NTH Consultants, Ltd.

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Ms. Emily McKinnon, P.E.
Principal, Director of Operations
SmithGroup
201 Depot Street, Second Floor
Ann Arbor, Michigan 48104

March 12, 2021
NTH Project No. 61-190115

RE: Geotechnical Exploration Report
Sugar Island Habitat Restoration Project
Grosse Ile Township, Michigan

Dear Ms. McKinnon:

In accordance with the scope of services presented and agreed upon in our proposal dated March 13, 2019, NTH Consultants, Ltd. (NTH) has completed the geotechnical exploration for the Sugar Island Habitat Restoration Project in Grosse Ile Township, Michigan. The purpose of this investigation was to explore and evaluate the general subsurface conditions at the site, and to provide geotechnical recommendations for the SmithGroup's proposed design for the barrier islands and flow deflector peninsula. The details of our exploration as well as our evaluations and recommendations are presented herein.

We appreciate this opportunity to be of service to you and trust that the information provided in the attached report satisfies your needs. If you have any questions, or if we may be of further assistance, please contact us.

Sincerely,

NTH Consultants, Ltd.

Deep Bansal
Project Engineer

Jason R. Edberg
Senior Vice President

DB/JRE/mlk

Attachments

TABLE OF CONTENTS

APPENDIX A

APPENDIX B

APPENDIX C

1.0 INTRODUCTION

This report presents the results of a geotechnical exploration performed by NTH Consultants, Ltd. (NTH) for the proposed Sugar Island Habitat restoration project in Grosse Ile Township, Michigan. The purpose of this investigation was to explore and evaluate the general subsurface conditions at the site and to provide geotechnical recommendations for the proposed barrier islands, along the southern portion of Sugar Island, and flow deflector peninsula, along the southwest portion of Sugar Island, located within the Detroit River in Grosse Ile Township, Michigan.

Our exploration was conducted on the basis of information provided to NTH regarding the proposed Sugar Island Habitat restoration project. The data obtained during our geotechnical exploration, along with our evaluations, recommendations, and analyses, are provided in the following sections of this report.

2.0 PROJECT BACKGROUND

Sugar Island is a small island in the Detroit River between Grosse Ile and Boblo Island and is part of Grosse Ile Township, Wayne County, Michigan. It lies about 0.5 miles (0.80 km) west of the border with Canada as shown on the Exploration Location Plan, Figure No. 1 in the Appendix. Currently, the island is uninhabited and entirely owned by the U.S. Fish and Wildlife Service (USFWS) as part of the Detroit River International Wildlife Refuge. Most of the island is wooded, a resting point for many species of migratory birds, and it is known for its white sandy beaches and easy access by boat.

We understand that SmithGroup has been contracted by Friends of the Detroit River to design the site improvements. NTH was retained by SmithGroup to provide the geotechnical design services for the project.

2.1 PROPOSED DEVELOPMENT

Based on the preliminary information provided by SmithGroup, the proposed design consists of five new barrier islands, three flow deflector peninsulas (Stone Revetment), shoreline stabilization and an expanded beach on the island's east side. This geotechnical report focuses on the barrier islands and flow deflector peninsulas planned for the project.

The proposed barrier islands are located around the southern edge of Sugar Island. Based on the information provided, two types of barrier islands (Type A and B) are planned for the site. Both types of barrier island include a stone core, a stone under layer, a stone armor layer, and a "strip" of planting soil at the crest. The design drawings (Appendix B) present a plan view and cross-sections of the islands.

The proposed flow deflector peninsulas are located along the southwest edge of Sugar Island. Similar to the barrier islands, the flow deflector peninsulas will consist of a stone core, a stone under layer and stone armor layer. They will extend offshore to a maximum distance of 210 feet as shown in the plan view (Appendix B).

3.0 CURRENT GEOTECHNICAL STUDY

3.1 FIELD EXPLORATION

Field work for the geotechnical exploration was conducted between October 02 and October 05, 2020. Prior to the start of drilling activities, a special use permit was obtained from USFWS to perform soil borings in the Detroit River.

The geotechnical exploration consisted of drilling five test borings, designated as TB-1 through TB-5. The approximate boring locations are presented on the Exploration Location Plan, Figure No. 1 of Appendix A. Test boring locations were selected by SmithGroup and the borings were located in the field by NTH using a handheld GPS. As such, locations shown on the exploration location plan are approximate.

Test borings were drilled by 7NT Engineering Company under the direct observation of an NTH geologist. The borings were drilled using a CME-750X all-terrain drill rig (ATV) atop a barge. The depth of test borings ranged between 20 to 31.5 feet below the surface of the river. The boreholes were advanced using 4-inch diameter casing. Upon completion, the test borings were backfilled with soil cuttings and/or bentonite grout.

Within each test boring, soil samples were typically obtained continuously (every 1.5-foot intervals) within the upper 15 feet and at 5-foot intervals thereafter to the termination depth. The soil samples were obtained using the Standard Penetration Test (SPT) Method (ASTM D 1586), described in the attached General Notes, Figure No. 2 of the Appendix A. In addition to the split-spoon samples, one undisturbed Shelby tube sample was collected in TB-4.

The soil samples obtained with the split-spoon sampler were sealed in jars and the ends of the Shelby tube were sealed with wax to preserve the in-situ moisture content prior to transportation to our laboratory for further classification and testing.

3.2 PRESENTATION OF DATA

NTH has evaluated the soil and groundwater conditions encountered in the test borings and has presented these conditions in the form of individual Logs of Test Boring (see Figure No. 3 of the Appendix A). In addition to subsoil stratification, the test boring logs present Standard Penetration Test (SPT) results, drilling and sampling information, and other pertinent data. We have prepared the test boring logs based on field and laboratory classification and testing. General notes defining the nomenclature used on the logs and elsewhere in this report are presented in Figure No. 2 of Appendix A.

The stratification shown on the Logs of Test Boring represents the subsurface conditions at the actual boring locations. Variations may occur between and away from the borings. Additionally, the stratigraphic lines represent the approximate boundary between soil types; however, the transition may be more gradual than what is shown.

3.3 LABORATORY TESTING

Representative soil samples obtained during the field exploration were subjected to laboratory testing to measure in-situ dry density, moisture content, Atterberg limits, and unconfined compressive strength on representative cohesive soils. The results of the laboratory tests are presented on the attached Tabulation of Laboratory Test Data, Figure No. 4 of Appendix A. In addition to their presentation on the Tabulation of Laboratory Test Data, in-situ dry density, moisture content, and unconfined compressive strength values are also presented on the individual Logs of Test Boring.

In addition to the laboratory testing, field pocket penetrometer measurements were taken on selected cohesive soil samples recovered from the test borings as an aid in evaluating the consistency of the soils. The pocket penetrometer values are also presented on the boring logs.

4.0 SUBSURFACE CONDITIONS

On the basis of information obtained during the field investigation, it appears that subsurface conditions within the area are relatively uniform. At the test boring locations, the depth of the river ranges between 5 and 9 feet. The subsurface soil conditions generally consist of very soft to hard silty clay deposits underlain by shale bedrock.

Test Borings TB-1, TB-2, TB-4, and TB-5 were located south of Sugar Island within the general vicinity of the proposed barrier islands and TB-3 was located west of Sugar Island near the flow deflector peninsulas. Two design soil profiles (DSPs) were developed on the basis of the field testing as well as the laboratory testing from the subsurface soils from the test borings completed within the vicinity of the proposed barrier islands and flow deflector peninsulas, respectively. They are included herewith as Figure No. 5A and Figure No. 5B in Appendix A and are summarized in the following sections.

4.1 DESIGN SOIL PROFILE

BARRIER ISLANDS

Review of the subsurface conditions near the barrier islands indicates that stiff to very stiff gray silty clay was encountered at the riverbed 5 to 7 feet below the water's surface at an approximate elevation of 568 feet. Stiff to very stiff clay extended downward to an elevation of 552 feet. Below 552 feet, the consistency of the clay was found to be medium. It extended to the top of the weathered shale bedrock which was encountered at a depth of 25.5 feet and an elevation of approximately 548.5 feet, the engineering properties of these layers are presented in Table 1 and in the DSP (Figure 5A).

FLOW DEFLECTOR PENINSULA (TB-3)

Review of the subsurface conditions near the flow deflector peninsula indicates that very soft gray silty clay was encountered at the riverbed 9 feet below the water's surface at an approximate elevation of 565 feet. The very soft clay extended downward to an elevation of 560.5 feet. Below

560.5 feet, the consistency of the clay was found to be medium. It extended to the top of the weathered shale bedrock which was encountered at a depth of 23.6 feet and an elevation of approximately 550.4 feet. The engineering properties of these layers are presented in Table 2 and in the DSP (Figure 5B).

4.2 SUBSOIL ENGINEERING PROPERTIES

Conditions encountered in the test borings completed for this study were used to model the subsoil profile and material engineering properties. Table 1 shows the materials and their properties used in the stability and settlement analysis model for the site.

Table 1: Material Properties (Barrier Islands)

Material Name	Total Unit Weight, γ (pounds per cubic foot)	Effective Stress (Drained)		Total Stress (Undrained)		Coefficient of Compressibility	
		Effective Cohesion, c' (psf)	Effective Angle of Friction, φ' (degrees)	Cohesion, c (psf)	Angle of Friction, φ (degrees)	Cc	Cr
Stiff to Very Stiff Gray SILTY CLAY	142	0	28	2,250	0	0.13	0.013
Medium Gray SILTY CLAY	127	0	28	580	0	0.27	0.027
Weathered SHALE	140	0	38	N/A	N/A	N/A	
Rock (Shale)	150	Infinite	N/A	Infinite	N/A	N/A	

Table 2: Material Properties (Flow Deflector Peninsulas)

Material Name	Total Unit Weight, γ (pounds per cubic foot)	Effective Stress (Drained)		Total Stress (Undrained)		Coefficient of Compressibility	
		Effective Cohesion, c' (psf)	Effective Angle of Friction, φ' (degrees)	Cohesion, c (psf)	Angle of Friction, φ (degrees)	Cc	Cr
Very Soft SILTY CLAY	100	0	28	150	0	0.34	0.034
Medium Gray SILTY CLAY	127	0	28	580	0	0.27	0.027
Weathered SHALE	140	0	38	N/A	N/A	N/A	
Rock (Shale)	150	Infinite	N/A	Infinite	N/A	N/A	

5.0 SLOPE STABILITY EVALUATION

The global slope stability of the barrier islands and the flow deflector peninsula was evaluated for short- and long-term conditions. Slope stability of the temporary construction conditions, shoreline stabilization, and wetland shelf have not been analyzed as part of this study and, therefore, are not addressed in this report.

5.1 ANALYSIS APPROACH

The computer software Slide2 (Rocscience Inc., 2020) was used to model the global stability of representative sections of the proposed design using two-dimensional limit-equilibrium methods. This method compares the ratio of forces and moments driving slope movement to forces and moments resisting slope movement for each trial failure surface and calculates a Factor of Safety (FS) against slope failure. The software presents the trial failure surface(s) with the lowest FS as the "critical" shear surface. An FS less than one represents a slope failure and FS = 1 represents a condition of incipient failure.

The failure surfaces identified by the software were analyzed in the program using the Spencer limit equilibrium method. The failure surfaces were also evaluated using the General Limit Equilibrium (GLE)/Morgenstern-Price method as a "check." Both methods satisfy force and moment equilibrium when computing inter-slice forces.

Material properties were modeled using the Mohr-Coulomb material strength model. Granular materials were assumed to behave in a drained manner and were modelled using effective stress strength parameters for short- and long-term conditions.

The analysis was performed for both low- and high-water conditions. The low water datum (LWD) level is at 569.67 ft above mean sea level and the 100-yr floodplain water level is at 577.00 ft as per the Design Drawings (Appendix B). The analysis only considered failure surfaces with a minimum depth of 3 ft, or greater, to exclude shallow, surficial sloughing failures from the results.

5.2 SLOPE STABILITY ANALYSIS RESULTS

Table 3 summarizes the results of the slope stability analyses. The table presents the calculated and required minimum factors of safety associated with each condition. The cross-section geometry, the soil and groundwater conditions, and the critical failure surfaces for the cases analyzed are depicted graphically in the output files from the Slide2 software (Appendix C).

Table 3: Slope Stability Analysis Results

Cross-Section	Water Level	Analysis Condition	Minimum Calculated FS	Minimum Required FS
Type A Barrier Island	LWD	Immediately after Construction (Short-Term; Total Stress)	1.9	1.3
		Long-Term (Effective Stress)	1.6	1.5
	100-yr Floodplain	Immediately after Construction (Short-Term; Total Stress)	1.7	1.3
		Long-Term (Effective Stress)	1.7	1.5
Type B Barrier Island	LWD	Immediately after Construction (Short-Term; Total Stress)	1.9	1.3
		Long-Term (Effective Stress)	1.6	1.5
	100-yr Floodplain	Immediately after Construction (Short-Term; Total Stress)	1.7	1.3
		Long-Term (Effective Stress)	1.7	1.5
Flow Deflector Peninsula - Revised Design	LWD	Immediately after Construction (Short-Term; Total Stress)	1.5	1.3
		Long-Term (Effective Stress)	1.8	1.5
	100-yr Floodplain	Immediately after Construction (Short-Term; Total Stress)	1.8	1.3
		Long-Term (Effective Stress)	1.8	1.5

This analysis indicates that the calculated factor of safety against slope failure meets the minimum requirements prescribed for the long-term and short-term conditions.

6.0 SETTLEMENT ANALYSIS

The settlement analysis was performed for the construction of the barrier islands using Settle3 software. Engineering parameters of the native soils used for the settlement analysis were determined using published correlations and regional data from NTH's files. The dimensions of the barrier island embankment and flow deflector peninsula were determined from the available design drawings (Appendix B) and the information provided by SmithGroup by email. On the basis of the subsurface conditions and the engineering parameters of the native soils underlying the embankment, the total estimated settlement for the barrier islands ranges between 3.9 and 4.4 inches and for the flow deflector peninsula it ranges from 6.7 to 8.6 inches as shown in Table 4. The estimated settlement for the flow deflector peninsula is based on the assumption that the stone for peninsula construction will mix with the very soft silty clay to reduce its compressibility. Thus, coefficients of compressibility (Cc and Cr) for the upper very soft clay layer were reduced/ "improved" to 0.2 and 0.02, respectively.

Table 4: Settlement Analysis Results

Cross section	Total Settlement (inches) (10 Years after Completion)
Type A Barrier Island	3.9
Type B Barrier Island	4.4
Flow Deflector Peninsula	6.7 to 8.6

7.0 RECOMMENDATIONS

Based on the results of our stability analyses at the project site, it appears that the factor of safety for the proposed embankment configuration is adequate for new construction. For Barrier Islands, any soft or loose soil materials at the mudline should be removed prior to placement of embankment fill material, and the embankment fill should be placed over competent subgrade soils that are at least of a stiff consistency or of a medium compact condition. Based on the information obtained during this study, we expect that competent native soils should be encountered at an elevation of about 568 feet.

For flow deflector peninsulas, the embankment fill should be placed over the existing soft soils and the "key" at the toe should extend into the medium to stiff gray silty clay to an elevation of about 556.3 ft and the minimum proposed width of toe is approximately 8 feet.

8.0 LIMITATIONS

The evaluations and recommendations regarding slope stability and settlement have been formulated on the basis of the information obtained during the course of this study, the assumptions stated herein relating to the proposed project, and the information provided to us, some of which may be preliminary and approximate. Our understanding of this data has been

outlined in the pertinent sections of this report. Any significant changes in this information should be brought to our attention for review, particularly those related to the prevailing subsurface conditions.

This report is intended for the exclusive use of SmithGroup, Friends of the Detroit River, and the USFWS for the Sugar Island Habitat Restoration Project in Grosse Ile Township, Michigan. The work was performed in accordance with the prevailing standard of practice in this area at the time the work was performed. No other warranty, express or implied, is provided or intended.
This report presents NTH's opinion as of this date, based on the results of the study described herein and on the information provided during the course of the study. The results of this study may not be relied upon by parties other than the ones identified above without the prior knowledge and written consent of NTH.

The scope of the present study was limited to an evaluation of subsurface conditions and slope stability. No environmental, hydrological, or chemical testing or analyses were performed as part of this geotechnical evaluation.

APPENDIX A

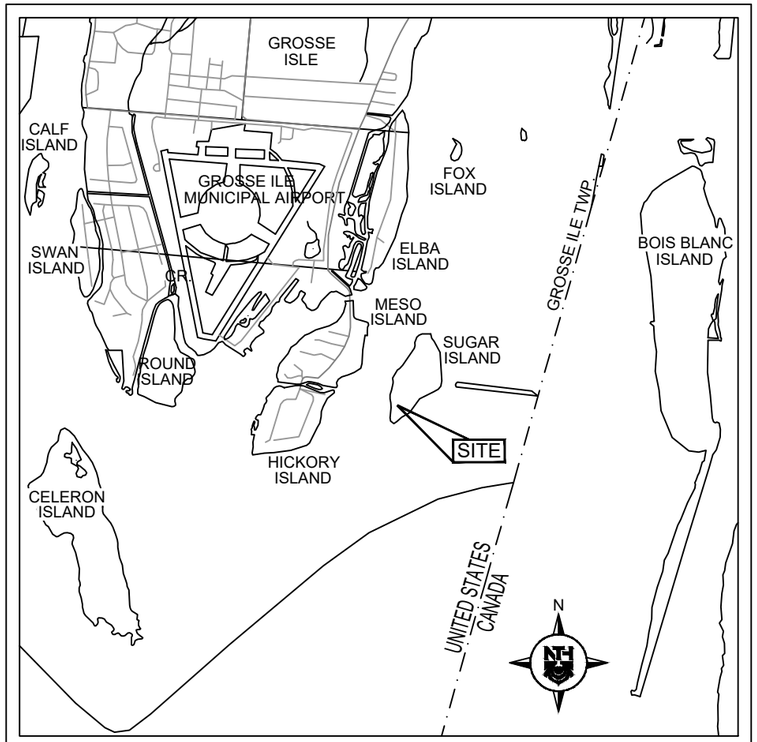
Test Boring Location Plan, Figure 1;

NTH General Notes, Figure 2;

Logs of Test Boring, Figure 3;

Tabulation of Laboratory Test Data, Figure 4;

Design Soil Profiles, Figures 5A-5B



SITE LOCATION MAP SCALE: NONE

LEGEND

TEST BORING DRILLED BY 7NT ENGINEERING
UNDER THE OBSERVATION OF NTH CONSULTANTS, LTD.
ON OCTOBER 2, 3, & 5, 2020

N

GRAPHIC SCALE

400 0 400

1" = 400'

NTH Consultants, Ltd.
Infrastructure Engineering
and Environmental Services

NTH PROJECT No: 61-190115-01	CAD FILE NAME: D190115O1
DESIGNED BY: ZP	INCEP DATE: 15 OCT 2020
DRAWN BY: DET	DRAWING SCALE: 1" = 400'
CHECKED BY: TAD	PLOT DATE: 15 Oct 2020

EXPLORATION LOCATION PLAN
SUGAR ISLAND HABITAT RESTORATION

SUGAR ISLAND
GROSSE ILE TWP., WAYNE COUNTY, MICHIGAN

FIGURE No.

1

NTH Consultants, Ltd.

A Neyer, Tiseo & Hindo Company

GENERAL NOTES

TERMINOLOGY

Unless otherwise noted, all terms utilized herein refer to the Standard Definitions presented in ASTM D 653.

PARTICLE SIZES

Boulders	-	Greater than 12 inches (305mm)
Cobbles	-	3 inches (76.2mm) to 12 inches (305mm)
Gravel - Coarse	-	3/4 inches (19.05 mm) to 3 inches (76.2mm)
Fine	-	No. 4 - 3/16 inches (4.75mm) to 3/4 inches (19.05 mm)
Sand - Coarse	-	No. 10 (2.00mm) to No. 4 (4.75mm)
Medium	-	No. 40 (0.425mm) to No. 10 (2.00mm)
Fine	-	No. 200 (0.074mm) to No. 40 (0.425mm)
Silt	-	0.005mm to 0.074mm
Clay	-	Less than 0.005mm

CLASSIFICATION

The major soil constituent is the principal noun, i.e., clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	Minor Constituents (percent by weight)
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35% (clayey, silty, etc.)	Little - 12 to 23%
And - Over 35%	Some - 23 to 33%

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modified; i.e., silty clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils; i.e., silty clay, trace of sand, little gravel.

Consistency	Unconfined Compressive Strength (psf)	Approximate Range of (N)
Very Soft	Below 500	0 - 2
Soft	500 - 1000	3 - 4
Medium	1000 - 2000	5 - 8
Stiff	2000 - 4000	9 - 15
Very Stiff	4000 - 8000	16 - 30
Hard	8000 - 16000	31 - 50
Very Hard	Over 16000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

Density Classification	Relative Density %	Approximate Range of (N)
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Compact	36 - 65	11 - 30
Compact	66 - 85	31 - 50
Very Compact	86 - 100	Over 50

Relative density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

SAMPLE DESIGNATIONS

AS - Auger Sample - directly from auger flight
BS - Miscellaneous Sample - bottle or bag
S - Split Spoon Sample - ASTM D 1586
LS - Split Spoon Sample S with Liner Insert 3 inches in length
ST - Shelby Tube Sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted
CS - Continuous Sample - from rock core barrel or continuous sampling device
VS - Vane Shear

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0" outside-diameter, 1-3/8" inside-diameter, split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

LOG OF TEST BORING NO: TB-1

Project Name: Sugar Island
Project Location: Grosse Ile Township, Michigan

NTH Consultants, Ltd.
NTH Proj. No.: 61-190115-01
Checked By: D. Bansal

SUBSURFACE PROFILE						SOIL SAMPLE DATA							
ELEV. (FT)	PRO-FILE	ELEV	WATER SURFACE ELEVATION: 574.0 / DESCRIPTION	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
			WATER Detroit River										
570		569.0		5.0	5								
		568.5	Black SAND, Saturated	5.5									
		567.5	Stiff to Very Stiff Brown SILTY CLAY with Trace of Sand and Gravel, Saturated	6.5		LS-1	2 5 5	10	10				*4500
						LS-2	2 5 7	12	18				*5000
565						LS-3	3 3 6	9	16		14.5	123.6	4500
					10	LS-4	5 7 10	17	1				
						LS-5	6 8 12	20	7				*4000
			Stiff to Very Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated			LS-6	3 5 9	14	15				*4500
560					15	LS-7	5 50/5	50+	11				*4500
555		554.0		20.0	20	LS-8	9 6 13	19	8				*4000
			END OF BORING AT 20.0 FEET.										
550													
545													

Total Depth: *20 FT*
Drilling Start Date: *10/2/20*
Drilling End Date: *10/2/20*
Inspector: *D. Verge*
Contractor: *7NT Engineering*
Driller: *F. Smith*
Drilling Method:
4" Casing Advanced to Depth Using CME-750X ATV Mounted Drill Rig

Plugging Procedure:
Backfilled with soil cuttings.

Water Level Observation:
No Meaningful Groundwater Observation was Possible Due to Drilling Taking Place Below River Surface

Notes:
** = Pocket Penetrometer*

Approximate GPS Coordinates:
N: 217446.12 E: 13455514.65

Figure No. 3

LOG OF TEST BORING 61-190115-01.GPJ NTH CORPORATE.GDT 12/30/20

LOG OF TEST BORING NO: TB-2

NTH Consultants, Ltd.

Project Name: Sugar Island
Project Location: Grosse Ile Township, Michigan
NTH Proj. No.: 61-190115-01
Checked By: D. Bansal

SUBSURFACE PROFILE						SOIL SAMPLE DATA							
ELEV. (FT)	PRO-FILE	ELEV	WATER SURFACE ELEVATION: 574.0	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
			WATER Detroit River										
570		569.0		5.0	5								
						LS-1	4 7 7	14	7				*2000
						LS-2	1 6 6	12	7				*3000
565						LS-3	1 5 8	13	15				*4000
					10	LS-4	3 5 7	12	16				*2250
			Stiff to Very Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated			LS-5	3 5 9	14	17				*4500
560						LS-6	7 7 10	17	17				*4000
					15	LS-7	6 7 12	19	17				*4000
555		554.0		20.0	20	LS-8	31 9 13	22	15				*5000
			END OF BORING AT 20.0 FEET.										
550													
545													

Total Depth: *20 FT*
Drilling Start Date: *10/2/20*
Drilling End Date: *10/2/20*
Inspector: *D. Verge*
Contractor: *7NT Engineering*
Driller: *F. Smith*
Drilling Method:
4" Casing Advanced to Depth Using CME-750X ATV Mounted Drill Rig

Plugging Procedure:
Backfilled with soil cuttings.

Water Level Observation:
No Meaningful Groundwater Observation was Possible Due to Drilling Taking Place Below River Surface

Notes:
** = Pocket Penetrometer*

Approximate GPS Coordinates:
N: 217050.52 E: 13454825.71

Figure No. 3

LOG OF TEST BORING 61-190115-01.GPJ NTH CORPORATE.GDT 12/30/20

LOG OF TEST BORING NO: TB-3

Project Name: Sugar Island
Project Location: Grosse Ile Township, Michigan

NTH Consultants, Ltd.
NTH Proj. No.: 61-190115-01
Checked By: D. Bansal

SUBSURFACE PROFILE						SOIL SAMPLE DATA							
ELEV. (FT)	PRO-FILE	ELEV	WATER SURFACE ELEVATION: 574.0 / DESCRIPTION	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
570			WATER Detroit River		5								
565		565.0		9.0									
		564.5	Black SILTY CLAY with Organics (Roots, Foliage), Saturated	9.5	10	LS-1	WOH WOH WOH		9				*500
			Very Soft to Soft Gray SILTY CLAY, with Trace of Sand and Gravel and Frequent Sand Seams, Saturated			LS-2	WOH WOH WOH		13		38.3	72.6	280
		560.5		13.5		LS-3	WOH WOH 1		1				*500
560			Medium to Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated		15	LS-4	1 4 6	10	14				*2500
		557.5		16.5		LS-5	2 4 7	11	10				*1750
		556.0	Very Stiff to Hard Gray SILTY CLAY with Trace of Sand and Gravel, Moist	18.0		LS-6	3 25 9	34	16				*9000
555			Medium to Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated		20	LS-7	6 7 5	12	8				*1000
		552.0		22.0									
		550.4	BEDROCK, Shale	23.6		LS-8	30 50/5"	50+	4				
550			END OF BORING AT 23.6 FEET.										
545													

Total Depth: *23.6 FT*
Drilling Start Date: *10/3/20*
Drilling End Date: *10/3/20*
Inspector: *D. Verge*
Contractor: *7NT Engineering*
Driller: *F. Smith*
Drilling Method:
4" Casing Advanced to Depth Using CME-750X ATV Mounted Drill Rig

Plugging Procedure:
Backfilled with soil cuttings.

Water Level Observation:
No Meaningful Groundwater Observation was Possible Due to Drilling Taking Place Below River Surface

Notes:
** = Pocket Penetrometer*

Approximate GPS Coordinates:
N: 217618.3 E: 13454420.33

Figure No. 3

LOG OF TEST BORING 61-190115-01.GPJ NTH CORPORATE.GDT 12/30/20

LOG OF TEST BORING NO: TB-4

Project Name: Sugar Island
Project Location: Grosse Ile Township, Michigan

NTH Consultants, Ltd.
NTH Proj. No.: 61-190115-01
Checked By: D. Bansal

SUBSURFACE PROFILE						SOIL SAMPLE DATA							
ELEV. (FT)	PRO-FILE	ELEV	WATER SURFACE ELEVATION: 574.0 / DESCRIPTION	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
570			WATER Detroit River		5								
		567.0		7.0		LS-1	5 6 8	14	15				*6750
565					10	LS-2	7 9 9	18	17				*7500
						LS-3	6 8 12	20	7				*7000
						LS-4	4 8 11	19	16				*8000
560			Stiff to Very Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated			LS-5	6 9 13	22	15				*8000
					15	LS-6	7 12 15	27	7				*8000
						LS-7	9 7 8	15	8				*8000
555													
		553.5		20.5	20								
			Medium Gray SILTY CLAY with Trace of Sand and Gravel, Saturated			LS-8	3 3 5	8	18		28.5	99.2	1160
550						ST-1	PUSH		9				#1600
		548.5		25.5	25								
			Weathered Rock; SHALE Fragments Interbedded with Layers of Medium Stiff Gray SILTY CLAY with Trace of Sand and Gravel			LS-9	8 7 10	17	3				
545		544.0		30.0	30								
		542.5	BEDROCK; Shale	31.5		LS-10	50/3"	50+					
			END OF BORING AT 31.5 FEET.										
540													

Total Depth: *31.5 FT*
Drilling Start Date: *10/5/20*
Drilling End Date: *10/5/20*
Inspector: *D. Verge*
Contractor: *7NT Engineering*
Driller: *F. Smith*
Drilling Method:
4" Casing Advanced to Depth Using CME-750X ATV Mounted Drill Rig

Plugging Procedure:
Bentonite hole plug.

Water Level Observation:
No Meaningful Groundwater Observation was Possible Due to Drilling Taking Place Below River Surface

Notes:
** = Pocket Penetrometer*
 # - Torvane

Approximate GPS Coordinates:
N: 216077.92 E: 13454986.15

Figure No. 3

LOG OF TEST BORING 61-190115-01.GPJ NTH CORPORATE.GDT 12/30/20

LOG OF TEST BORING NO: TB-5

Project Name: Sugar Island
Project Location: Grosse Ile Township, Michigan

NTH Consultants, Ltd.
NTH Proj. No.: 61-190115-01
Checked By: D. Bansal

SUBSURFACE PROFILE						SOIL SAMPLE DATA							
ELEV. (FT)	PRO-FILE	ELEV	WATER SURFACE ELEVATION: 574.0 / DESCRIPTION	DEPTH	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN RESIST. (N)	REC (in)	FIELD TEST (ppm)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
570			WATER Detroit River		5								
		567.0		7.0		LS-1	7 13 19	32	12				*9000
565			Hard to Very Hard SILTY CLAY with Trace of Sand and Gravel, Saturated		10	LS-2	8 16 56	72	11				*9000
		562.5		11.5		LS-3	11 14 18	32					
			Stiff to Very Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated			LS-4	3 8 9	17	15				*6500
560		559.5		14.5		LS-5	2 3 7	10	15				*3000
					15	LS-6	38 31 50/5"/5"	81+	5				*9000
			Very Hard Gray SILTY CLAY with Trace of Sand and Gravel, Saturated			LS-7	18 33 37	70	13				*9000
555					20								
		553.0		21.0		LS-8	7 8 9	17	18				*2500
550			Stiff Gray SILTY CLAY with Trace of Sand and Gravel, Saturated		25								
		548.0		26.0		LS-9	23 10 12	22	5				
545			Weathered BEDROCK; SHALE Fragments with Sand and Gravel, Saturated										
		544.0		30.0	30								
		542.5	BEDROCK; Shale	31.5		LS-10	50/5"	50+	6				
540			END OF BORING AT 31.5 FEET.										

Total Depth: *31.5 FT*
Drilling Start Date: *10/5/20*
Drilling End Date: *10/5/20*
Inspector: *D. Verge*
Contractor: *7NT Engineering*
Driller: *F. Smith*
Drilling Method:
4" Casing with Water Excavation Advanced Using CME-750X ATV Mounted Drill Rig

Plugging Procedure:
Backfilled with bentonite hole plug.

Water Level Observation:
No Meaningful Groundwater Observation was Possible Due to Drilling Taking Place Below River Surface

Notes:
** = Pocket Penetrometer*

Approximate GPS Coordinates:
N: 216696.39 E: 13455486.51

Figure No. 3

LOG OF TEST BORING 61-190115-01.GPJ NTH CORPORATE.GDT 12/30/20

Project No.	61-190115-01	NTH Consultants, Ltd.	Sugar Island Habitat Restoration Project Gross Ile Township, Michigan

TABULATION OF LABORATORY TEST DATA

Boring / Test Pit / Probe Designation	Sample Number	Depth of Sample Tip (ft)	Elevation of Sample Tip (ft)	Unconfined Compressive Strength (Tsf)	Failure Strain (%)	Natural Water Content (% of dry weight)	In-Place Dry Density (lbs/cu.ft)	PERMEABILITY (CM/SEC)	PARTICLE SIZE DISTRIBUTION (%)							ATTERBERG LIMITS (%)			Proctor (Maximum Dry Density- lbf/ft³)	Unified Soil Classification
									Colloids	Clay	Silt	Fine Sand	Medium Sand	Coarse Sand	Gravel	Liquid Limit	Plastic Limit	Plasticity Index		
TB-1	LS-3	9.5	564.5	2.25	15.0	14.5	123.6	-	-	-	-	-	-	-	-	-				
TB-3	LS-2	12.0	562.0	0.14	15.0	38.3	72.6	-	-	-	-	-	-	-	-					
TB-4	LS-8	22.5	551.5	0.58	15.0	28.5	99.2	-	-	-	-	-	-	-	-					

FIGURE No. 4

DETROIT RIVER WATER SURFACE 574’

WATER

6’ (varies 5’ – 7’) 568’

Stiff to Very Stiff Gray SILTY CLAY

γ = 142 pcf Su = 2,250 psf ω_n = 15%

e_0 = 0.39 Cc = 0.13 Cr = 0.013

22’ 552’

Medium Gray SILTY CLAY

γ = 127 pcf Su = 580 psf ω_n = 29%

e_0 = 0.78 Cc = 0.27 Cr = 0.027

LL = 38 PI = 20

25.5’ 548.5’

Weathered SHALE

γ = 140 pcf * ϕ = 38°

30’ 544’

ROCK

(Shale)

* Estimated

FIGURE No. 5A

DETROIT RIVER WATER SURFACE 574’

WATER

9’ 565’

Very Soft SILTY CLAY

γ = 100 pcf Su = 150 psf ω_n = 38%

e_0 = 1.1 Cc = 0.34 Cr = 0.034

13.5’ 560.5’

Medium Gray SILTY CLAY

γ = 127 pcf Su = 580 psf ω_n = 29%

e_0 = 0.78 Cc = 0.27 Cr = 0.027

LL = 38 PI = 20

22’ 552’

Weathered SHALE

γ = 140 pcf * ϕ = 38°

23.6’ 550.4’

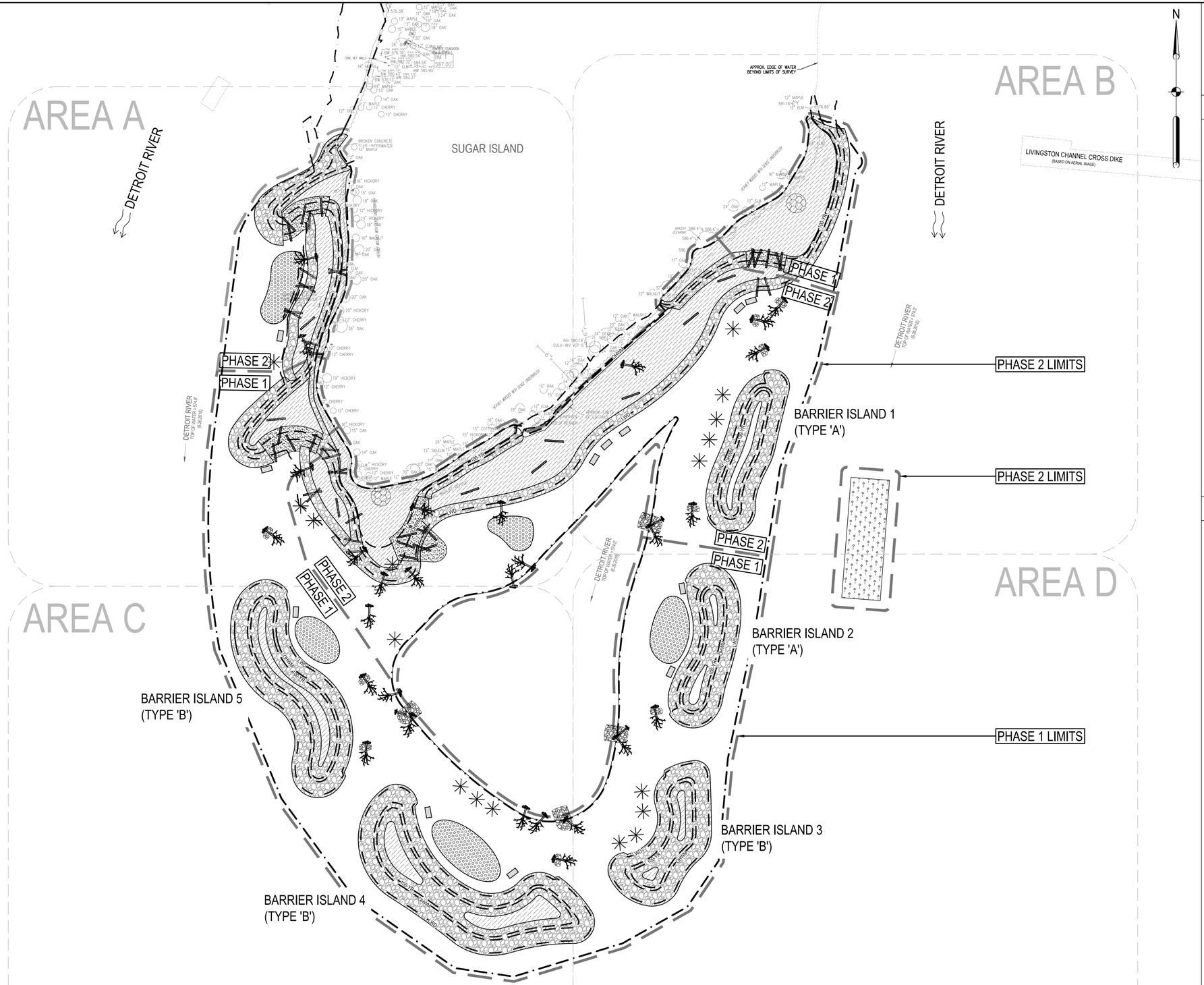
ROCK

(Shale)

* Estimated

APPENDIX B

Barrier Island Design Drawings by SmithGroup



DATUM ELEVATIONS		
DATUM/ELEVATION	NAVD88	IGLD85
100-YEAR FLOODPLAIN	577.00	576.73
ORDINARY HIGH WATER MARK (OHWM)	573.77	573.50
LOW WATER DATUM (LWD)	569.67	569.40
DATUM CONVERSION: NAVD88 - 0.27 FEET = IGLD85		

LEGEND

- LIMITS OF CONSTRUCTION
- PROPOSED LWD CONTOUR
- PROPOSED OHWM CONTOUR
- PROPOSED 100-YEAR CONTOUR
- PLANTING AREA
- RIPRAP
- COARSE WOODY DEBRIS - BURIED & BALLAST
- COARSE WOODY DEBRIS - ANCHORED
- ROCK SPAWNING REEF
- AGGREGATE SPAWNING BED
- SAND SLOPE
- WOODY SPAWNING STRUCTURES
- SUBMERGED ROCK SLAB STRUCTURE
- SNAKE HIBERNACULUM
- ROCK MOUNDS

PHASING NOTES

THIS PROJECT IS FUNDED IN 2 PHASES. PHASE 1 FUNDING HAS BEEN APPLIED FOR IN JUNE, 2020. PHASE 2 FUNDING WILL BE APPLIED FOR IN JUNE 2021. ALL WORK WILL BE PERFORMED BY THE SAME CONTRACTOR IN TWO MOBILIZATIONS.

PHASE 1 (CONSTRUCTION 2021)

THIS PHASE INCLUDES ALL WORK ASSOCIATED WITH BARRIER ISLANDS 2, 3, 4 AND 5, THE EXPANDED BEACH ON THE ISLAND'S EAST SIDE, AND THE PENINSULA ON THE ISLANDS SOUTHEAST SIDE AS INDICATED ON THIS PLAN. WORK ALSO INCLUDES 3 SHALLOW SPAWNING AGGREGATE BEDS.

PHASE 2 (CONSTRUCTION 2022)

THIS PHASE INCLUDES WORK ASSOCIATED WITH BARRIER ISLAND 1, DEEP WATER AGGREGATE BED, EMERGENT WETLAND, WESTERN PENINSULA, SHORELINE STABILIZATION, AND ALL OTHER REMAINING WORK IN THE PROJECT.

SUGAR ISLAND HABITAT RESTORATION

DETROIT, MICHIGAN

PREPARED FOR:

FRIENDS OF THE DETROIT RIVER
20600 EUREKA ROAD, SUITE 250
TAYLOR, MI 48180

SMITHGROUP

201 DEPOT STREET
SECOND FLOOR
ANN ARBOR, MI 48104
734.662.4457
www.smithgroup.com

ISSUED FOR	REV	DATE
PRELIMINARY DESIGN - REVISED	1	12JUNE2020
PRELIMINARY DESIGN	0	17APRIL2020

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

DRAWING TITLE

OVERALL LAYOUT & MATERIALS PLAN

0' 50' 100' 200'

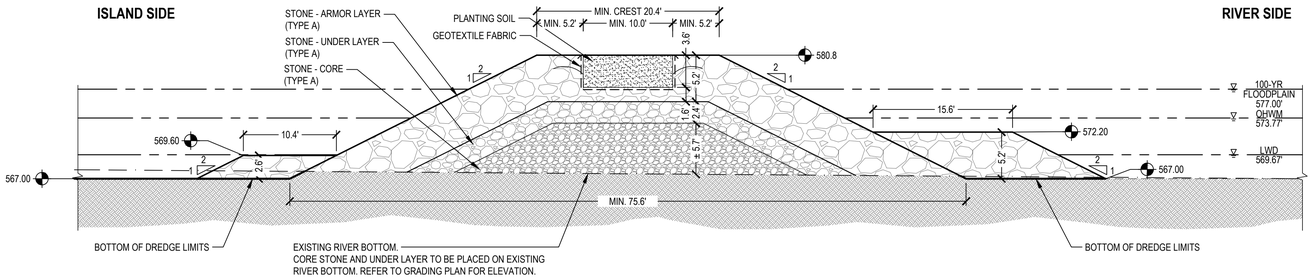
SCALE: 1" = 100'

SCALE 10626

PROJECT NUMBER

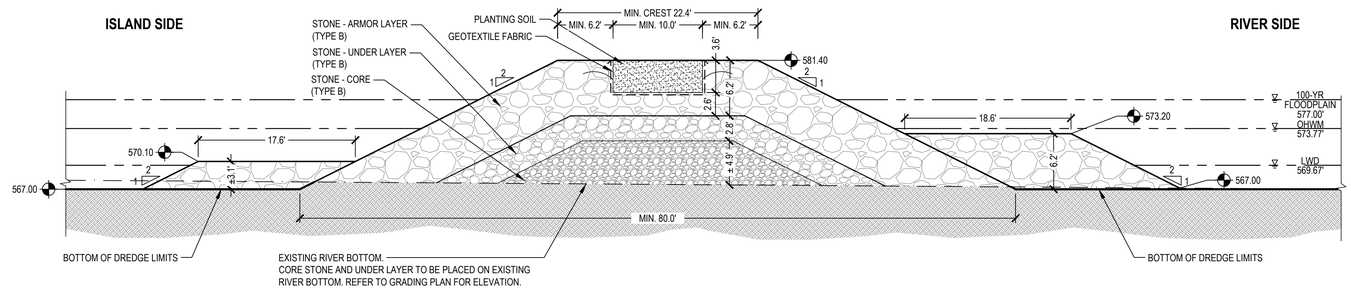
CS100

DRAWING NUMBER



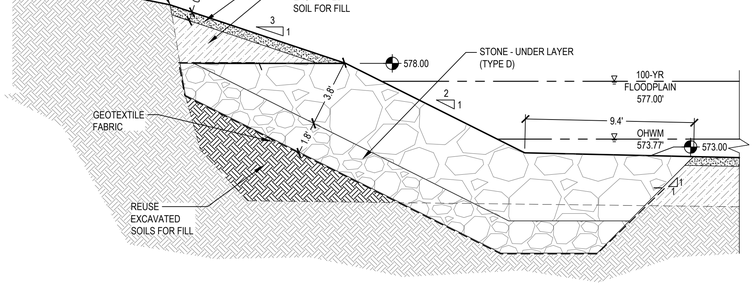
1 TYPE 'A' BARRIER ISLAND - TYPICAL CROSS SECTION

1/8" = 1'-0"



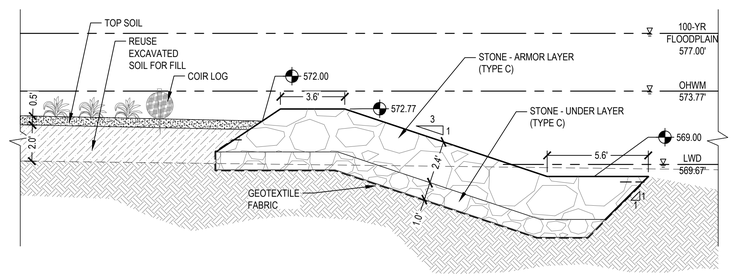
2 TYPE 'B' BARRIER ISLAND - TYPICAL CROSS SECTION

1/8" = 1'-0"



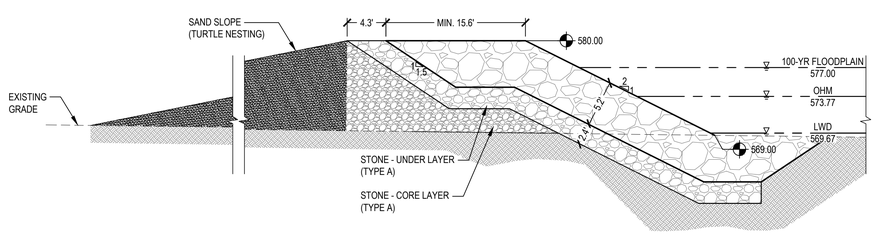
3 SHORELINE STABILIZATION - TYPICAL CROSS SECTION

1/4" = 1'-0"



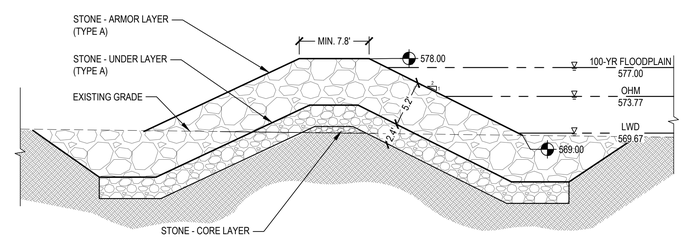
4 EMERGENT WETLAND SHELF - TYPICAL CROSS SECTION

1/4" = 1'-0"



5 SAND SLOPE IN PENINSULA - TYPICAL CROSS SECTION

1/8" = 1'-0"



6 PENINSULA - TYPICAL CROSS SECTION

1/8" = 1'-0"

DATUM ELEVATIONS		
DATUM/ELEVATION	NAVD88	IGLD85
100-YEAR FLOODPLAIN	577.00	576.73
ORDINARY HIGH WATER MARK (OHWM)	573.77	573.50
LOW WATER DATUM (LWD)	569.67	569.40
DATUM CONVERSION: NAVD88 - 0.27 FEET = IGLD85		

STONE SIZE			
STRUCTURE	LAYER	D50 (FEET)	SIZE RANGE
BARRIER ISLAND - TYPE A	ARMOR LAYER (TYPE A)	2.6	1-2 tons
	UNDER LAYER (TYPE A)	1.2	200-400 lb
	CORE (TYPE A)	0.2	1-2 lb
BARRIER ISLAND - TYPE B	ARMOR LAYER (TYPE B)	3.1	2-3 tons
	UNDER LAYER (TYPE B)	1.4	300-600 lb
	CORE (TYPE B)	0.2	2-3 lb
WETLAND SHELF	ARMOR LAYER (TYPE C)	1.2	200-330 LB
	UNDER LAYER (TYPE C)	0.5	20-35 LB
SHORELINE STABILIZATION	ARMOR LAYER (TYPE D)	1.9	900-1500 LB
	UNDER LAYER (TYPE D)	0.9	9-15 LB

SUGAR ISLAND HABITAT RESTORATION

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734.662.4457
www.smithgroup.com

ISSUED FOR	REV	DATE
PRELIMINARY DESIGN - REVISED	1	12JUNE2020
PRELIMINARY DESIGN	0	17APRIL2020

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

DRAWING TITLE
CROSS SECTIONS

0" 1/2" 1" 2"
SCALE: AS NOTED

SCALE
10626

PROJECT NUMBER
CS500

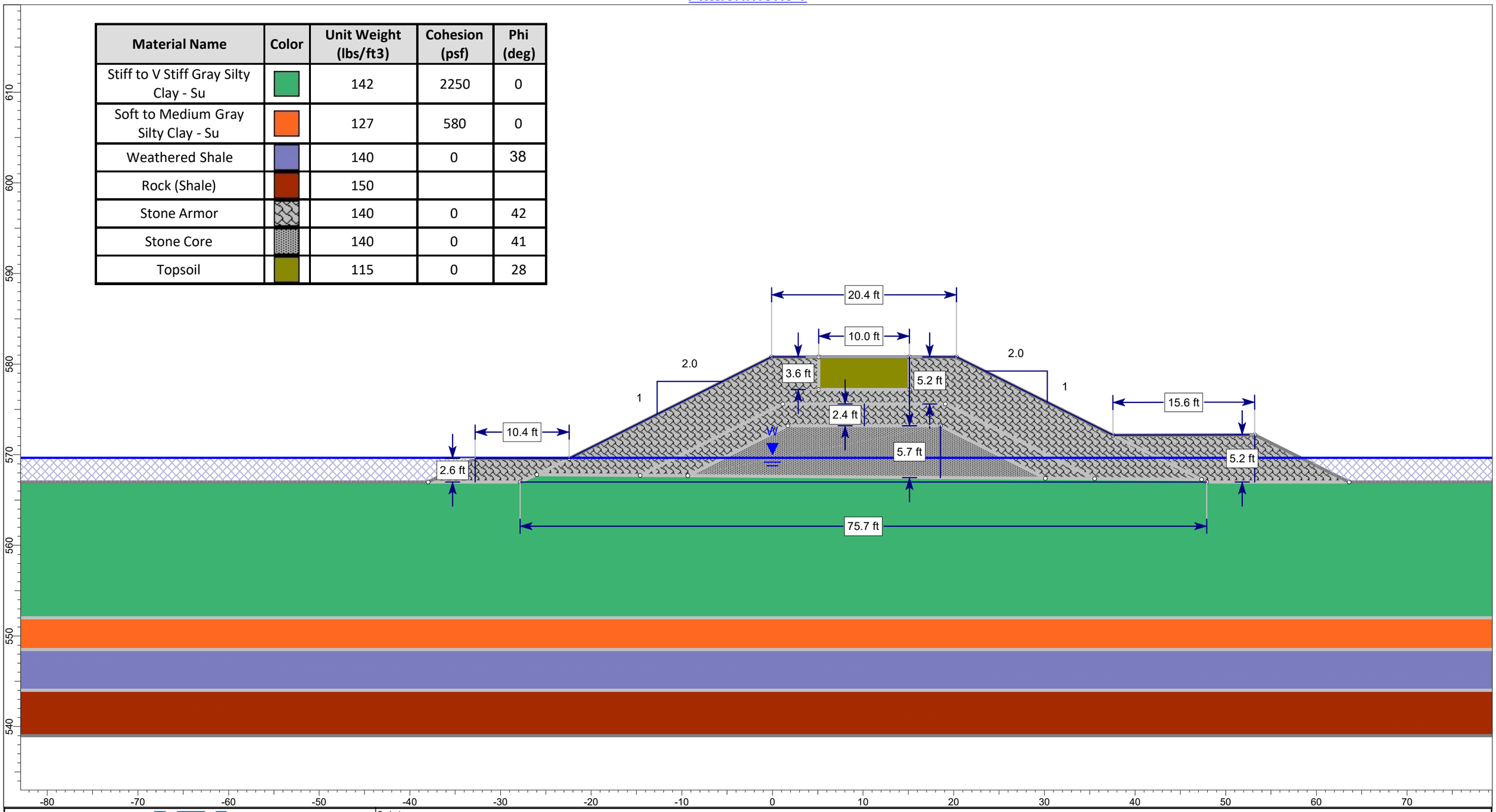
DRAWING NUMBER

APPENDIX C

Soil Stability Plots

Attachment 1

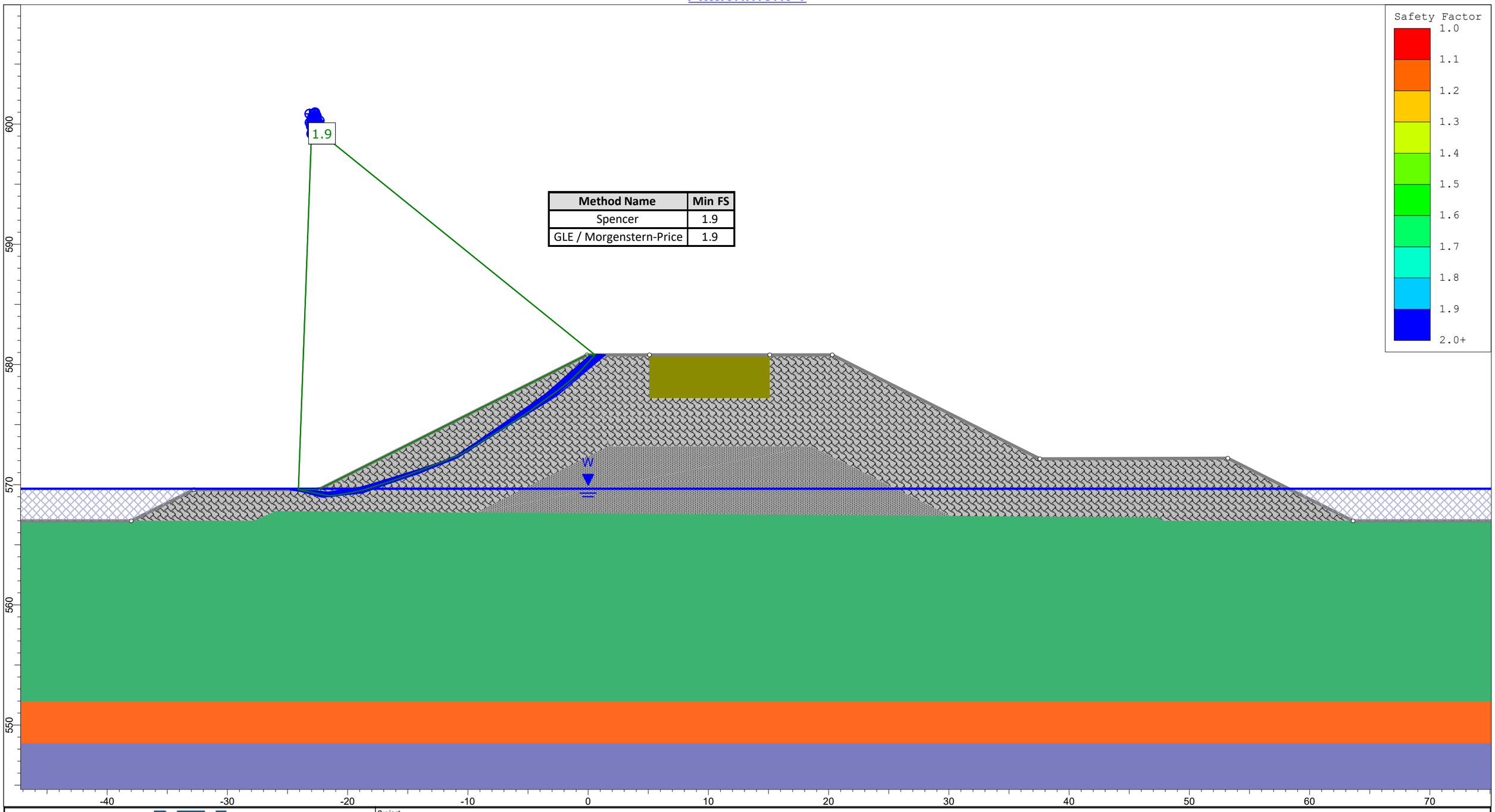
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Stiff to V Stiff Gray Silty Clay - Su		142	2250	0
Soft to Medium Gray Silty Clay - Su		127	580	0
Weathered Shale		140	0	38
Rock (Shale)		150		
Stone Armor		140	0	42
Stone Core		140	0	41
Topsoil		115	0	28



	Project	Sugar Island Habitat Restoration - Slope Stability Analysis
	Analysis Description	Type A Barrier Island - Typical Cross Section
	Drawn By S. McManus	*Company* NTH Consultants, Ltd.
SLIDE 9.011	*Date* 12/15/2020	Figure 1

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

Attachment 1



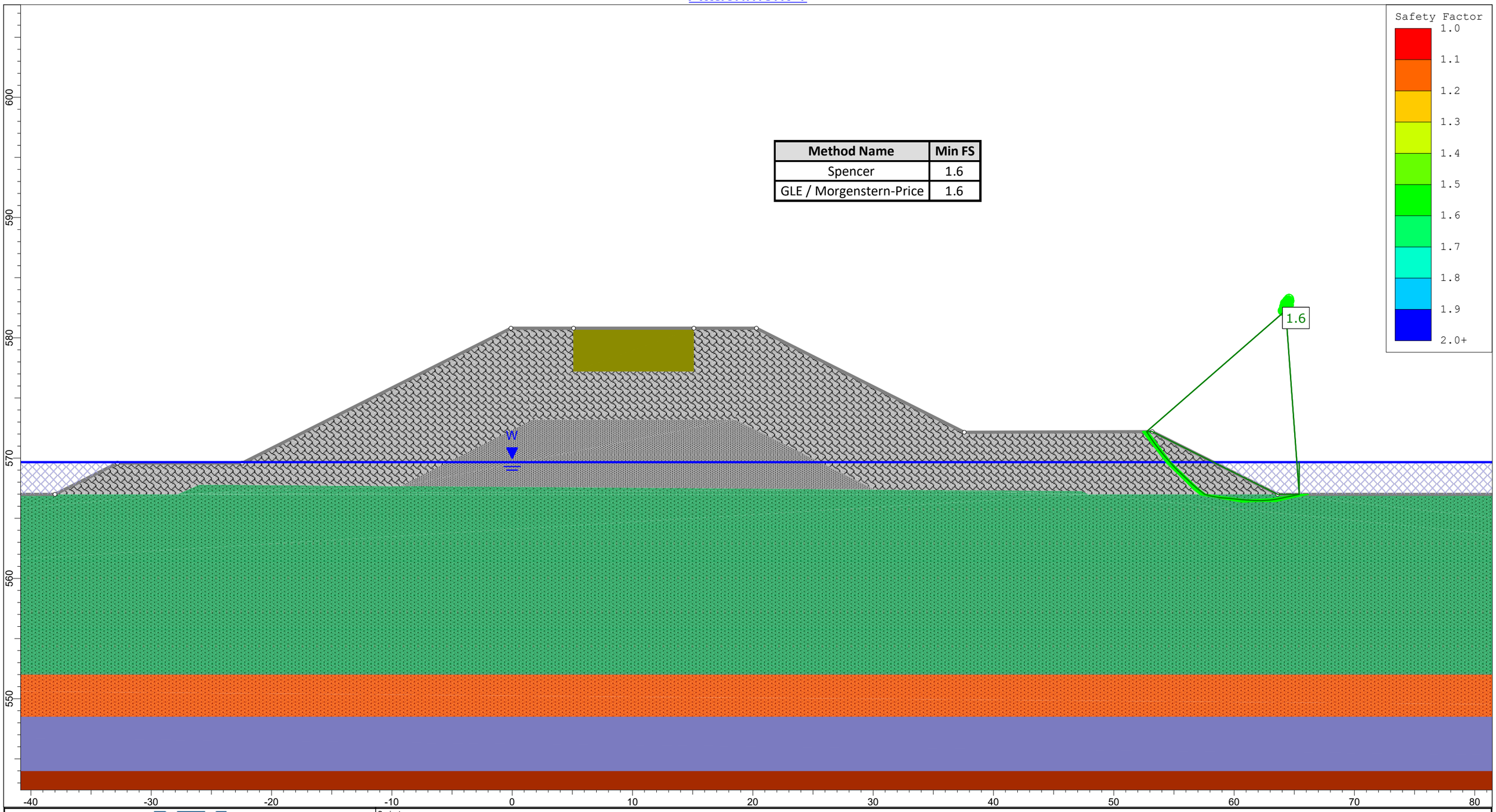
Method Name	Min FS
Spencer	1.9
GLE / Morgenstern-Price	1.9

SLIDEINTERPRET 9.008	*Project*	Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description	Type A Barrier Island - Low Water Datum - Immediately after Construction (Short-Term; Total Stress)	
	Drawn By	S. McManus	*Company* NTH Consultants, Ltd.
	Date	12/16/2020	Figure 2

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

Attachment 1

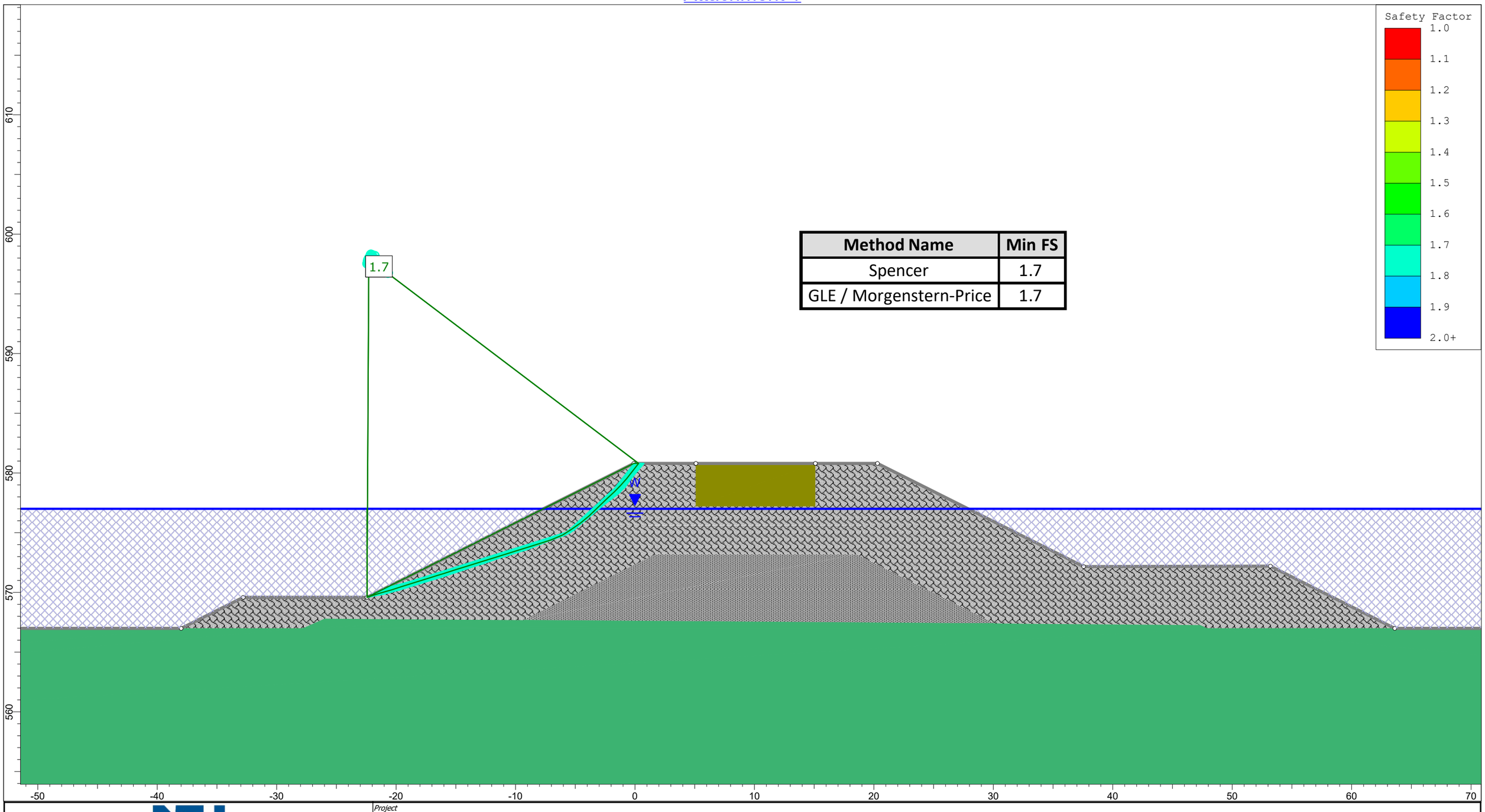
Method Name	Min FS
Spencer	1.6
GLE / Morgenstern-Price	1.6



Project	Sugar Island Habitat Restoration - Slope Stability Analysis
Analysis Description	Type A Barrier Island - Low Water Datum - Long-Term (Effective Stress)
Drawn By	S. McManus
Company	NTH Consultants, Ltd.
Date	12/16/2020
	Figure 3

SLIDEINTERPRET 9.008

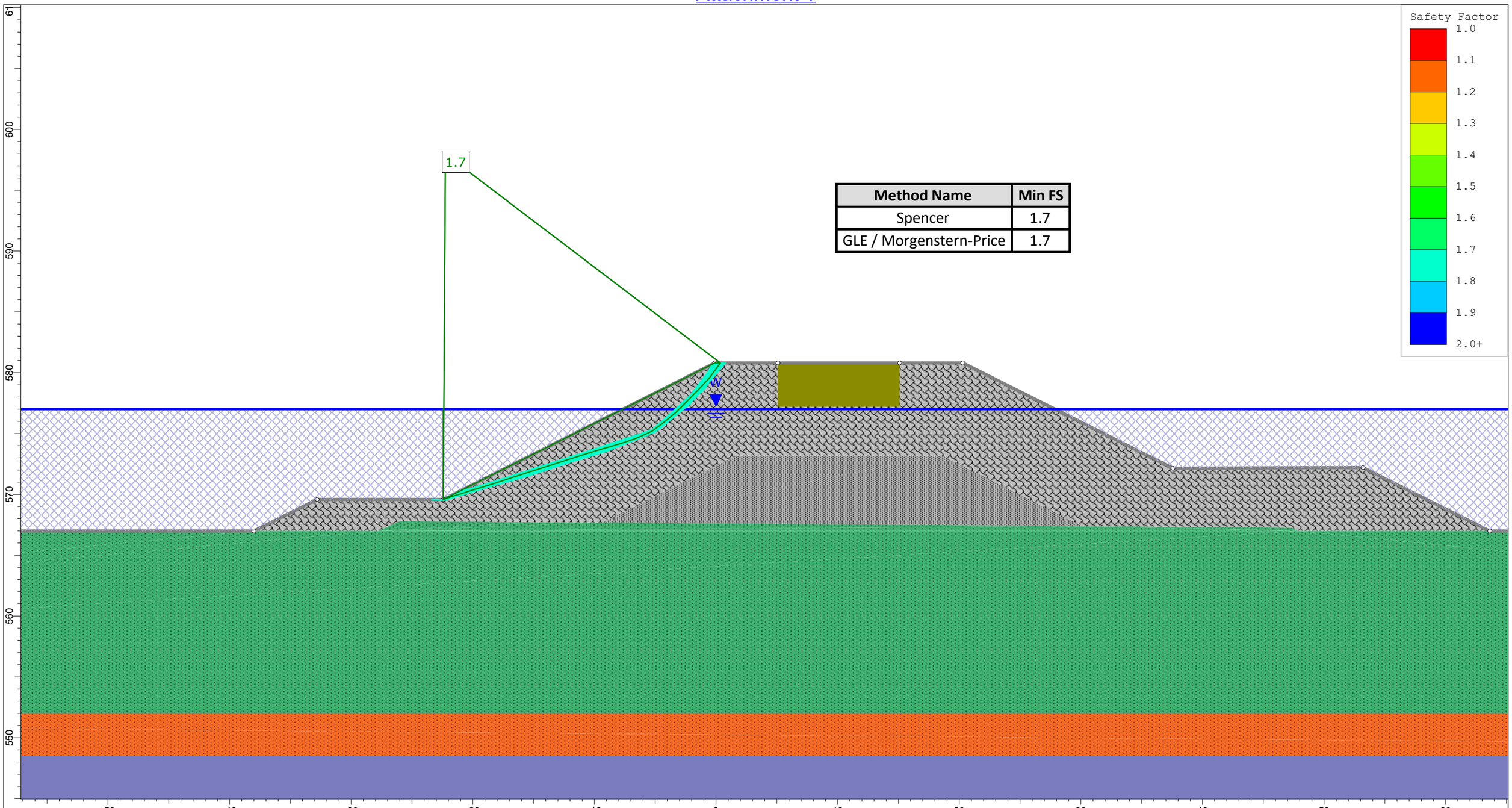
S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd



Method Name	Min FS
Spencer	1.7
GLE / Morgenstern-Price	1.7

	Project Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description Type A Barrier Island - 100-yr FLoodplain - Immediately after Construction (Short-Term; Total Stress)	
	Drawn By S. McManus	*Company* NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	*Date* 12/16/2020	Figure 4

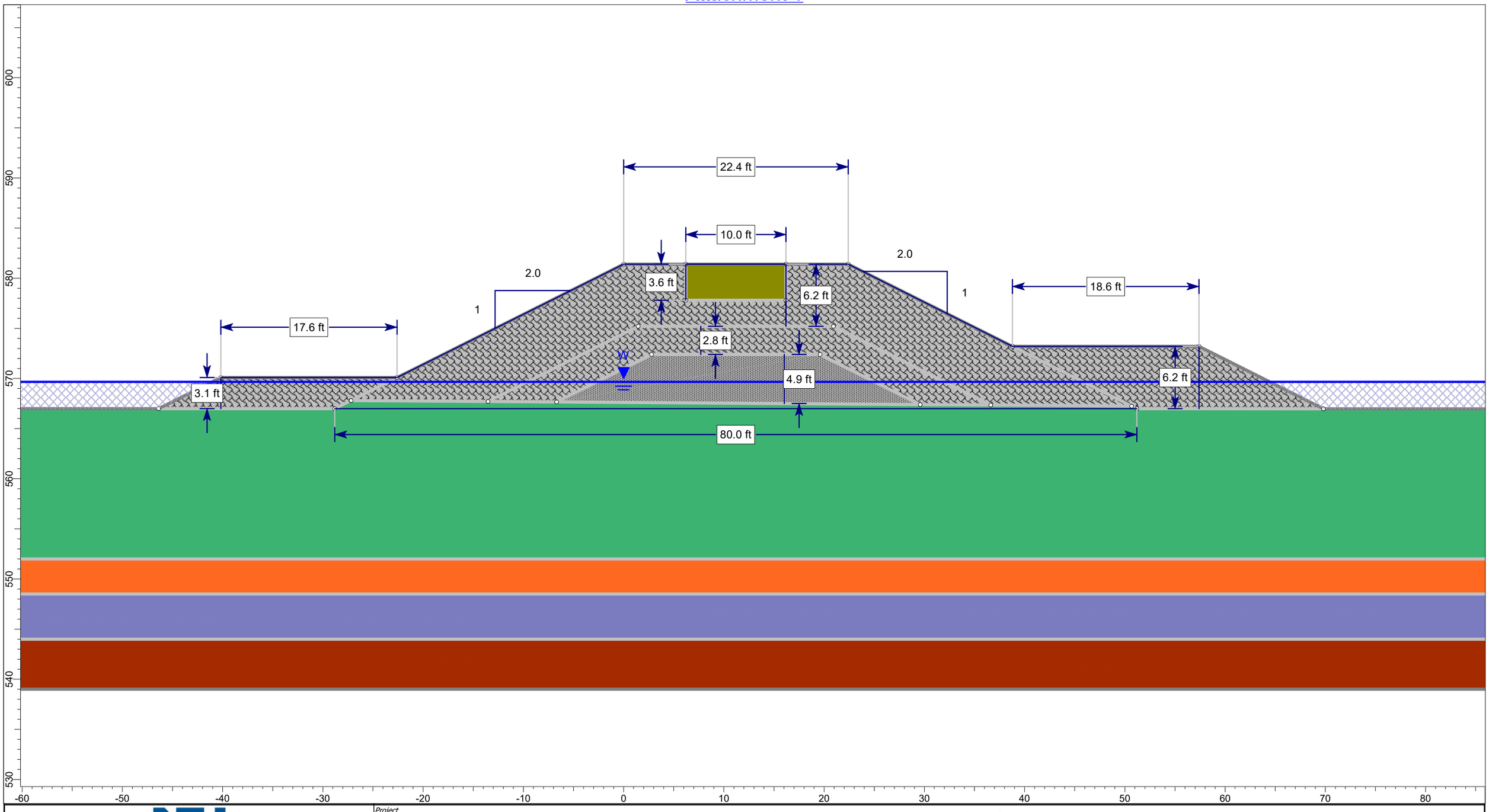
S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd



	Project Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description Type A Barrier Island - 100-yr FLoodplain - Long-Term (Effective Stress)	
	Drawn By S. McManus	*Company* NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	*Date* 12/16/2020	Figure 5

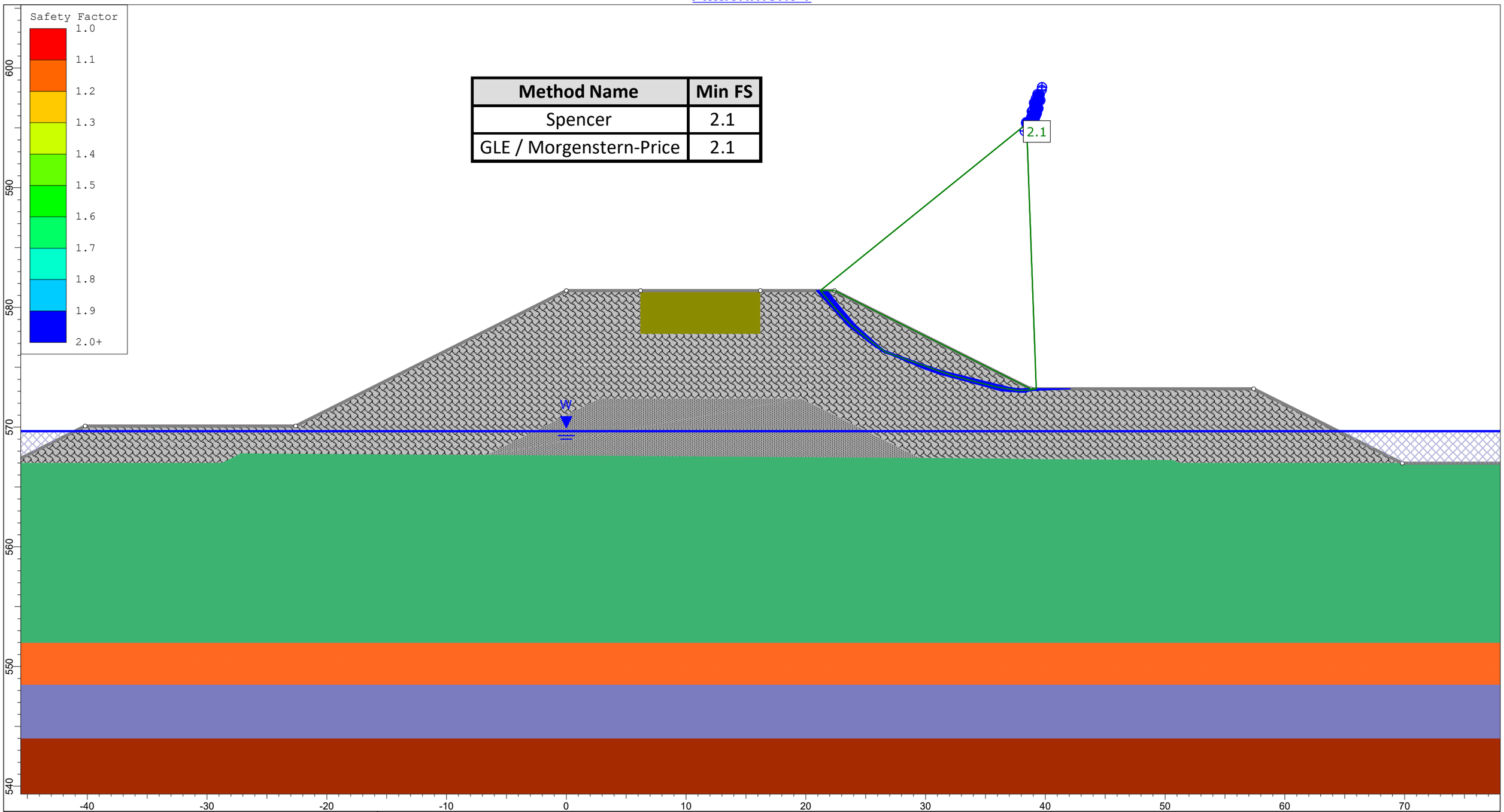
S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

Attachment 1



	Project	Sugar Island Habitat Restoration - Slope Stability Analysis
	Analysis Description	Type B Barrier Island - Typical Cross Section
	Drawn By S. McManus	*Company* NTH Consultants, Ltd.
SLIDE 9.011	*Date* 12/15/2020	Figure 6

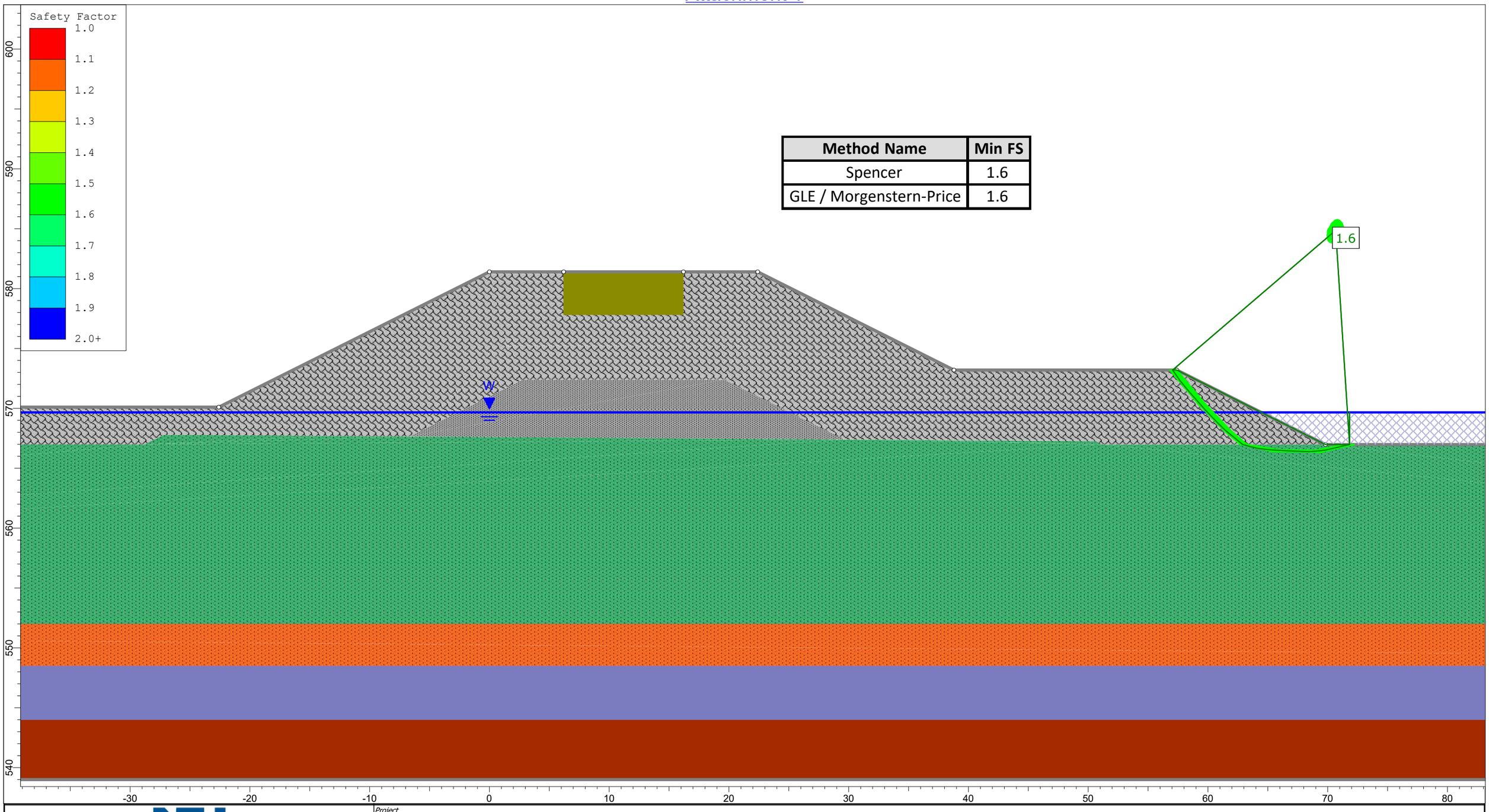
S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd



SLIDEINTERPRET 9.008	*Project* Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description Type B Barrier Island - Low Water Datum - Immediately after Construction (Short-Term; Total Stress)	
	Drawn By S. McManus	*Company* NTH Consultants, Ltd.
	Date 12/17/2020	Figure 7

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

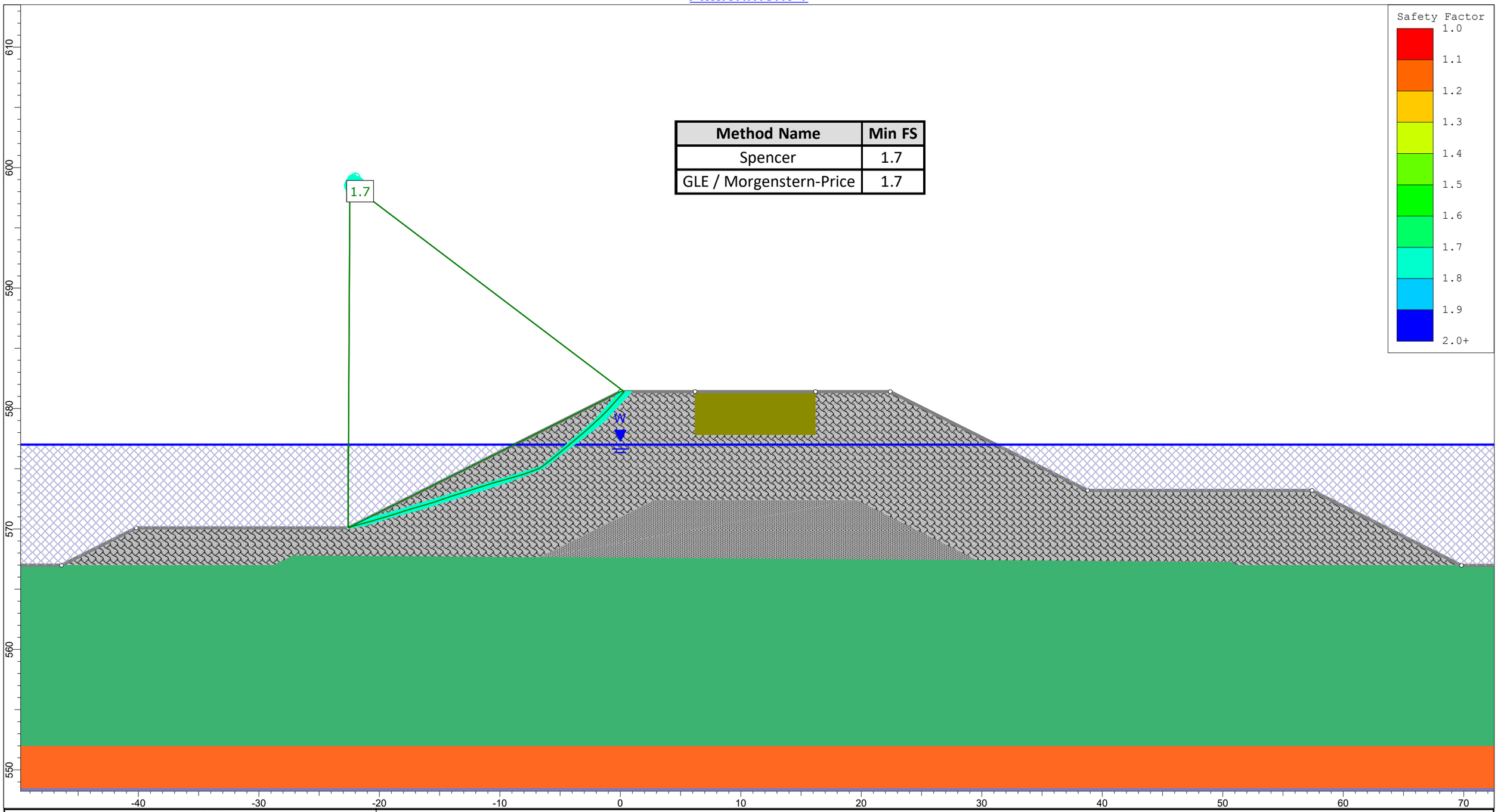
Attachment 1



	Project	Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description	Type B Barrier Island - Low Water Datum - Long-Term (Effective Stress)	
	Drawn By	S. McManus	Company: NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	Date	12/17/2020	Figure 8

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

Method Name	Min FS
Spencer	1.7
GLE / Morgenstern-Price	1.7

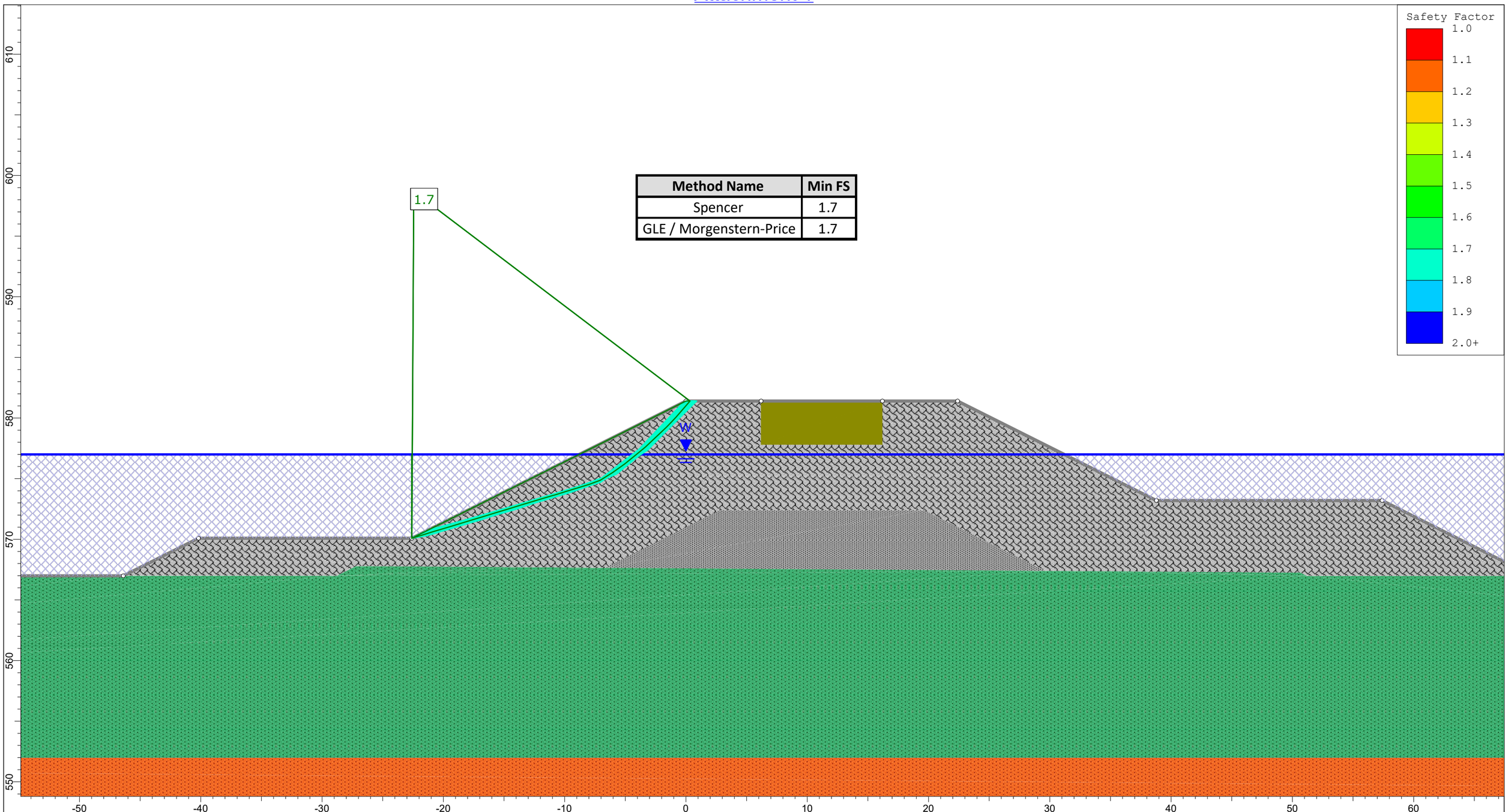


Project	Sugar Island Habitat Restoration - Slope Stability Analysis
Analysis Description	Type B Barrier Island - 100-yr Floodplain - Immediately after Construction (Short-Term; Total Stress)
Drawn By	S. McManus
Company	NTH Consultants, Ltd.
Date	12/17/2020
	Figure 9

SLIDEINTERPRET 9.008

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

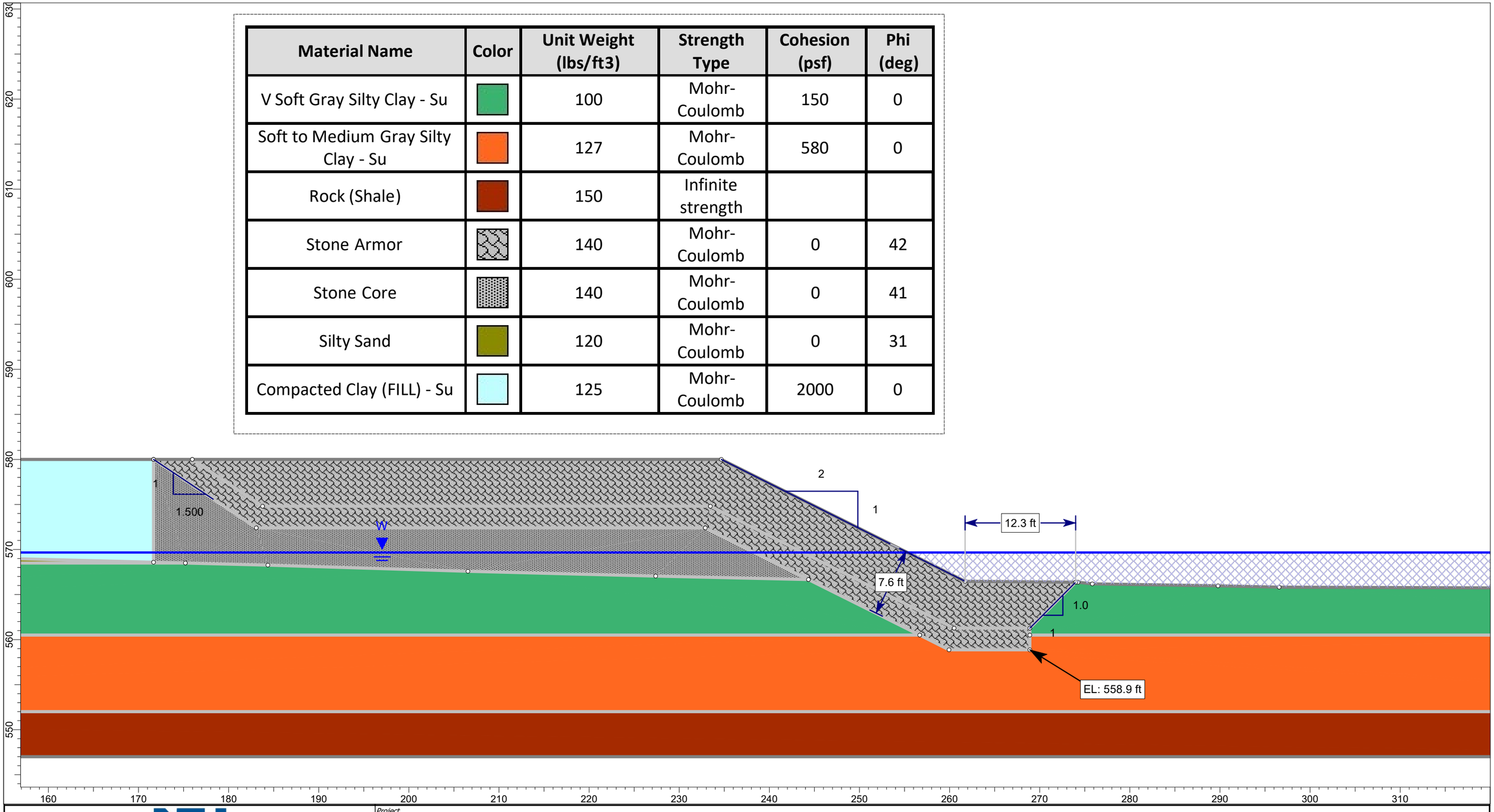
Method Name	Min FS
Spencer	1.7
GLE / Morgenstern-Price	1.7



	Project	Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description	Type B Barrier Island - 100-yr Floodplain - Long-Term (Effective Stress)	
	Drawn By	S. McManus	*Company* NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	*Date*	12/17/2020	Figure 10

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-01_Slope_Stability\Sugar_Island_XS-B.slmd

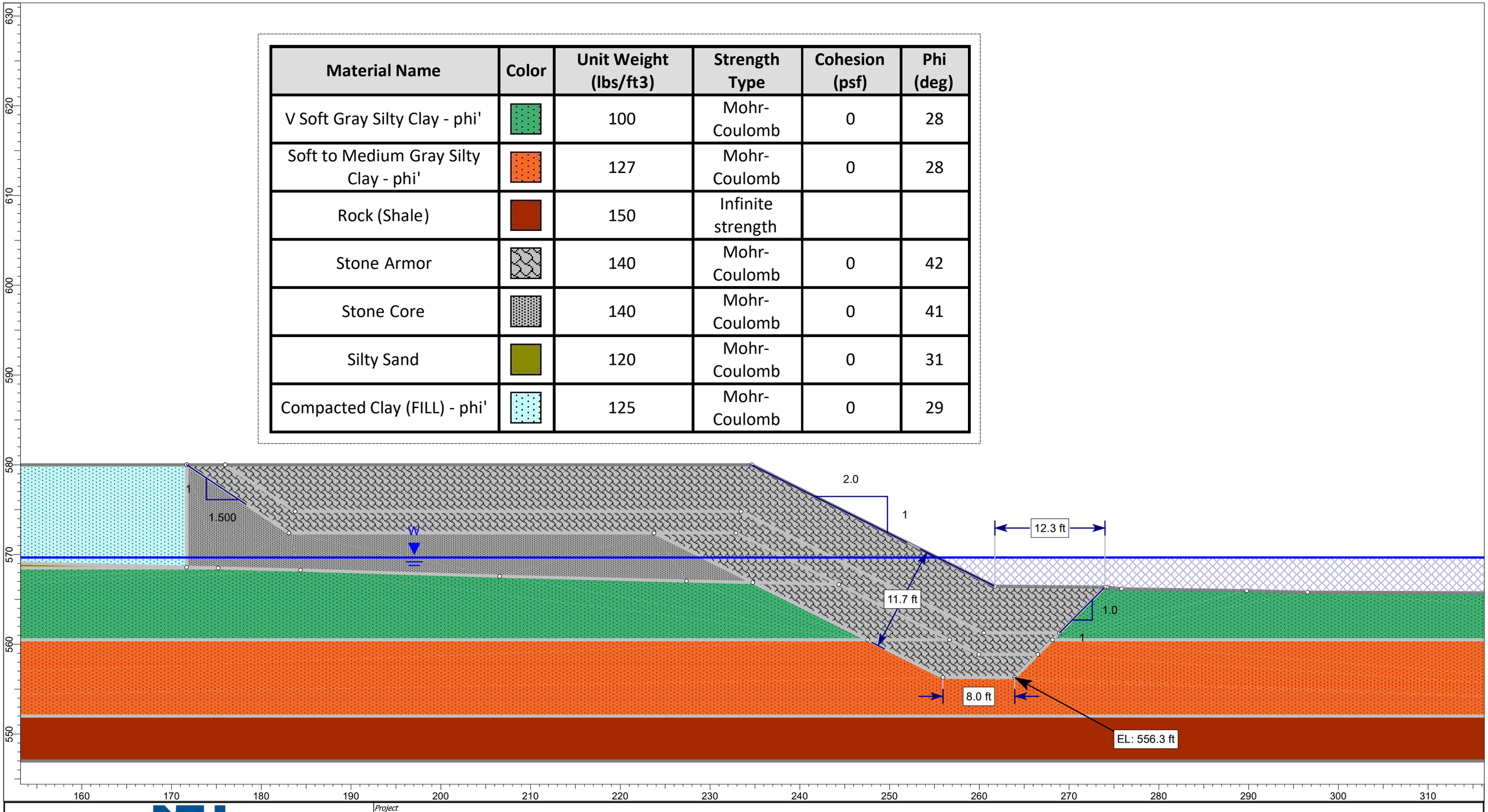
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
V Soft Gray Silty Clay - Su		100	Mohr-Coulomb	150	0
Soft to Medium Gray Silty Clay - Su		127	Mohr-Coulomb	580	0
Rock (Shale)		150	Infinite strength		
Stone Armor		140	Mohr-Coulomb	0	42
Stone Core		140	Mohr-Coulomb	0	41
Silty Sand		120	Mohr-Coulomb	0	31
Compacted Clay (FILL) - Su		125	Mohr-Coulomb	2000	0



	Project: Sugar Island Habitat Restoration - Flow Deflector Peninsula	
	Analysis Description: Slope Stability Cross-Section - Original Design	
	Drawn By: S. McManus	Company: NTH Consultants, Ltd.
SLIDE 9.008	Date: 3/12/2021	Figure 1

S:\Shared\0 Working Documents\61-190115 Sugar Island project\500 Design\520 Calculations\CP-04_Slope_Stability_TB-3\Sugar_Island_FDP.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
V Soft Gray Silty Clay - phi'		100	Mohr-Coulomb	0	28
Soft to Medium Gray Silty Clay - phi'		127	Mohr-Coulomb	0	28
Rock (Shale)		150	Infinite strength		
Stone Armor		140	Mohr-Coulomb	0	42
Stone Core		140	Mohr-Coulomb	0	41
Silty Sand		120	Mohr-Coulomb	0	31
Compacted Clay (FILL) - phi'		125	Mohr-Coulomb	0	29



	Project	Sugar Island Habitat Restoration - Flow Deflector Peninsula
	Analysis Description	Slope Stability Cross-Section - Revised Design (Enlarged Key)
	Drawn By: S. McManus	Company: NTH Consultants, Ltd.
SLIDE 9.008	Date: 3/12/2021	Figure 2

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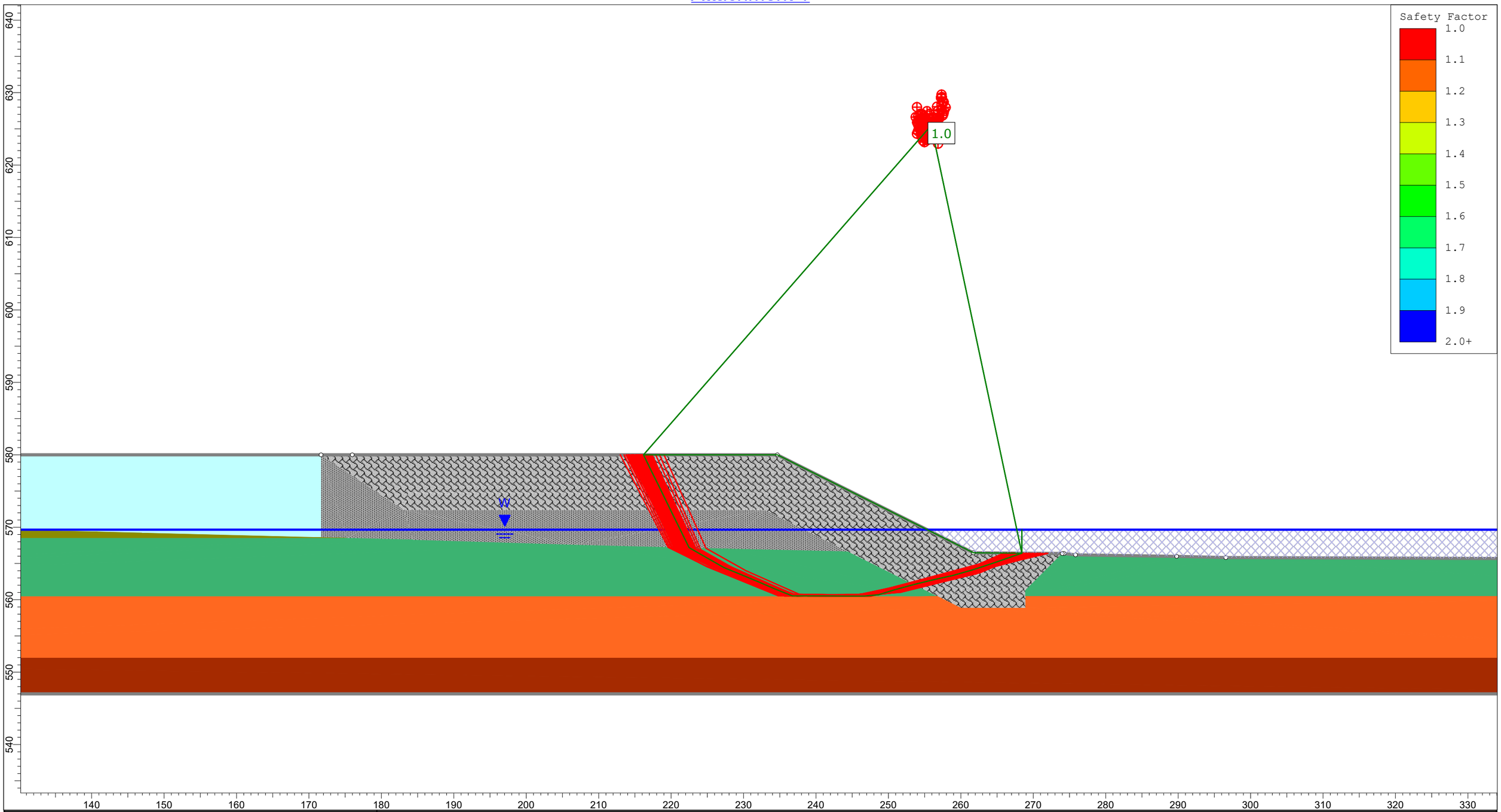
Attachment 1



	Project	Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description	Flow Deflector Peninsula - Original Design - Low Water Datum- Immediately after Construction (Short Term; Total Stress)	
	Drawn By	S. McManus	Company: NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	Date	3/11/2021	Figure 3

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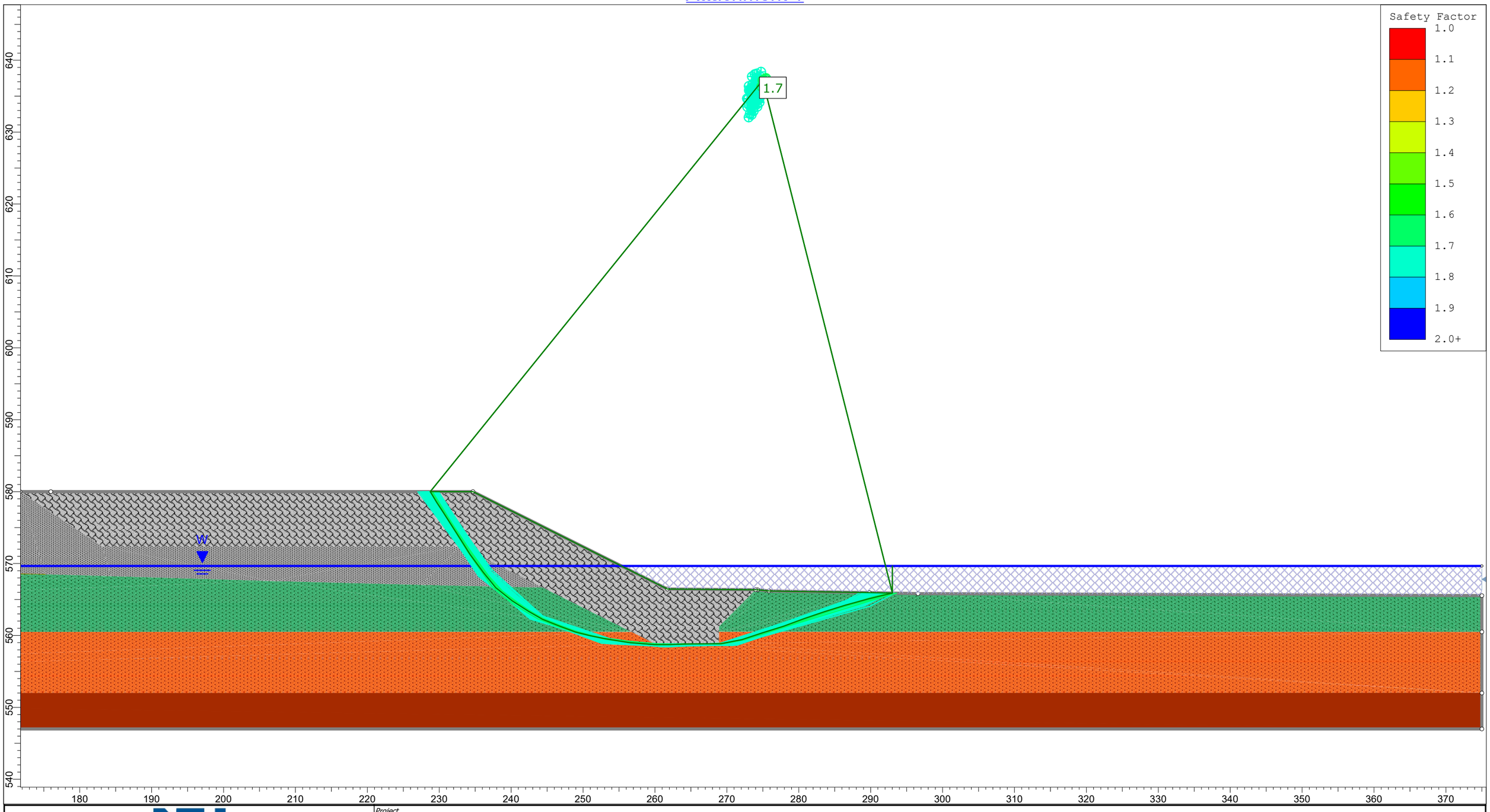

	Project: Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description: Flow Deflector Peninsula - Original Design - Low Water Datum- Long-Term (Effective Stress)	
SLIDEINTERPRET 9.008	Drawn By: S. McManus	Company: NTH Consultants, Ltd.
	Date: 3/11/2021	Figure 4

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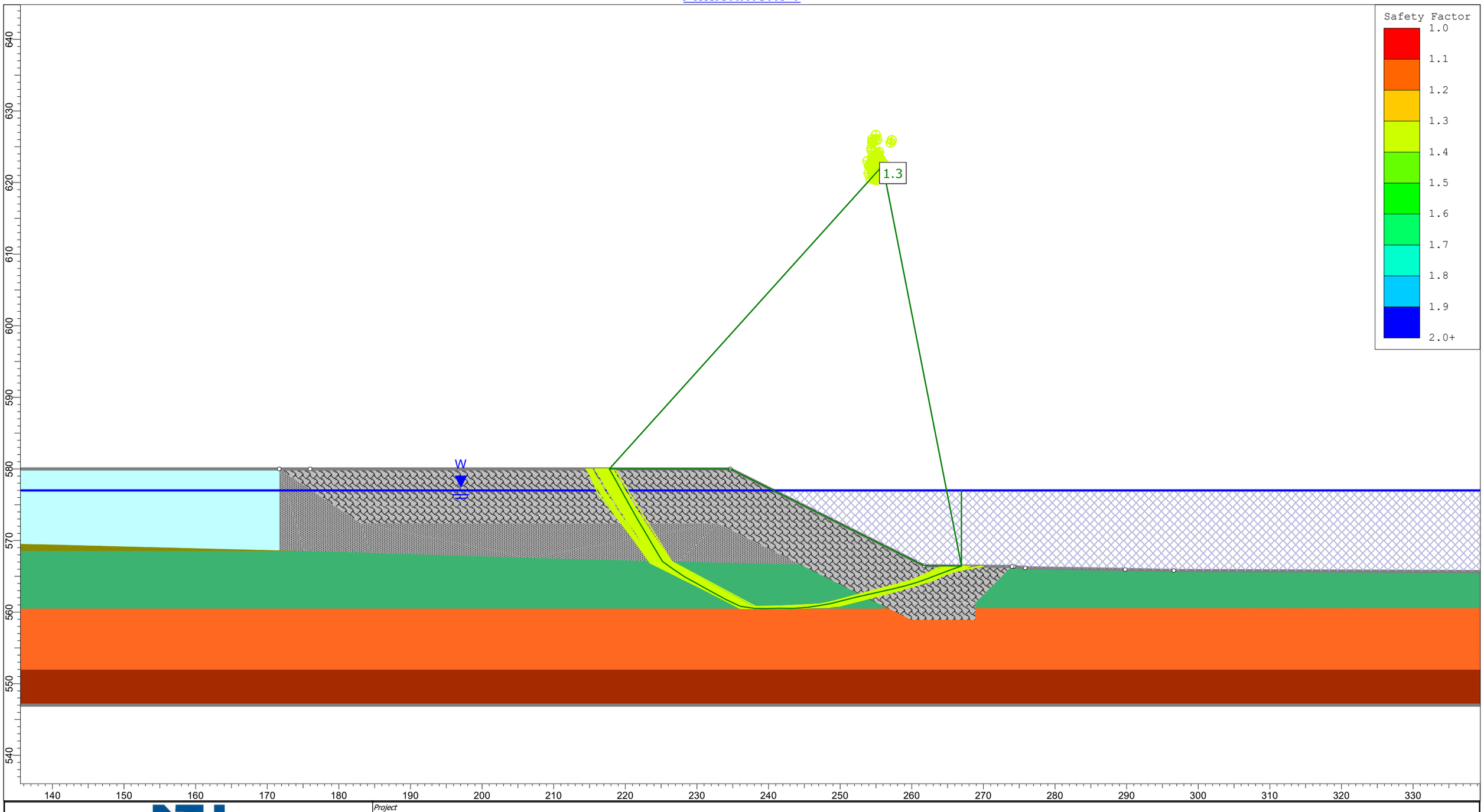
Attachment 1



	Project: Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description: Flow Deflector Peninsula - Original Design - 100-yr Floodplain - Immediately after Construction (Short Term; Total Stress)	
	Drawn By: S. McManus	Company: NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	Date: 3/11/2021	Figure 5

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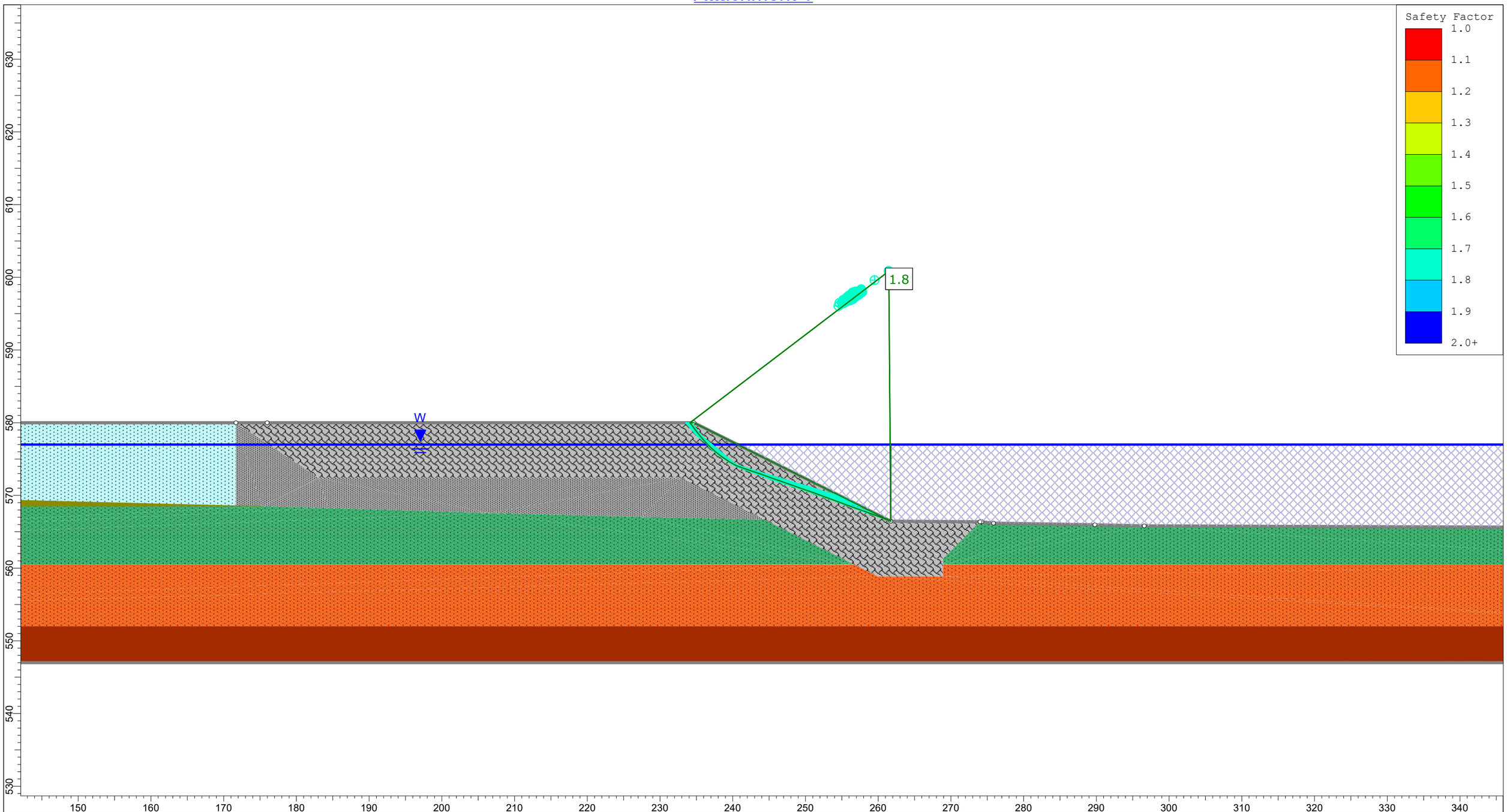

	Project: Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description: Flow Deflector Peninsula - Original Design - 100-yr Floodplain - Long-Term (Effective Stress)	
SLIDEINTERPRET 9.008	Drawn By: S. McManus	Company: NTH Consultants, Ltd.
	Date: 3/11/2021	Figure 6

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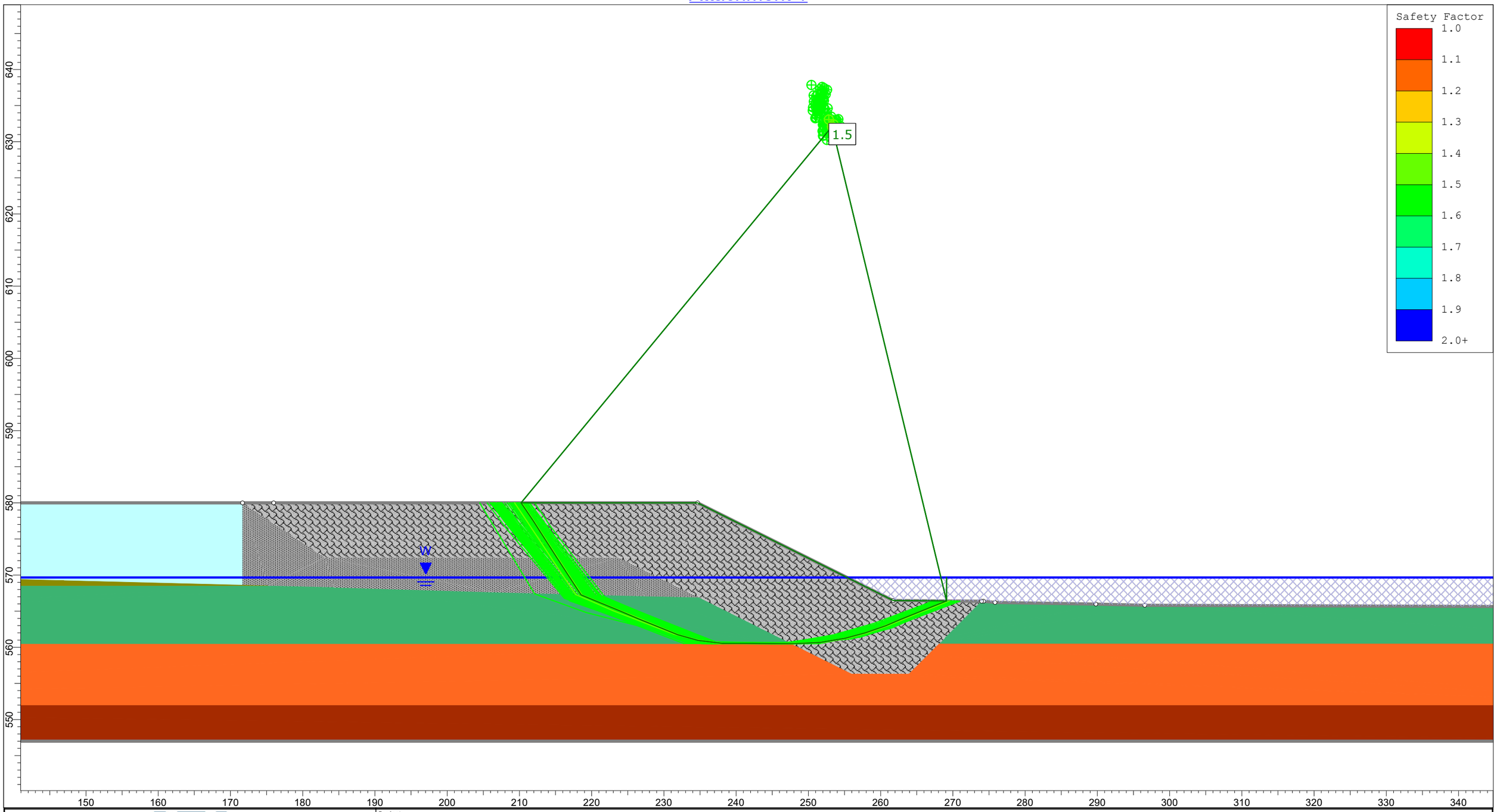
Attachment 1



SLIDEINTERPRET 9.008	*Project* Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description Flow Deflector Peninsula - Revised Design (Enlarged Key) - Low Water Datum- Immediately after Construction (Short Term; Total Stress)	
	Drawn By S. McManus	*Company* NTH Consultants, Ltd.
	Date 3/11/2021	Figure 7

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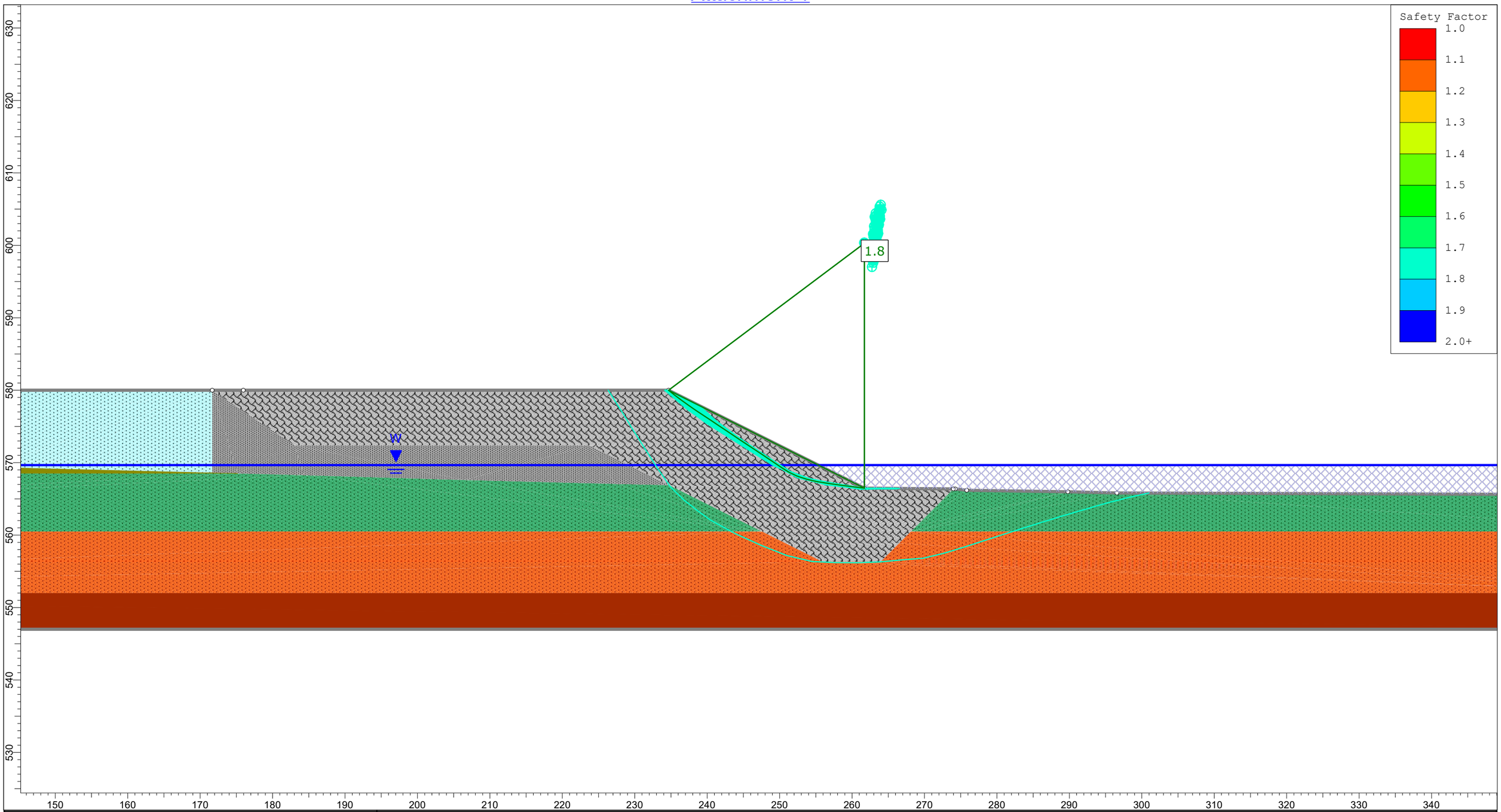

	Project Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description Flow Deflector Peninsula - Revised Design (Enlarged Key) - Low Water Datum - Long-Term (Effective Stress)	
SLIDEINTERPRET 9.008	*Drawn By* S. McManus	*Company* NTH Consultants, Ltd.
	Date 3/11/2021	Figure 8

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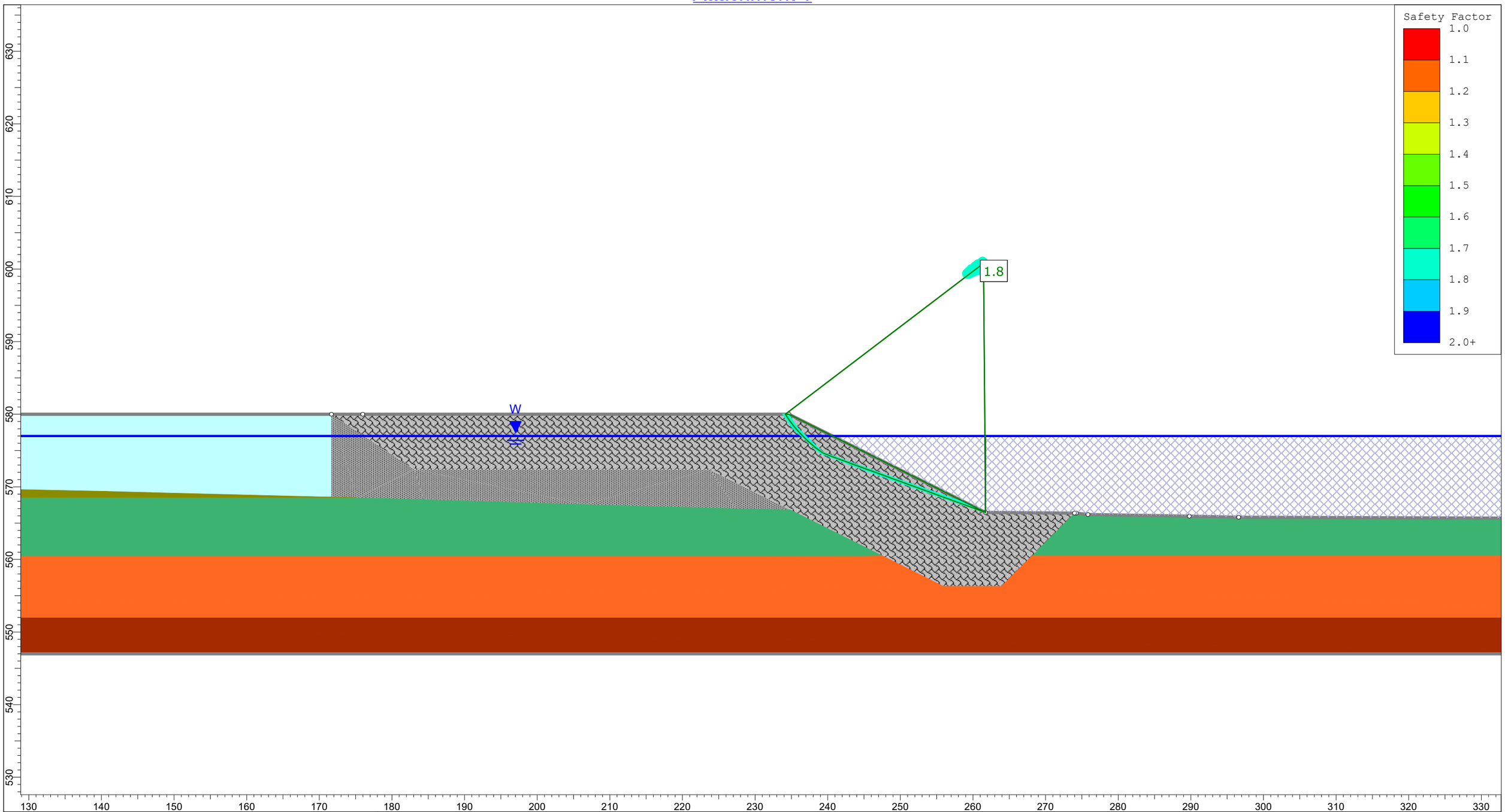

	Project	Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description	Flow Deflector Peninsula - Revised Design (Enlarged Key) - 100-yr Floodplain - Immediately after Construction (Short-Term; Total Stress)	
	Drawn By	S. McManus	Company: NTH Consultants, Ltd.
SLIDEINTERPRET 9.008	Date	3/11/2021	Figure 9

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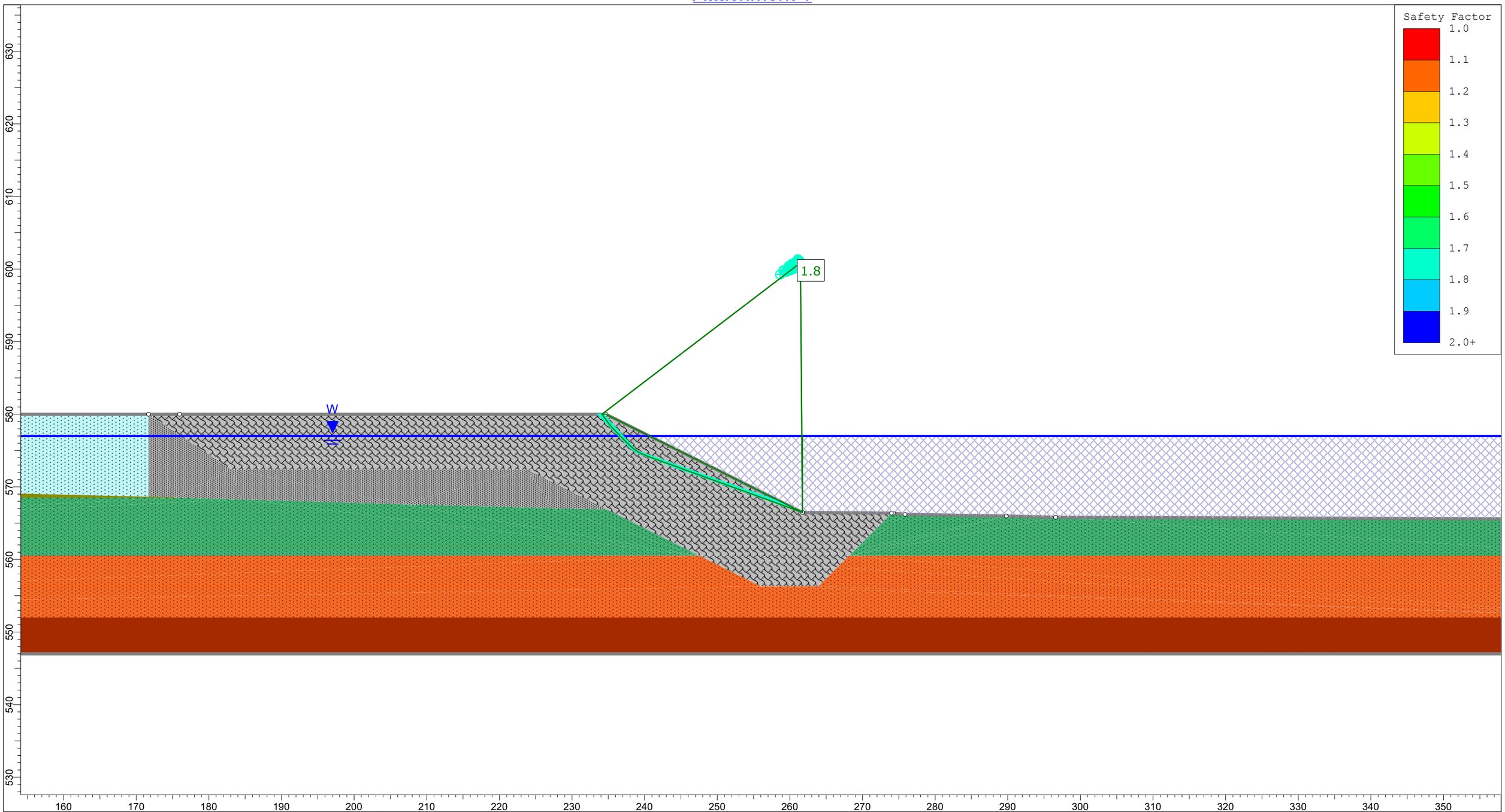

SLIDEINTERPRET 9.008	*Project*	Sugar Island Habitat Restoration - Slope Stability Analysis	
	Analysis Description	Flow Deflector Peninsula - Revised Design (Enlarged Key) - 100-yr Floodplain - Long-Term (Effective Stress)	
	Drawn By	S. McManus	*Company* NTH Consultants, Ltd.
	Date	3/11/2021	Figure 10

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