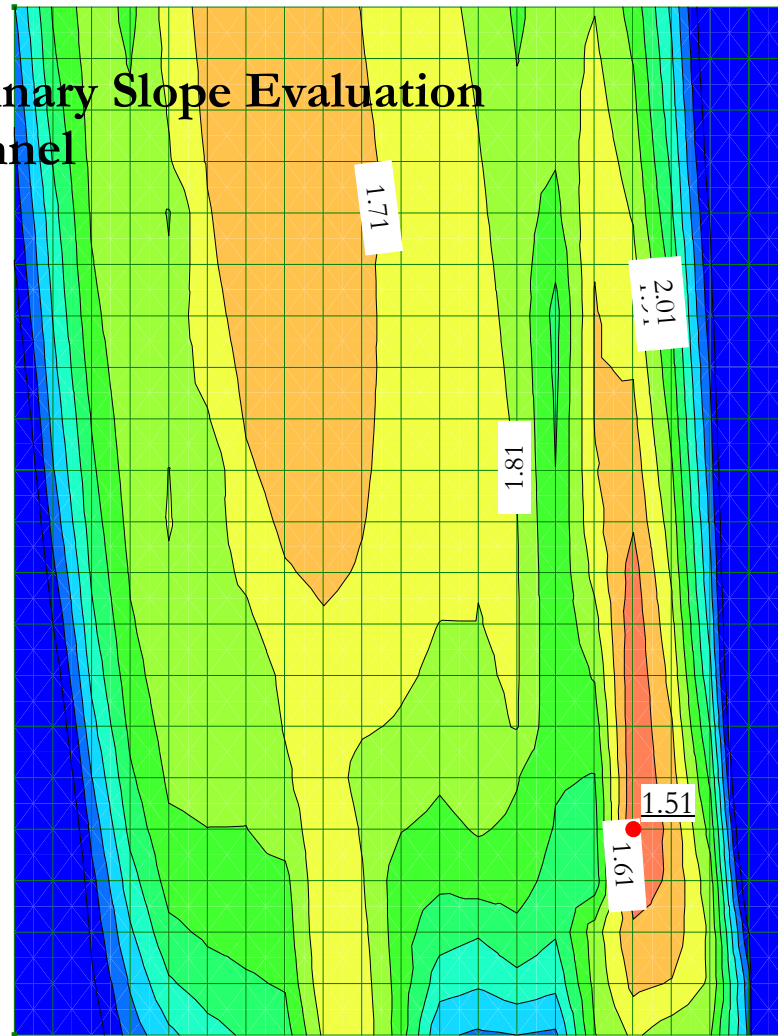
Slip Surface: 56,311
 F of S: 1.89
 Volume: 1,416.1025 ft³
 Weight: 177,012.82 lbs
 Resisting Moment: 1,960,247.2 lbs-ft
 Activating Moment: 1,036,636.3 lbs-ft
 Resisting Force: 47,193.626 lbs
 Activating Force: 24,979.701 lbs
 F of S Rank (Analysis): 1 of 57,600 slip surfaces
 F of S Rank (Query): 1 of 57,600 slip surfaces
 Exit: (421.36609, -7.7113021) ft
 Entry: (515.75335, 14.428763) ft
 Radius: 45.460396 ft
 Center: (464.66474, 19.963779) ft

Slip Slices

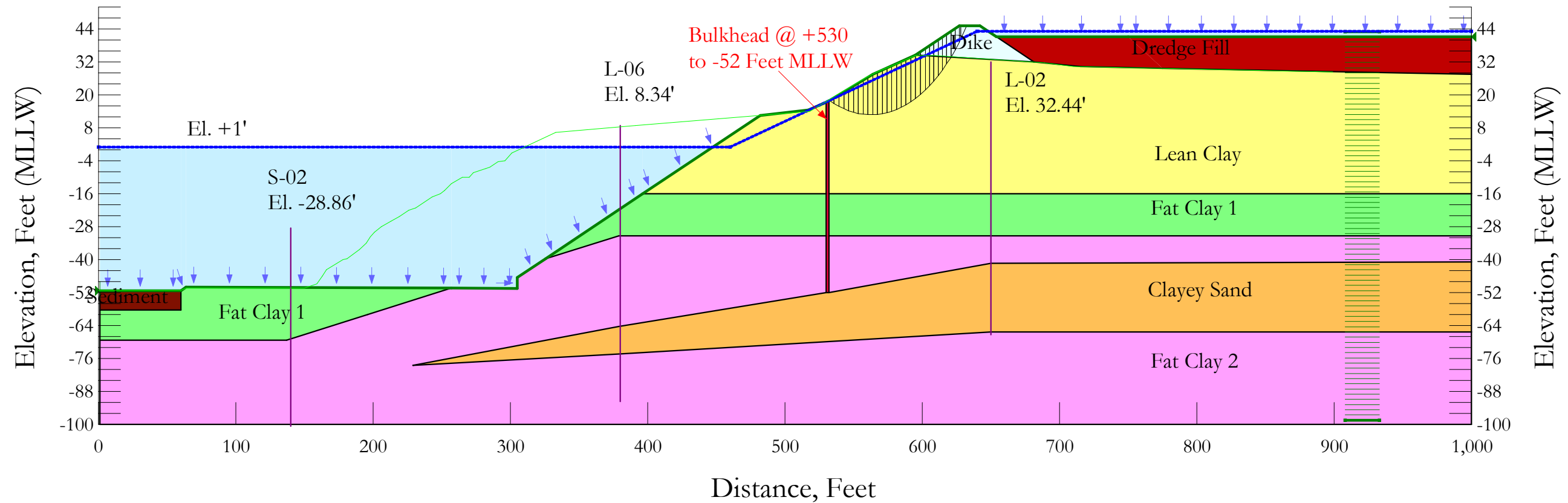
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	422.8955	-8.3448018	583.11563	774.65696	0	500
Slice 2	425.9543	-9.6118011	662.17639	1,019.7655	0	500
Slice 3	429.01311	-10.8788	741.23714	1,267.5007	0	500
Slice 4	432.23826	-11.597205	786.06557	1,326.0842	0	500
Slice 5	435.62976	-11.767014	796.66166	1,427.146	0	500
Slice 6	439.02126	-11.936823	807.25775	1,525.9477	0	500
Slice 7	442.41275	-12.106632	817.85384	1,622.3396	0	500
Slice 8	445.80425	-12.276441	828.44993	1,716.2343	0	500
Slice 9	448.75	-12.423932	837.65336	1,822.9009	0	500
Slice 10	451.6	-12.566629	840.15794	1,960.1299	0	500
Slice 11	454.8	-12.72685	881.96475	2,112.6431	0	500
Slice						

12	458	-12.887071	923.77155	2,263.3675	0	500
Slice 13	461.2	-13.047292	965.57835	2,412.229	0	500
Slice 14	464.4	-13.207513	1,007.3852	2,559.1853	0	500
Slice 15	467.6	-13.367734	1,049.192	2,704.2279	0	500
Slice 16	470.8	-13.527955	1,090.9988	2,847.3842	0	500
Slice 17	474	-13.688176	1,132.8056	2,988.7182	0	500
Slice 18	477.2	-13.848397	1,174.6124	3,128.3306	0	500
Slice 19	480.4	-14.008618	1,216.4192	3,266.359	0	500
Slice 20	483.24655	-14.151143	1,253.6083	3,344.6796	0	500
Slice 21	485.73965	-14.27597	1,286.1797	3,363.838	0	500
Slice 22	488.59107	-12.73351	1,221.0613	2,612.3032	0	500
Slice 23	491.80082	-9.5237636	1,058.2531	2,299.5167	0	500
Slice 24	495.01057	-6.3140172	895.44497	1,984.8576	0	500
Slice 25	498.22031	-3.1042707	732.6368	1,665.6035	0	500
Slice 26	501.43006	0.10547572	569.82862	1,339.1319	0	500
Slice 27	504.63981	3.3152222	407.02044	1,002.9678	0	500
Slice 28	507.84955	6.5249686	244.21227	654.84443	0	500
Slice 29	511.0593	9.7347151	81.404088	292.77487	0	500
Slice 30	514.20876	12.884175	-78.346194	-77.568077	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 56+00
HVJ Project Number: HG1710448
Loading Condition: Long Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Lean Clay	125	100	25
Light Green	Fat Clay 1	125	300	22
Orange	Clayey Sand	120	0	30
Dark Red	Dredge Fill	90	16	15
Light Blue	Dike	125	100	25
Pink	Fat Clay 2	125	300	22
Dark Brown	Sediment	90	16	15
Bright Red	Bulkhead	150		



Long Term 56+00

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File Information

File Version: 8.16

Title: [Barbours Cut Ship Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 153

Date: [4/26/2018](#)

Time: [5:15:44 PM](#)

Tool Version: 8.16.1.13452

File Name: [56+00.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\Rec\](#)

Last Solved Date: [4/26/2018](#)

Last Solved Time: [5:15:58 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

Long Term 56+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [No](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dike

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 300 psf
Phi': 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Bulkhead

Model: High Strength
Unit Weight: 150 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (289.8782, 285.48819) ft
Lower Left: (289.8782, 59.18752) ft
Lower Right: (630.7282, 59.18752) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (907.9586, 42.95493) ft
Upper Right Coordinate: (933.1186, 42.95493) ft

Lower Left Coordinate: (907.9586, -98.52178) ft
 Lower Right Coordinate: (933.1186, -98.52178) ft
 Number of Increments: 75
 Left Projection: No
 Left Projection Angle: 135 °
 Right Projection: No
 Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (1, -51.26) ft
 Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	460	1
Coordinate 3	640	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96
Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.28	32
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	1,000	-16.06
Point 19	1,000	-31.26
Point 20	379	-31.26
Point 21	137	-69.26
Point 22	1	-69.26
Point 23	1	-100

Point 24	1,000	-100
Point 25	1,000	-66.26
Point 26	229	-78.46
Point 27	379	-64.26
Point 28	1,000	-40.86
Point 29	60	-51.26
Point 30	63.6	-50.06
Point 31	60	-58.26
Point 32	1	-58.26
Point 33	1	-51.26
Point 34	325.7	-39.6
Point 35	305	-50.5
Point 36	305	-46.5
Point 37	256.9893	-50.4
Point 38	196	-60
Point 39	396.32	-16.06
Point 40	482	12.5
Point 41	715.3	30.4
Point 42	530	17.26444
Point 43	532	17.86888
Point 44	530	-16.06
Point 45	532	-16.06
Point 46	530	-31.26
Point 47	532	-31.26
Point 48	530	-52
Point 49	532	-52
Point 50	517	14.5

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	10,11,12,41,14	984
Region 2	Dredge Fill	11,13,9,12	2,972.5
Region 3	Dike	15,16,17,10,14	597.58
Region 4	Lean Clay	8,43,45,18,9,12,41,14,15	21,354
Region 5	Fat Clay 1	18,19,47,45	7,113.6
Region 6	Fat Clay 2	48,46,20,34,36,35,37,38,21,22,23,24,25,7,5,26,27	39,169
Region 7	Clayey Sand	26,5,7,25,28,6,49,48,27	14,233
Region 8	Sediment	29,33,32,31	413
Region 9	Fat Clay 1	37,30,29,31,32,22,21,38	3,265.5
Region 10	Lean Clay	42,50,40,39,44	2,673.4
Region 11	Fat Clay 1	44,39,34,20,46	2,496.4
Region 12	Bulkhead	43,42,44,46,48,49,47,45	139.13
Region 13	Fat Clay 2	19,47,49,6,28	5,243.7

Current Slip Surface

Slip Surface: 7,617
 F of S: 1.51
 Volume: 1,180.5726 ft³
 Weight: 147,571.57 lbs

Resisting Moment: 4,820,813.2 lbs-ft

Activating Moment: 3,190,855.2 lbs-ft

Resisting Force: 48,909.248 lbs

Activating Force: 32,356.786 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (532.22515, 17.936926) ft

Entry: (632.46386, 45.14) ft

Radius: 91.674422 ft

Center: (562.5582, 104.44765) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	532.24929	17.92847	-0.83458265	28.247795	13.172163	100
Slice 2	534.03602	17.34286	58.553957	182.87414	57.97145	100
Slice 3	537.56119	16.266063	171.07659	481.77189	144.8796	100
Slice 4	541.08637	15.341689	274.58221	764.43145	228.42045	100
Slice 5	544.61154	14.565027	369.34952	1,027.1747	306.74891	100
Slice 6	548.13672	13.932269	455.60383	1,266.6331	378.18917	100
Slice 7	551.66189	13.440408	533.523	1,479.9915	441.34553	100
Slice 8	555.18706	13.087164	603.24187	1,665.1746	495.18734	100
Slice 9	558.71224	12.870932	664.85548	1,820.9622	539.10143	100
Slice 10	562.23741	12.790739	718.42128	1,947.0289	572.90915	100
Slice 11	565.72222	12.844057	763.52992	2,025.332	588.38797	100
Slice 12	569.16667	13.028037	800.34977	2,058.7849	586.81792	100
Slice 13	572.61111	13.342569	829.44654	2,068.7051	577.8758	100
Slice 14	576.05556	13.789013	850.73972	2,057.3655	562.65886	100
Slice 15	579.5	14.369332	864.1131	2,027.14	542.32835	100
Slice 16	582.94444	15.086139	869.41216	1,980.3274	518.02826	100
Slice 17	586.38889	15.942757	866.4404	1,918.9943	490.81397	100
Slice 18	589.83333	16.943297	854.95451	1,844.847	461.59446	100
Slice 19	593.27778	18.092771	834.658	1,759.1339	431.0902	100
Slice 20	596.80074	19.430717	804.29934	1,681.4077	409.00236	100
Slice 21	600.40221	20.972382	762.97659	1,610.084	395.01268	100
Slice 22	603.76257	22.573656	714.78797	1,531.7241	380.94359	100
Slice 23	606.88179	24.2202	660.58183	1,447.023	366.72355	100
Slice 24	610.00101	26.025358	596.99251	1,350.2485	351.24905	100
Slice 25	613.12024	28.000393	523.35358	1,239.8389	334.10257	100

Slice 26	616.23946	30.158897	438.8611	1,113.6534	314.66082	100
Slice 27	619.35868	32.517441	342.53466	968.8434	292.05256	100
Slice 28	622.41872	35.043104	235.50222	805.32811	265.71417	100
Slice 29	625.41957	37.751356	116.84853	619.39665	234.34204	100
Slice 30	627.5124	39.760356	26.985282	456.93245	200.48766	100
Slice 31	630.28433	42.747601	-111.34344	167.06194	77.902262	100

Project Name: HSC-ECIP Preliminary Slope Evaluation

Location: Barbours Cut Ship Channel

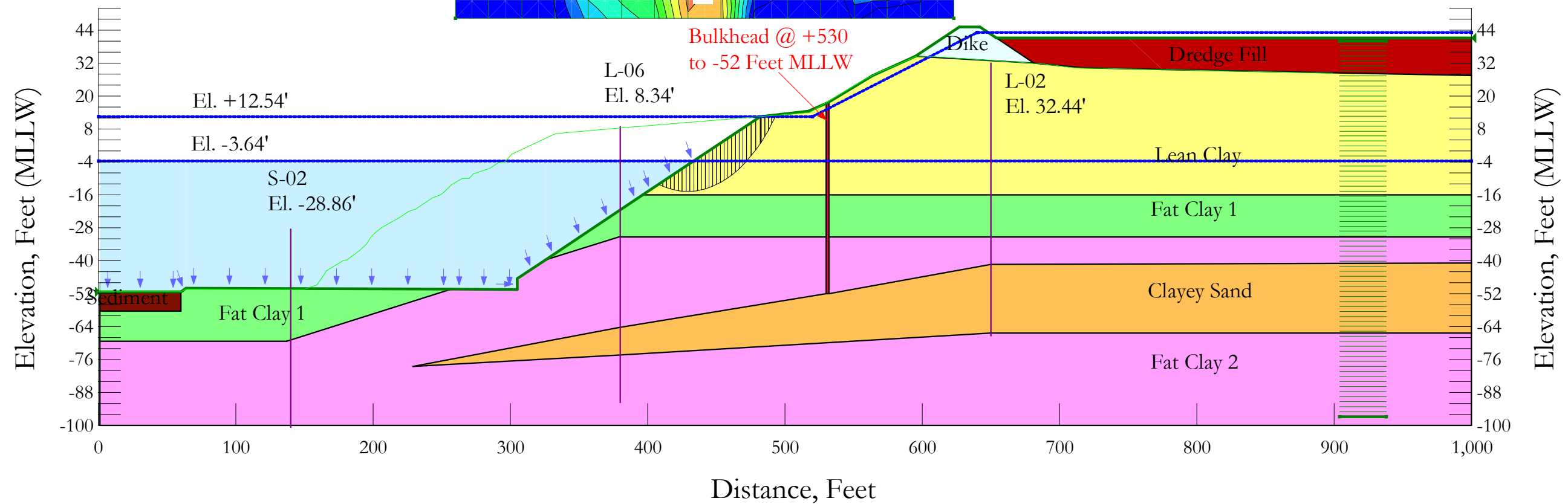
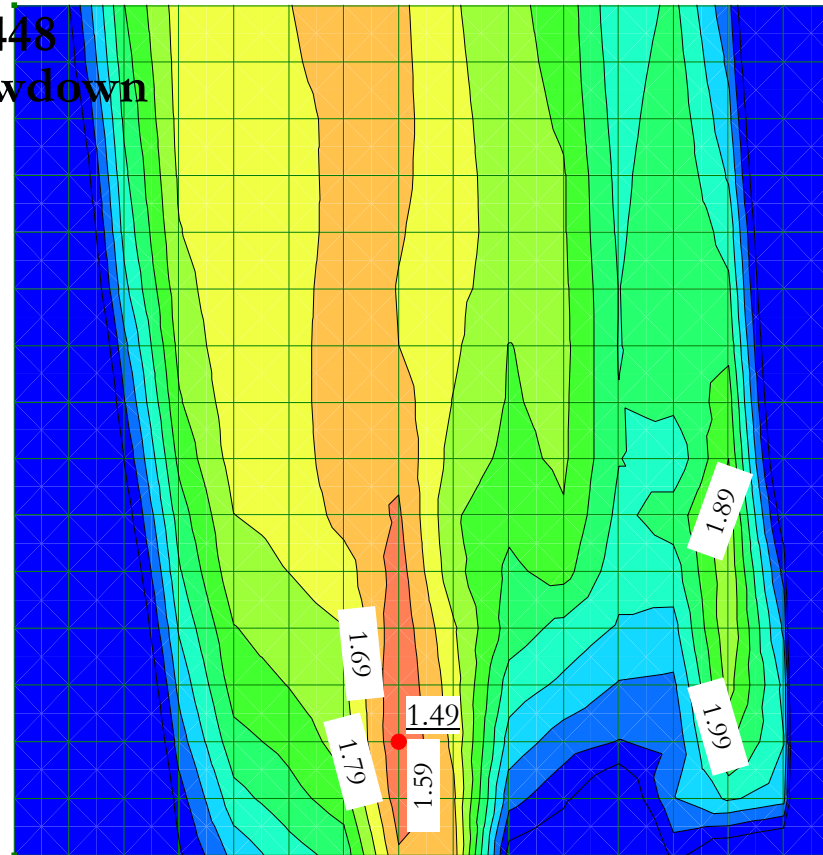
Station Analyzed: 56+00

HVJ Project Number: HG1710448

Loading Condition: Rapid Drawdown

Slip Surface: Circular

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Lean Clay	125	100	25	150	20	2
Light Green	Fat Clay 1	125	300	22	500	15	2
Orange	Clayey Sand	120	0	30	0	30	2
Dark Red	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Pink	Fat Clay 2	125	300	22	500	15	2
Dark Brown	Sediment	90	16	15	50	0	2
Bright Red	Bulkhead	150					2



RDD 56+00

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File Information

File Version: 8.16

Title: [Barbours Cut Ship Channel Widening](#)

Created By: [Anil Raavi](#)

Last Edited By: [Anil Raavi](#)

Revision Number: 153

Date: [4/26/2018](#)

Time: [5:15:44 PM](#)

Tool Version: 8.16.1.13452

File Name: [56+00.gsz](#)

Directory: [G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\56+00\Rec\](#)

Last Solved Date: [4/26/2018](#)

Last Solved Time: [5:16:20 PM](#)

Project Settings

Length(L) Units: [Feet](#)

Time(t) Units: [Seconds](#)

Force(F) Units: [Pounds](#)

Pressure(p) Units: [psf](#)

Strength Units: [psf](#)

Unit Weight of Water: [62.4 pcf](#)

View: [2D](#)

Element Thickness: 1

Analysis Settings

RDD 56+00

Kind: [SLOPE/W](#)

Method: [Morgenstern-Price](#)

Settings

Side Function

Interslice force function option: [Half-Sine](#)

PWP Conditions Source: [Piezometric Line](#)

Apply Phreatic Correction: [Yes](#)

Use Staged Rapid Drawdown: [Yes](#)

Slip Surface

Direction of movement: [Right to Left](#)

Use Passive Mode: [No](#)

Slip Surface Option: [Grid and Radius](#)

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: [No](#)

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 20 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Slip Surface Grid

Upper Left: [\(259.892, 235.51225\) ft](#)

Lower Left: [\(259.892, 48.36902\) ft](#)

Lower Right: [\(623.1356, 48.36902\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(903.9399, 39.9822\) ft](#)

Upper Right Coordinate: [\(937.9492, 39.9822\) ft](#)

Lower Left Coordinate: [\(903.9399, -96.76581\) ft](#)

Lower Right Coordinate: [\(937.9492, -96.76581\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(1, -51.26\) ft](#)

Right Coordinate: [\(1,000, 41.14\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	520	12.54
Coordinate 3	640	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64

Coordinate 2	1,000	-3.64
--------------	-------	-------

Points

	X (ft)	Y (ft)
Point 1	140	-37.96
Point 2	140	-41.96
Point 3	380	4.34
Point 4	380	-4.66
Point 5	380	-74.26
Point 6	650	-41.26
Point 7	650	-66.26
Point 8	564	27.54
Point 9	1,000	27.54
Point 10	653.92	41.14
Point 11	750	41.14
Point 12	775	29.6
Point 13	1,000	41.14
Point 14	681.28	32
Point 15	595	34.5
Point 16	626.92	45.14
Point 17	641.92	45.14
Point 18	1,000	-16.06
Point 19	1,000	-31.26
Point 20	379	-31.26
Point 21	137	-69.26
Point 22	1	-69.26
Point 23	1	-100
Point 24	1,000	-100
Point 25	1,000	-66.26
Point 26	229	-78.46
Point 27	379	-64.26
Point 28	1,000	-40.86
Point 29	60	-51.26
Point 30	63.6	-50.06
Point 31	60	-58.26
Point 32	1	-58.26
Point 33	1	-51.26
Point 34	325.7	-39.6
Point 35	305	-50.5
Point 36	305	-46.5
Point 37	256.9893	-50.4
Point 38	196	-60
Point 39	396.32	-16.06
Point 40	482	12.5
Point 41	715.3	30.4
Point 42	530	17.26444
Point 43	532	17.86888
Point 44	530	-16.06
Point 45	532	-16.06
Point 46	530	-31.26
Point 47	532	-31.26

Point 48	530	-52
Point 49	532	-52
Point 50	517	14.5

Regions

	Material	Points	Area (ft ²)
Region 1	Dredge Fill	10,11,12,41,14	984
Region 2	Dredge Fill	11,13,9,12	2,972.5
Region 3	Dike	15,16,17,10,14	597.58
Region 4	Lean Clay	8,43,45,18,9,12,41,14,15	21,354
Region 5	Fat Clay 1	18,19,47,45	7,113.6
Region 6	Fat Clay 2	48,46,20,34,36,35,37,38,21,22,23,24,25,7,5,26,27	39,169
Region 7	Clayey Sand	26,5,7,25,28,6,49,48,27	14,233
Region 8	Sediment	29,33,32,31	413
Region 9	Fat Clay 1	37,30,29,31,32,22,21,38	3,265.5
Region 10	Lean Clay	42,50,40,39,44	2,673.4
Region 11	Fat Clay 1	44,39,34,20,46	2,496.4
Region 12	Bulkhead	43,42,44,46,48,49,47,45	139.13
Region 13	Fat Clay 2	19,47,49,6,28	5,243.7

Current Slip Surface

Slip Surface: 2,995

F of S: 1.49

Volume: 850.17355 ft³

Weight: 106,271.69 lbs

Resisting Moment: 3,412,790 lbs-ft

Activating Moment: 2,296,239.1 lbs-ft

Resisting Force: 35,944.601 lbs

Activating Force: 24,201.048 lbs

F of S Rank (Analysis): 1 of 19,456 slip surfaces

F of S Rank (Query): 1 of 19,456 slip surfaces

Exit: (408.1571, -12.1143) ft

Entry: (493.68883, 13.167933) ft

Radius: 88.038455 ft

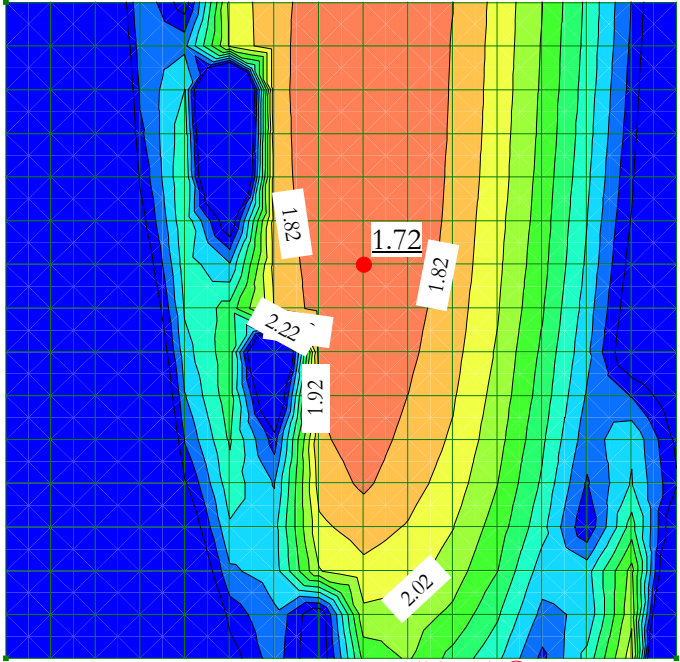
Center: (429.40568, 73.321451) ft

Slip Slices

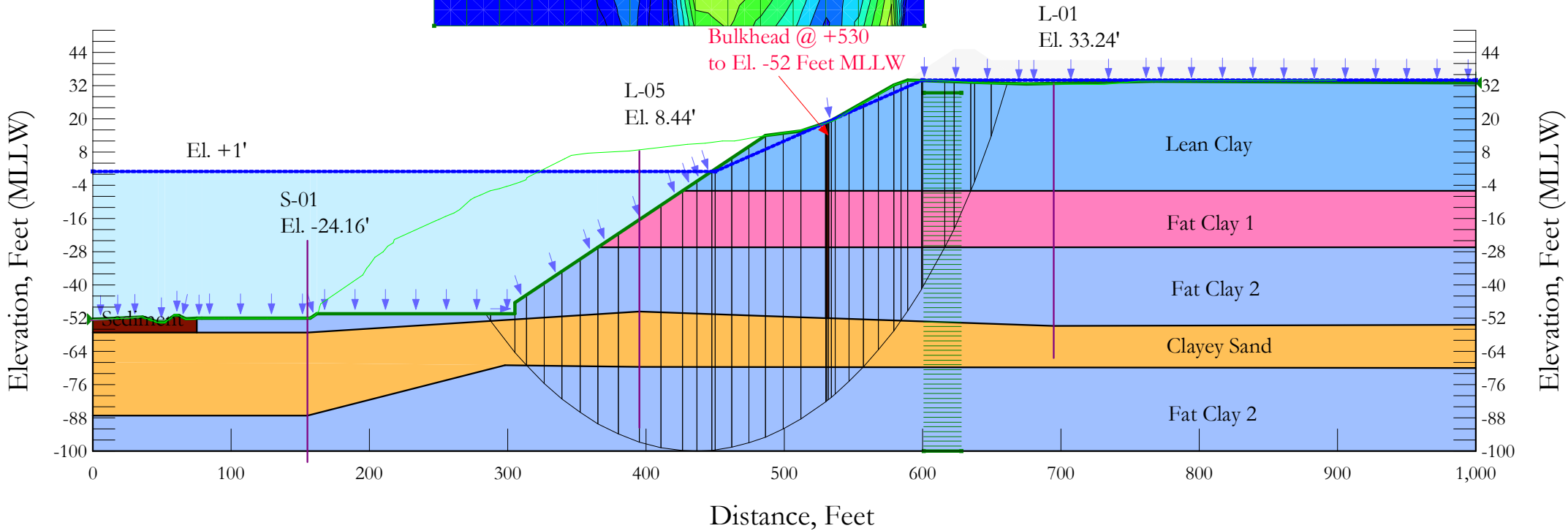
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	409.56948	-12.440973	549.18072	631.85524	38.551764	100
Slice 2	412.39425	-13.045838	586.9243	794.74909	96.910292	100
Slice 3	415.21902	-13.554669	618.67532	943.03083	151.24946	100
Slice 4	418.04378	-13.969146	644.53869	1,075.0069	200.73064	100
Slice 5	420.86855	-14.29061	664.59806	1,189.2515	244.64993	100
Slice 6	423.69332	-14.520084	678.91722	1,284.7108	282.48618	100
Slice 7	426.51808	-14.658287	687.54113	1,360.7748	313.93403	100
Slice 8	429.34285	-14.705652	690.49666	1,417.3101	338.91866	100
Slice 9	432.16762	-14.662323	687.79295	1,454.6507	357.59163	100
Slice 10	434.95776	-14.530915	679.59307	1,505.5591	385.15426	100

Slice 11	437.71329	-14.313234	666.00978	1,570.7569	421.89049	100
Slice 12	440.46881	-14.008086	646.96855	1,619.2236	453.36999	100
Slice 13	443.22434	-13.614549	622.41187	1,649.5655	0	546.46544
Slice 14	445.97986	-13.131415	592.26433	1,666.7363	0	550.14844
Slice 15	448.73538	-12.557171	556.43146	1,670.8407	0	551.01858
Slice 16	451.49091	-11.889971	514.79821	1,663.0115	0	549.30985
Slice 17	454.24643	-11.127611	467.22692	1,644.3188	0	545.23645
Slice 18	457.00196	-10.267483	413.55494	1,615.7158	0	538.98349
Slice 19	459.75748	-9.3065304	353.59149	1,577.9935	0	530.69853
Slice 20	462.51301	-8.2411844	287.11391	1,531.7421	0	520.48376
Slice 21	465.26853	-7.0672886	213.86281	1,477.319	0	508.38898
Slice 22	468.02406	-5.7800026	133.53616	1,414.8177	0	494.4053
Slice 23	470.77958	-4.3736804	45.781658	1,344.0382	0	478.45947
Slice 24	473.79779	-2.6818479	-59.788689	1,255.6653	0	458.4033
Slice 25	477.07867	-0.66670475	-185.53362	1,146.8777	0	433.56137
Slice 26	480.35956	1.5549939	-324.16762	1,021.7218	0	404.86991
Slice 27	482.35	2.9831498	-413.28454	929.22794	0	383.66782
Slice 28	483.99943	4.2740182	-493.83473	800.95046	0	356.49321
Slice 29	486.59829	6.4121621	-627.25491	586.41127	0	312.85686
Slice 30	489.19715	8.7256701	-771.61782	350.44864	163.41688	100
Slice 31	491.796	11.234227	-928.15177	133.04665	0	139.69643
Slice 32	493.39213	12.853967	-1,029.2235	-25.186583	-11.744696	100

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Lean Clay (U)	125			500
Pink	Fat Clay1 (U)	125			1,000
Blue	Fat Clay 2 (U)	125			2,200
Dark Brown	Sediment (U)	90			50
Red	Bulkhead	150			



Short Term 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 161

Date: 4/26/2018

Time: 5:28:50 PM

Tool Version: 8.16.1.13452

File Name: 64+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\Rec\

Last Solved Date: 4/26/2018

Last Solved Time: 5:29:08 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Slip Surface Grid

Upper Left: [\(246.9755, 226.94565\) ft](#)

Lower Left: [\(246.9755, 53.57301\) ft](#)

Lower Right: [\(601.0543, 53.57301\) ft](#)

Grid Horizontal Increment: [15](#)

Grid Vertical Increment: [15](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(600.8933, 29.3081\) ft](#)

Upper Right Coordinate: [\(627.8293, 29.3081\) ft](#)

Lower Left Coordinate: [\(600.8933, -99.99257\) ft](#)

Lower Right Coordinate: [\(627.8293, -99.99257\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -52.4\) ft](#)

Right Coordinate: [\(1,000, 33\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16
Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	675	32.67
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52

Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5
Point 55	36	-51.6
Point 56	530	18.64324
Point 57	532	18.97162
Point 58	530	-6.06
Point 59	532	-6.06
Point 60	530	-26.46
Point 61	532	-26.46
Point 62	530	-52
Point 63	532	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,63,62,6,1	15,325
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2 (U)	22,24,25,21,7,23,3	26,362
Region 4		17,26,27,29,28	596.48
Region 5		29,30,31,28	678.15
Region 6		30,32,16,31	1,992.6
Region 7	Lean Clay (U)	33,16,31,28,17,47,34,57,59	18,035
Region 8	Fat Clay1 (U)	61,35,33,59	9,547.2
Region 9	Fat Clay 2 (U)	36,49,38,37,39,1,6,62,60,43,42,41	5,940.7
Region 10	Sediment (U)	37,50,51,52,53,54,55,40,19,39	383
Region 11	Fat Clay1 (U)	58,44,43,60	2,739.3
Region 12	Lean Clay (U)	56,46,45,44,58	1,554.7
Region 13	Bulkhead	57,56,58,60,62,63,61,59	141.61
Region 14	Fat Clay 2 (U)	61,63,13,18,35	12,974

Current Slip Surface

Slip Surface: 11,628
 F of S: 1.72
 Volume: 27,283.039 ft³
 Weight: 3,388,956.9 lbs
 Resisting Moment: 2.0876853e+008 lbs-ft
 Activating Moment: 1.213929e+008 lbs-ft
 Resisting Force: 731,404.33 lbs
 Activating Force: 428,218.63 lbs
 F of S Rank (Analysis): 1 of 19,456 slip surfaces
 F of S Rank (Query): 1 of 19,456 slip surfaces
 Exit: (284.0019, -50.5) ft
 Entry: (661.19811, 32.873819) ft
 Radius: 257.58916 ft
 Center: (435.81753, 157.59659) ft

Slip Slices

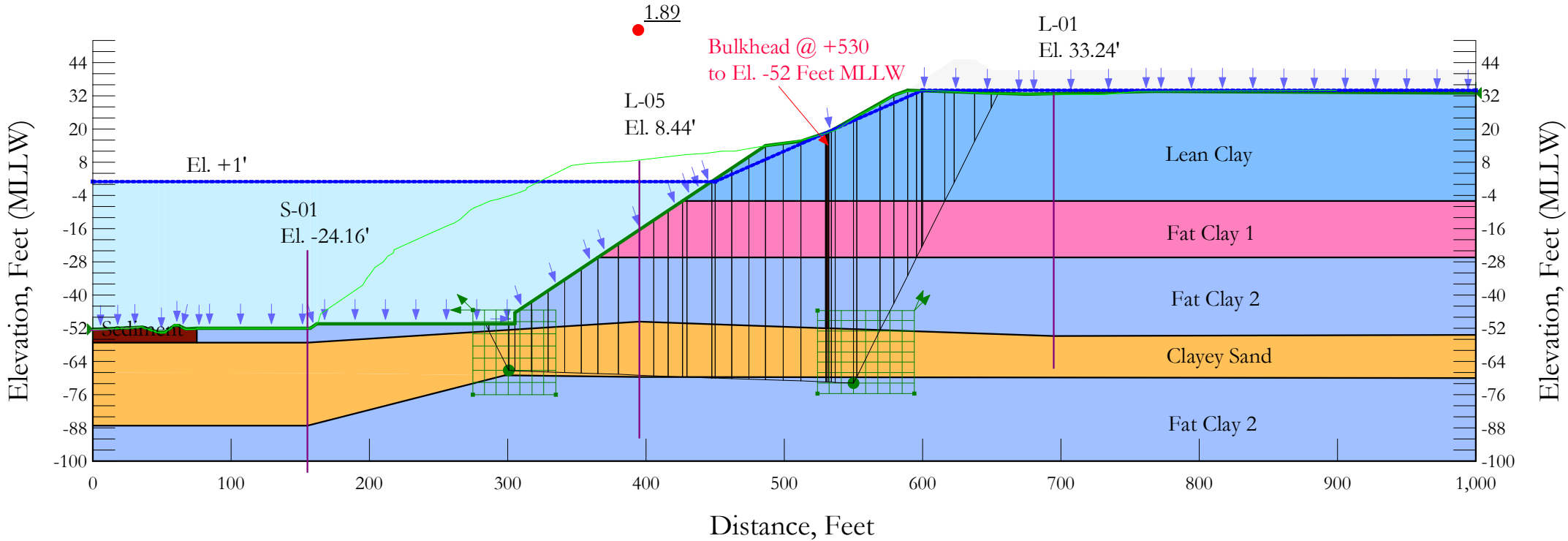
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress	Frictional Strength	Cohesive Strength
--	--------	--------	-----------	--------------------	---------------------	-------------------

				(psf)	(psf)	(psf)
Slice 1	285.72151	-51.733016	3,290.5402	4,302.6216	0	2,200
Slice 2	296.22056	-58.633977	3,721.1602	4,453.4033	422.76074	0
Slice 3	309.2371	-66.69318	4,224.0544	6,179.9548	1,129.2396	0
Slice 4	319.92993	-72.338135	4,576.2996	7,494.5056	0	2,200
Slice 5	332.84138	-78.408659	4,955.1003	8,586.182	0	2,200
Slice 6	345.75283	-83.635745	5,281.2705	9,547.7616	0	2,200
Slice 7	358.66428	-88.073442	5,558.1828	10,376.726	0	2,200
Slice 8	372.59	-91.99322	5,802.7769	11,117.322	0	2,200
Slice 9	387.53	-95.311803	6,009.8565	11,747.013	0	2,200
Slice 10	402.83	-97.74958	6,161.9738	12,216.678	0	2,200
Slice 11	418.49	-99.289269	6,258.0504	12,526.91	0	2,200
Slice 12	431.615	-99.903836	6,296.3994	12,669.123	0	2,200
Slice 13	442.205	-99.858884	6,293.5944	12,698.456	0	2,200
Slice 14	448.75	-99.664678	6,281.4759	12,717.601	0	2,200
Slice 15	456.08333	-99.121611	6,038.8216	12,821.939	0	2,200
Slice 16	468.25	-97.869076	6,123.5849	12,945.313	0	2,200
Slice 17	480.41667	-96.02703	6,173.2609	12,992.751	0	2,200
Slice 18	492.875	-93.508729	6,186.5058	12,760.451	0	2,200
Slice 19	505.625	-90.264718	6,160.3762	12,253.038	0	2,200
Slice 20	521	-85.313189	6,066.9888	11,647.506	0	2,200
Slice 21	530.38739	-82.004211	5,992.9615	12,987.554	0	2,200
Slice 22	531.38739	-81.60655	6,271.9348	12,951.938	0	2,200
Slice 23	533	-80.954403	6,253.3788	11,202.088	0	2,200
Slice 24	535.35	-79.981439	6,224.9266	11,119.382	0	2,200
Slice 25	541.7812	-77.121952	5,851.5664	10,913.892	0	2,200
Slice 26	551.94361	-72.260974	5,695.3135	10,568.975	0	2,200
Slice 27	562.51861	-66.589022	5,496.1947	10,057.201	2,633.298	0
Slice 28	573.5062	-60.007956	5,248.3686	9,606.4377	2,516.1324	0
Slice 29	581.65393	-54.708737	5,039.6513	9,211.932	2,408.8674	0
Slice 30	586.65393	-51.190809	4,895.738	8,944.6507	0	2,200
Slice 31	594.02625	-45.582136	4,658.4487	8,277.3989	0	2,200
Slice	599.52625	-41.278378	4,690.8672	7,734.2741	0	2,200

32						
Slice 33	608.01335	-33.6742	4,222.8701	6,779.3387	0	2,200
Slice 34	619.31335	-23.12286	3,564.4664	6,085.6863	0	1,000
Slice 35	628.66817	-12.92286	2,927.9864	4,869.0966	0	1,000
Slice 36	636.16817	-4.2879502	2,389.1681	4,164.4967	0	500
Slice 37	643.6	5.6911445	1,766.4726	2,970.0985	0	500
Slice 38	655.39905	23.386004	662.31335	772.80516	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1710448
Loading Condition: Short Term
Slip Surface: Block

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Orange	Clayey Sand	120	0	30	
Light Blue	Lean Clay (U)	125			500
Pink	Fat Clay1 (U)	125			1,000
Blue	Fat Clay 2 (U)	125			2,200
Dark Brown	Sediment (U)	90			50
Red-Orange	Bulkhead	150			



Short Term 64+00 Block

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 161

Date: 4/26/2018

Time: 5:28:50 PM

Tool Version: 8.16.1.13452

File Name: 64+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\Rec\

Last Solved Date: 4/26/2018

Last Solved Time: 5:30:00 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Short Term 64+00 Block

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Block

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Lean Clay (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 500 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay1 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 1,000 psf

Pore Water Pressure

Piezometric Line: 1

Fat Clay 2 (U)

Model: Undrained (Phi=0)

Unit Weight: 125 pcf

Cohesion: 2,200 psf

Pore Water Pressure

Piezometric Line: 1

Sediment (U)

Model: [Undrained \(Phi=0\)](#)

Unit Weight: [90 pcf](#)

Cohesion: [50 psf](#)

Pore Water Pressure

Piezometric Line: 1

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: 1

Slip Surface Limits

Left Coordinate: [\(0, -52.4\) ft](#)

Right Coordinate: [\(1,000, 33\) ft](#)

Slip Surface Block

Left Grid

Upper Left: [\(274.9243, -45.46814\) ft](#)

Lower Left: [\(274.9243, -75.96312\) ft](#)

Lower Right: [\(334.9245, -75.96312\) ft](#)

X Increments: 7

Y Increments: 7

Starting Angle: [135 °](#)

Ending Angle: [180 °](#)

Angle Increments: 2

Right Grid

Upper Left: [\(523.9153, -45.59091\) ft](#)

Lower Left: [\(523.9153, -75.50747\) ft](#)

Lower Right: [\(593.8581, -75.50747\) ft](#)

X Increments: 8

Y Increments: 8

Starting Angle: [45 °](#)

Ending Angle: [65 °](#)

Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	450	1
Coordinate 3	600	34
Coordinate 4	1,000	34

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16
Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	675	32.67
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52

Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5
Point 55	36	-51.6
Point 56	530	18.64324
Point 57	532	18.97162
Point 58	530	-6.06
Point 59	532	-6.06
Point 60	530	-26.46
Point 61	532	-26.46
Point 62	530	-52
Point 63	532	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,63,62,6,1	15,325
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2 (U)	22,24,25,21,7,23,3	26,362
Region 4		17,26,27,29,28	596.48
Region 5		29,30,31,28	678.15
Region 6		30,32,16,31	1,992.6
Region 7	Lean Clay (U)	33,16,31,28,17,47,34,57,59	18,035
Region 8	Fat Clay1 (U)	61,35,33,59	9,547.2
Region 9	Fat Clay 2 (U)	36,49,38,37,39,1,6,62,60,43,42,41	5,940.7
Region 10	Sediment (U)	37,50,51,52,53,54,55,40,19,39	383
Region 11	Fat Clay1 (U)	58,44,43,60	2,739.3
Region 12	Lean Clay (U)	56,46,45,44,58	1,554.7
Region 13	Bulkhead	57,56,58,60,62,63,61,59	141.61
Region 14	Fat Clay 2 (U)	61,63,13,18,35	12,974

Current Slip Surface

Slip Surface: 13,888
 F of S: 1.89
 Volume: 20,802.16 ft³
 Weight: 2,579,893.1 lbs
 Resisting Moment: 93,548,999 lbs-ft
 Activating Moment: 49,730,421 lbs-ft
 Resisting Force: 632,043.17 lbs
 Activating Force: 335,821.83 lbs
 F of S Rank (Analysis): 1 of 46,656 slip surfaces
 F of S Rank (Query): 1 of 46,656 slip surfaces
 Exit: (283.8884, -50.5) ft
 Entry: (654.87889, 32.967137) ft
 Radius: 175.42348 ft
 Center: (455.29953, 53.833922) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress	Frictional Strength	Cohesive Strength
--	--------	--------	-----------	--------------------	---------------------	-------------------

				(psf)	(psf)	(psf)
Slice 1	285.1381	-51.749693	3,291.5809	4,560.2299	0	2,200
Slice 2	293.51323	-60.124828	3,814.1892	4,842.5768	593.73987	0
Slice 3	302.81934	-67.289752	4,261.2806	5,385.1031	648.83922	0
Slice 4	311.012	-67.438092	4,270.5369	5,891.0789	935.62036	0
Slice 5	323.036	-67.655803	4,284.1221	6,184.0455	1,096.9213	0
Slice 6	335.06	-67.873514	4,297.7073	6,505.3127	1,274.5616	0
Slice 7	347.084	-68.091225	4,311.2924	6,821.6026	1,449.3283	0
Slice 8	359.108	-68.308935	4,324.8776	7,131.7859	1,620.5692	0
Slice 9	372.59	-68.553045	4,340.11	7,470.8238	1,807.5184	0
Slice 10	387.53	-68.823555	4,356.9898	7,834.5722	2,007.7831	0
Slice 11	400.22	-69.053324	4,371.3274	8,134.1178	2,172.4481	0
Slice 12	410.66	-69.242355	4,383.1229	8,373.7249	2,303.9751	0
Slice 13	421.1	-69.431385	4,394.9184	8,605.6414	2,431.0621	0
Slice 14	428.05565	-69.557327	4,402.7772	8,756.0966	2,513.3901	0
Slice 15	438.64565	-69.749073	4,414.7422	8,934.3331	0	2,200
Slice 16	448.75	-69.932026	4,426.1584	9,155.4507	0	2,200
Slice 17	456.08333	-70.064806	4,309.3818	9,452.9657	0	2,200
Slice 18	468.25	-70.2851	4,481.8068	9,940.8195	0	2,200
Slice 19	480.41667	-70.505394	4,654.2318	10,421.184	0	2,200
Slice 20	492.875	-70.730969	4,830.7902	10,692.305	0	2,200
Slice 21	505.625	-70.961826	5,011.4822	10,754.546	0	2,200
Slice 22	521	-71.240211	5,229.3754	10,932.362	0	2,200
Slice 23	530.38739	-71.410182	5,362.4126	12,858.311	0	2,200
Slice 24	531.38739	-71.428289	5,636.8112	12,880.667	0	2,200
Slice 25	533	-71.457487	5,660.7712	11,135.822	0	2,200
Slice 26	535.35	-71.500037	5,695.6871	11,192.31	0	2,200
Slice 27	543.42192	-71.64619	5,547.137	11,439.512	0	2,200
Slice 28	551.18283	-70.728918	5,594.1648	9,125.0803	0	2,200
Slice 29	560.75116	-61.160594	5,149.9551	8,591.9351	1,987.2281	0
Slice 30	574.14025	-47.771501	4,528.3661	7,619.2256	0	2,200
Slice 31	584	-37.91175	4,070.6269	6,868.6667	0	2,200
Slice	592.22587	-29.685875	3,688.7404	6,110.7945	0	2,200

32						
Slice 33	597.25213	-24.659624	3,455.3965	6,118.517	0	1,000
Slice 34	599.52625	-22.385499	3,511.9515	5,886.0185	0	1,000
Slice 35	607.92588	-13.985875	2,994.3186	4,999.597	0	1,000
Slice 36	619.22587	-2.685875	2,289.1986	4,010.4346	0	500
Slice 37	630.1	8.18825	1,610.6532	2,786.1738	0	500
Slice 38	643.6	21.68825	768.2532	1,196.4692	0	500
Slice 39	652.23944	30.327694	229.15191	132.06112	0	500

Project Name: HSC-ECIP Preliminary Slope Evaluation

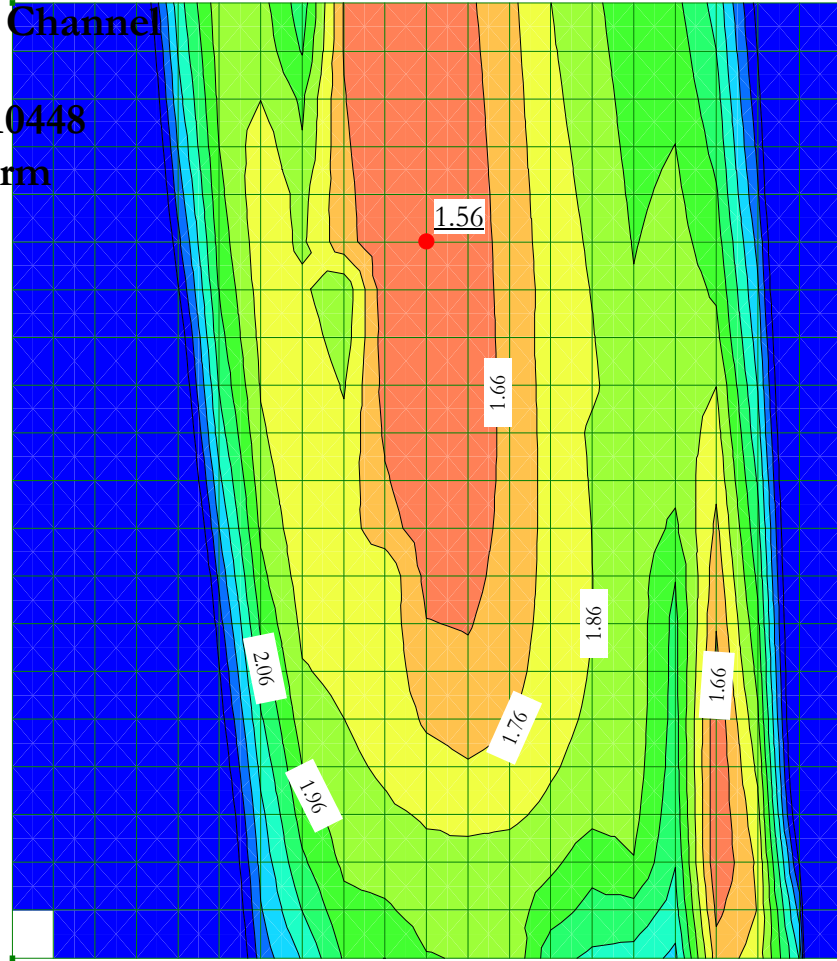
Location: Barbours Cut Ship Channel

Station Analyzed: 64+00

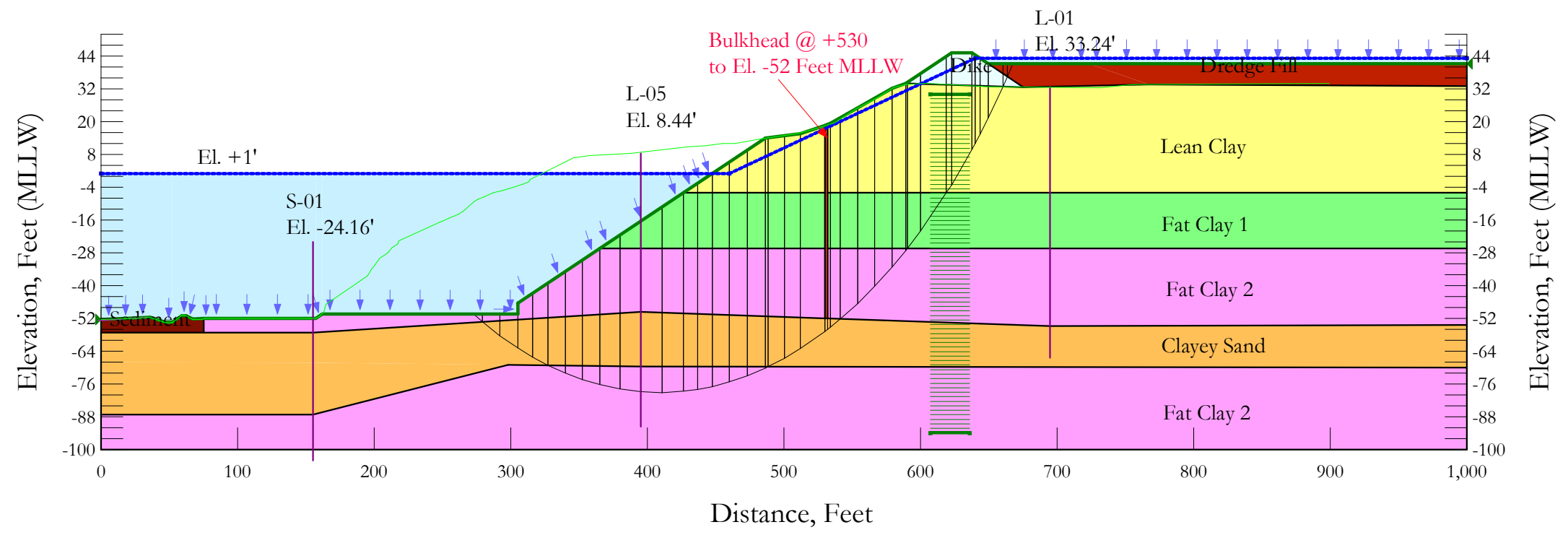
HVJ Project Number: HG1710448

Loading Condition: Long Term

Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	Lean Clay	125	100	25
Light Green	Fat Clay 1	125	400	18
Orange	Clayey Sand	120	0	30
Dark Red	Dredge Fill	90	16	15
Light Blue	Dike	125	100	25
Pink	Fat Clay 2	125	300	22
Dark Brown	Sediment	90	16	15
Red	Bulkhead	150		



Long Term 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 161

Date: 4/26/2018

Time: 5:28:50 PM

Tool Version: 8.16.1.13452

File Name: 64+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\Rec\

Last Solved Date: 4/26/2018

Last Solved Time: 5:29:04 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

Long Term 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: No

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 400 psf

Phi': 18 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dike

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fat Clay 2

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 300 psf
Phi': 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sediment

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 16 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Bulkhead

Model: High Strength
Unit Weight: 150 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (189.9206, 322.48791) ft
Lower Left: (189.9206, 70.01732) ft
Lower Right: (627.8489, 70.01732) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (607, 30) ft
Upper Right Coordinate: (636, 30) ft

Lower Left Coordinate: (607, -94) ft
 Lower Right Coordinate: (636, -94) ft
 Number of Increments: 75
 Left Projection: No
 Left Projection Angle: 135 °
 Right Projection: No
 Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, -52.4) ft
 Right Coordinate: (1,000, 41.14) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	1
Coordinate 2	460	1
Coordinate 3	640	43.14
Coordinate 4	1,000	43.14

Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16
Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417

Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	675	32.67
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2
Point 48	395	8.7
Point 49	157	-52
Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5
Point 55	36	-51.6
Point 56	530	18.64324
Point 57	532	18.97162
Point 58	530	-6.06
Point 59	532	-6.06
Point 60	530	-26.46
Point 61	532	-26.46
Point 62	530	-52
Point 63	532	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,63,62,6,1	15,325
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2	22,24,25,21,7,23,3	26,362
Region 4	Dike	17,26,27,29,28	596.48
Region 5	Dredge Fill	29,30,31,28	678.15
Region 6	Dredge Fill	30,32,16,31	1,992.6
Region 7	Lean Clay	33,16,31,28,17,47,34,57,59	18,035
Region 8	Fat Clay 1	61,35,33,59	9,547.2

Region 9	Fat Clay 2	36,49,38,37,39,1,6,62,60,43,42,41	5,940.7
Region 10	Sediment	37,50,51,52,53,54,55,40,19,39	383
Region 11	Fat Clay 1	58,44,43,60	2,739.3
Region 12	Lean Clay	56,46,45,44,58	1,554.7
Region 13	Bulkhead	57,56,58,60,62,63,61,59	141.61
Region 14	Fat Clay 2	61,63,13,18,35	12,974

Current Slip Surface

Slip Surface: 24,767

F of S: 1.56

Volume: 21,385.487 ft³

Weight: 2,655,065 lbs

Resisting Moment: 2.3774872e+008 lbs-ft

Activating Moment: 1.5277225e+008 lbs-ft

Resisting Force: 659,527.2 lbs

Activating Force: 424,234.86 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (272.66405, -50.5) ft

Entry: (667.63407, 41.14) ft

Radius: 338.49026 ft

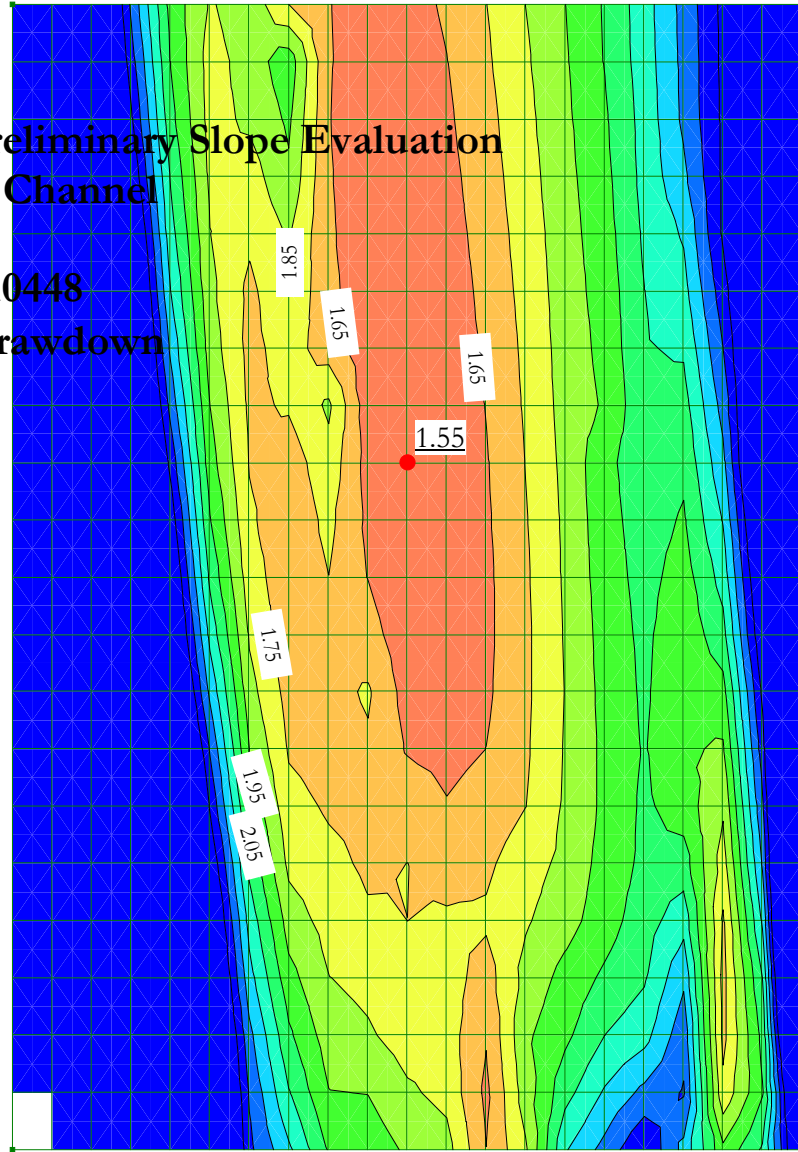
Center: (408.88475, 259.37026) ft

Slip Slices

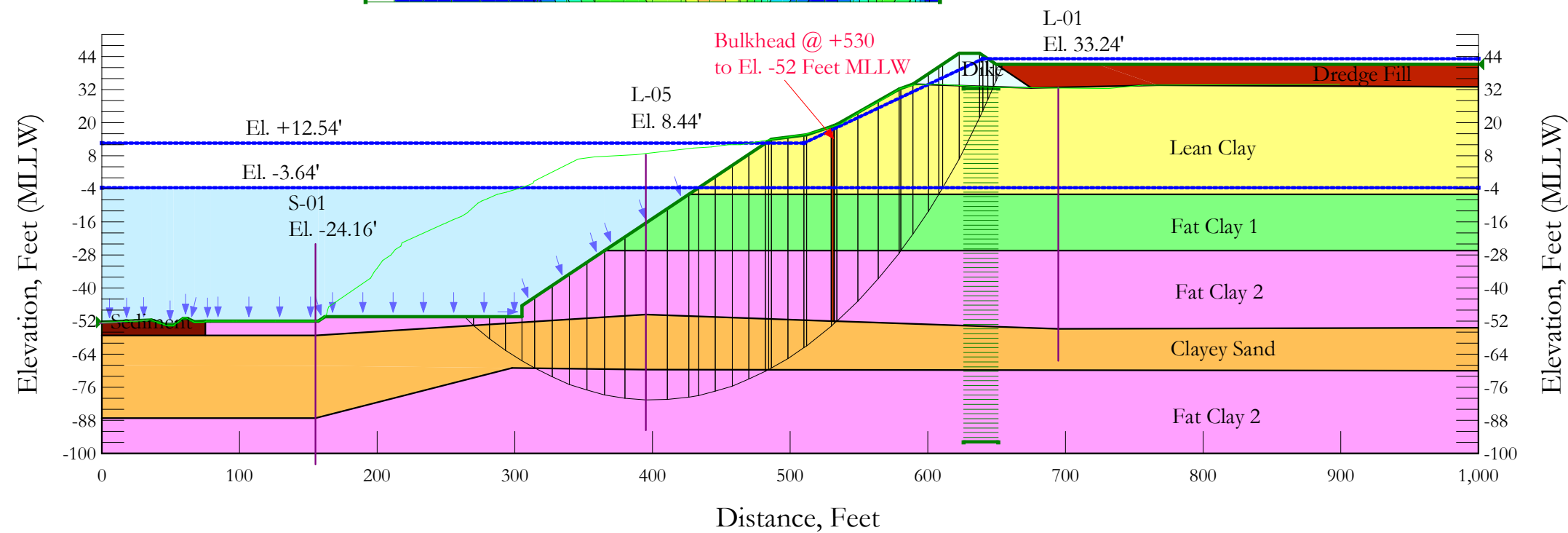
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	275.85957	-51.865794	3,298.8256	3,507.1496	84.168354	300
Slice 2	285.54132	-55.770245	3,542.4633	3,993.2159	260.24211	0
Slice 3	298.51377	-60.546643	3,840.5105	4,684.872	487.49233	0
Slice 4	310.59994	-64.483882	4,086.1943	5,850.537	1,018.6437	0
Slice 5	321.79983	-67.674524	4,285.2903	6,546.8759	1,305.727	0
Slice 6	333.68648	-70.598377	4,467.7387	7,230.2379	1,116.1221	300
Slice 7	346.25989	-73.214856	4,631.007	7,888.8083	1,316.2372	300
Slice 8	358.8333	-75.338721	4,763.5362	8,444.3841	1,487.1591	300
Slice 9	372.59	-77.084636	4,872.4813	8,930.27	1,639.453	300
Slice 10	387.53	-78.362781	4,952.2375	9,324.7176	1,766.5966	300
Slice 11	402.83	-78.975226	4,990.4541	9,587.9656	1,857.5152	300
Slice 12	418.49	-78.893006	4,985.3236	9,722.2445	1,913.8403	300
Slice 13	431.615	-78.314249	4,949.2092	9,742.5741	1,936.6451	300
Slice 14	442.205	-77.433994	4,894.2812	9,693.4147	1,938.9758	300
Slice 15	453.75	-76.074228	4,809.4318	9,719.1693	1,983.6627	300
Slice 16	466.625	-74.091152	4,533.9714	9,810.5735	2,131.8856	300
Slice 17	479.875	-71.522668	4,565.5314	9,831.7073	2,127.6732	300
Slice 18	487.47217	-69.869279	4,572.9376	9,792.0863	2,108.673	300

Slice 19	494.33326	-68.100605	4,563.3293	9,522.5526	2,863.2089	0
Slice 20	506.11109	-64.797747	4,531.0566	9,076.7455	2,624.4547	0
Slice 21	521	-59.870772	4,445.7917	8,563.3853	2,377.2937	0
Slice 22	531	-56.323218	4,374.4214	9,799.3404	3,132.0784	0
Slice 23	533	-55.542276	4,355.9216	8,187.5496	2,212.1914	0
Slice 24	537.63607	-53.652576	4,308.3384	8,073.9418	2,174.0721	0
Slice 25	547.56012	-49.332316	4,190.2047	7,881.8018	1,491.502	300
Slice 26	560.13607	-43.366071	4,011.4257	7,533.5102	1,423.0145	300
Slice 27	572.71202	-36.745663	3,793.948	7,135.5182	1,350.082	300
Slice 28	584	-30.243561	3,565.6312	6,676.5447	1,256.8906	300
Slice 29	589.60207	-26.840154	3,441.8791	6,409.5457	1,199.0151	300
Slice 30	595.10609	-23.229821	3,304.528	6,242.6785	954.66297	400
Slice 31	609.4731	-13.029821	2,900.0952	5,636.2143	889.01898	400
Slice 32	620.76908	-4.590297	2,557.2758	5,101.0498	1,186.1813	100
Slice 33	630.1	3.3600634	2,216.1792	4,338.6508	989.72474	100
Slice 34	638.8	10.951338	1,887.5874	3,523.7241	762.94305	100
Slice 35	641.8	13.76898	1,832.7517	3,154.1315	616.16953	100
Slice 36	646.6	18.435922	1,541.5345	2,553.7189	471.98932	100
Slice 37	655.02005	27.140426	998.37343	1,530.1899	247.9901	100
Slice 38	662.02912	34.67523	528.20168	661.23466	62.034298	100
Slice 39	665.62611	38.802723	270.64607	312.61827	11.246416	16

Project Name: HSC-ECIP Preliminary Slope Evaluation
Location: Barbours Cut Ship Channel
Station Analyzed: 64+00
HVJ Project Number: HG1710448
Loading Condition: Rapid Drawdown
Slip Surface: Circular



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
Yellow	Lean Clay	125	100	25	150	20	2
Light Green	Fat Clay 1	125	400	18	500	14	2
Orange	Clayey Sand	120	0	30	0	30	2
Dark Red	Dredge Fill	90	16	15	50	0	2
Light Blue	Dike	125	100	25	150	22	2
Pink	Fat Clay 2	125	300	22	500	15	2
Dark Brown	Sediment	90	16	15	50	0	2
Red	Bulkhead	150					2



RDD 64+00

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File Information

File Version: 8.16

Title: Barbours Cut Ship Channel Widening

Created By: Anil Raavi

Last Edited By: Anil Raavi

Revision Number: 161

Date: 4/26/2018

Time: 5:28:50 PM

Tool Version: 8.16.1.13452

File Name: 64+00 with Bulkhead.gsz

Directory: G:\HOUSTON\HOU PS\GEO\PROJECTS\2017\HG1710448 HSC-ECIP Preliminary Slope Evaluation – Barbours Cut and Bayport Channels, TCB&GBA\Slope Stability\BCC\64+00\Rec\

Last Solved Date: 4/26/2018

Last Solved Time: 5:29:36 PM

Project Settings

Length(L) Units: Feet

Time(t) Units: Seconds

Force(F) Units: Pounds

Pressure(p) Units: psf

Strength Units: psf

Unit Weight of Water: 62.4 pcf

View: 2D

Element Thickness: 1

Analysis Settings

RDD 64+00

Kind: SLOPE/W

Method: Morgenstern-Price

Settings

Side Function

Interslice force function option: Half-Sine

PWP Conditions Source: Piezometric Line

Apply Phreatic Correction: Yes

Use Staged Rapid Drawdown: Yes

Slip Surface

Direction of movement: Right to Left

Use Passive Mode: No

Slip Surface Option: Grid and Radius

Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No

Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Linear Search

Must Obtain Factor of Safety at Lambda: 0.2

Lambda

Lambda 1: -1

Lambda 2: -0.8

Lambda 3: -0.6

Lambda 4: -0.4

Lambda 5: -0.2

Lambda 6: 0

Lambda 7: 0.2

Lambda 8: 0.4

Lambda 9: 0.6

Lambda 10: 0.8

Lambda 11: 1

Materials

Lean Clay

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 20 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 1

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 400 psf

Phi': 18 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 14 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Clayey Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 30 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dredge Fill

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Dike

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 100 psf

Phi': 25 °

Phi-B: 0 °

Cohesion R: 150 psf

Phi R: 22 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Fat Clay 2

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion': 300 psf

Phi': 22 °

Phi-B: 0 °

Cohesion R: 500 psf

Phi R: 15 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Sediment

Model: Mohr-Coulomb

Unit Weight: 90 pcf

Cohesion': 16 psf

Phi': 15 °

Phi-B: 0 °

Cohesion R: 50 psf

Phi R: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Bulkhead

Model: [High Strength](#)

Unit Weight: [150 pcf](#)

Pore Water Pressure

Piezometric Line: [1](#)

Piezometric Line After Drawdown: [2](#)

Slip Surface Grid

Upper Left: [\(191.7483, 366.48988\) ft](#)

Lower Left: [\(191.7483, 63.70715\) ft](#)

Lower Right: [\(608.9357, 63.70715\) ft](#)

Grid Horizontal Increment: [20](#)

Grid Vertical Increment: [20](#)

Left Projection Angle: [0 °](#)

Right Projection Angle: [0 °](#)

Slip Surface Radius

Upper Left Coordinate: [\(625.9097, 32.48158\) ft](#)

Upper Right Coordinate: [\(651.0697, 32.48158\) ft](#)

Lower Left Coordinate: [\(625.9097, -96.0427\) ft](#)

Lower Right Coordinate: [\(651.0697, -96.0427\) ft](#)

Number of Increments: [75](#)

Left Projection: [No](#)

Left Projection Angle: [135 °](#)

Right Projection: [No](#)

Right Projection Angle: [45 °](#)

Slip Surface Limits

Left Coordinate: [\(0, -52.4\) ft](#)

Right Coordinate: [\(1,000, 41.14\) ft](#)

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	12.54
Coordinate 2	510	12.54
Coordinate 3	640	43.14
Coordinate 4	1,000	43.14

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	-3.64

Coordinate 2	1,000	-3.64
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Points

	X (ft)	Y (ft)
Point 1	155	-57.16
Point 2	155	-68.16
Point 3	155	-87.16
Point 4	155	-104.16
Point 5	395	-14.56
Point 6	395	-49.56
Point 7	395	-69.56
Point 8	395	-91.56
Point 9	695	29.24
Point 10	695	25.24
Point 11	695	5.24
Point 12	695	-4.76
Point 13	695	-54.76
Point 14	695	-64.76
Point 15	695	-66.76
Point 16	1,000	33
Point 17	589	33.94
Point 18	1,000	-54.46
Point 19	0	-57.26
Point 20	0	-68.06
Point 21	1,000	-70.06
Point 22	0	-87.26
Point 23	298	-68.99417
Point 24	0	-100
Point 25	1,000	-100
Point 26	622.6	45.14
Point 27	637.6	45.14
Point 28	675	32.67
Point 29	649.6	41.14
Point 30	723	41.14
Point 31	767	33.6
Point 32	1,000	41.14
Point 33	1,000	-6.06
Point 34	534	19.3
Point 35	1,000	-26.46
Point 36	162	-50.5
Point 37	75	-52.1
Point 38	78.6	-52
Point 39	75	-57.26
Point 40	0	-52.4
Point 41	305	-50.5
Point 42	305	-46.5
Point 43	365.12	-26.46
Point 44	426.32	-6.06
Point 45	486.5	14
Point 46	512	15.68783
Point 47	579	32.2

Point 48	395	8.7
Point 49	157	-52
Point 50	67	-52.2
Point 51	62	-51
Point 52	59	-51
Point 53	52	-53.5
Point 54	47	-53.5
Point 55	36	-51.6
Point 56	530	18.64324
Point 57	532	18.97162
Point 58	530	-6.06
Point 59	532	-6.06
Point 60	530	-26.46
Point 61	532	-26.46
Point 62	530	-52
Point 63	532	-52

Regions

	Material	Points	Area (ft ²)
Region 1	Clayey Sand	39,19,20,2,23,7,21,18,13,63,62,6,1	15,325
Region 2	Clayey Sand	20,22,3,23,2	4,319
Region 3	Fat Clay 2	22,24,25,21,7,23,3	26,362
Region 4	Dike	17,26,27,29,28	596.48
Region 5	Dredge Fill	29,30,31,28	678.15
Region 6	Dredge Fill	30,32,16,31	1,992.6
Region 7	Lean Clay	33,16,31,28,17,47,34,57,59	18,035
Region 8	Fat Clay 1	61,35,33,59	9,547.2
Region 9	Fat Clay 2	36,49,38,37,39,1,6,62,60,43,42,41	5,940.7
Region 10	Sediment	37,50,51,52,53,54,55,40,19,39	383
Region 11	Fat Clay 1	58,44,43,60	2,739.3
Region 12	Lean Clay	56,46,45,44,58	1,554.7
Region 13	Bulkhead	57,56,58,60,62,63,61,59	141.61
Region 14	Fat Clay 2	61,63,13,18,35	12,974

Current Slip Surface

Slip Surface: 19,979

F of S: 1.55

Volume: 20,683.923 ft³

Weight: 2,568,434.2 lbs

Resisting Moment: 2.3143757e+008 lbs-ft

Activating Moment: 1.4895596e+008 lbs-ft

Resisting Force: 660,892.95 lbs

Activating Force: 425,516.19 lbs

F of S Rank (Analysis): 1 of 33,516 slip surfaces

F of S Rank (Query): 1 of 33,516 slip surfaces

Exit: (263.48188, -50.5) ft

Entry: (654.43077, 41.14) ft

Radius: 325.99657 ft

Center: (400.342, 245.37679) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	266.83679	-52.006131	3,018.0466	3,244.2796	91.40406	300
Slice 2	275.99308	-55.906672	3,261.4403	3,728.9044	269.89055	0
Slice 3	287.59585	-60.439891	3,544.3132	4,389.8274	488.15785	0
Slice 4	299.19862	-64.472434	3,795.9439	4,977.8806	682.39149	0
Slice 5	309.70451	-67.728028	3,999.0929	6,062.4146	1,191.2594	0
Slice 6	320.7479	-70.686206	4,183.6832	6,659.179	1,000.1652	300
Slice 7	333.42564	-73.612268	4,366.2695	7,378.5135	1,217.0256	300
Slice 8	346.10339	-76.011783	4,515.9993	7,988.2885	1,402.8959	300
Slice 9	358.78113	-77.896494	4,633.6052	8,487.4651	1,557.0605	300
Slice 10	372.59	-79.349842	4,724.2942	8,903.184	1,688.3811	300
Slice 11	387.53	-80.282132	4,782.469	9,216.1562	1,791.3259	300
Slice 12	402.83	-80.516237	4,797.0772	9,395.1491	1,857.7416	300
Slice 13	418.49	-80.019765	4,766.0974	9,445.0466	1,890.4182	300
Slice 14	429.95	-79.251994	4,718.1884	9,412.226	1,896.5143	300
Slice 15	439.6475	-78.18385	4,651.5362	9,453.4274	0	2,154.7956
Slice 16	451.7825	-76.47704	4,545.0313	9,554.317	0	2,143.3286
Slice 17	463.9175	-74.30063	4,409.2233	9,594.7564	0	2,121.7478
Slice 18	476.0525	-71.644934	4,243.5079	9,579.985	0	2,091.9748
Slice 19	483.18966	-69.914837	4,135.5498	9,553.9167	0	2,080.4291
Slice 20	485.37966	-69.331039	4,099.1208	9,497.0539	3,116.4981	0
Slice 21	492.375	-67.299063	3,972.3255	9,245.5026	3,044.4702	0
Slice 22	504.125	-63.596424	3,741.2808	8,748.1073	2,890.6926	0
Slice 23	511	-61.262158	3,595.6227	8,448.1502	2,801.608	0
Slice 24	521	-57.313719	3,349.2401	8,062.2632	2,721.0651	0
Slice 25	531	-53.288681	3,098.0777	9,198.7315	3,522.2141	0
Slice 26	532.92102	-52.441199	3,045.1948	7,613.046	2,637.2501	0
Slice 27	533.92102	-51.995713	3,017.3965	7,711.0964	0	1,802.614
Slice 28	541.5	-48.35599	2,790.2778	7,488.0559	0	1,763.8869
Slice 29	556.5	-40.657179	2,309.8719	7,017.6561	0	1,685.8993
Slice 30	571.5	-31.933557	1,765.518	6,467.2661	0	1,598.764
Slice						

31	579.64117	-26.882251	1,450.3164	6,138.8101	0	1,546.752
Slice 32	584.64117	-23.471969	1,237.5149	5,880.7103	0	1,415.0303
Slice 33	594.60582	-16.322644	791.39699	5,375.6657	0	1,344.5293
Slice 34	604.02328	-9.1106751	341.37013	4,924.079	0	1,294.2979
Slice 35	609.28399	-4.85	75.504	4,646.8079	0	1,266.674
Slice 36	616.66654	1.6258387	-328.58834	4,217.1193	0	1,192.4957
Slice 37	630.1	14.350504	-1,122.6075	3,102.517	0	922.96658
Slice 38	638.8	23.096669	-1,668.3681	2,175.4212	0	663.54743
Slice 39	641.8	26.368518	-1,872.5315	1,755.3675	0	519.03764
Slice 40	645.66492	30.71287	-2,143.6191	1,162.4605	0	384.91401
Slice 41	648.66492	34.172124	-2,359.4766	612.0183	285.38882	100
Slice 42	651.50275	37.571269	-2,571.5832	252.95602	117.95533	100
Slice 43	653.91814	40.5055	-2,754.6792	43.239655	0	17.315825