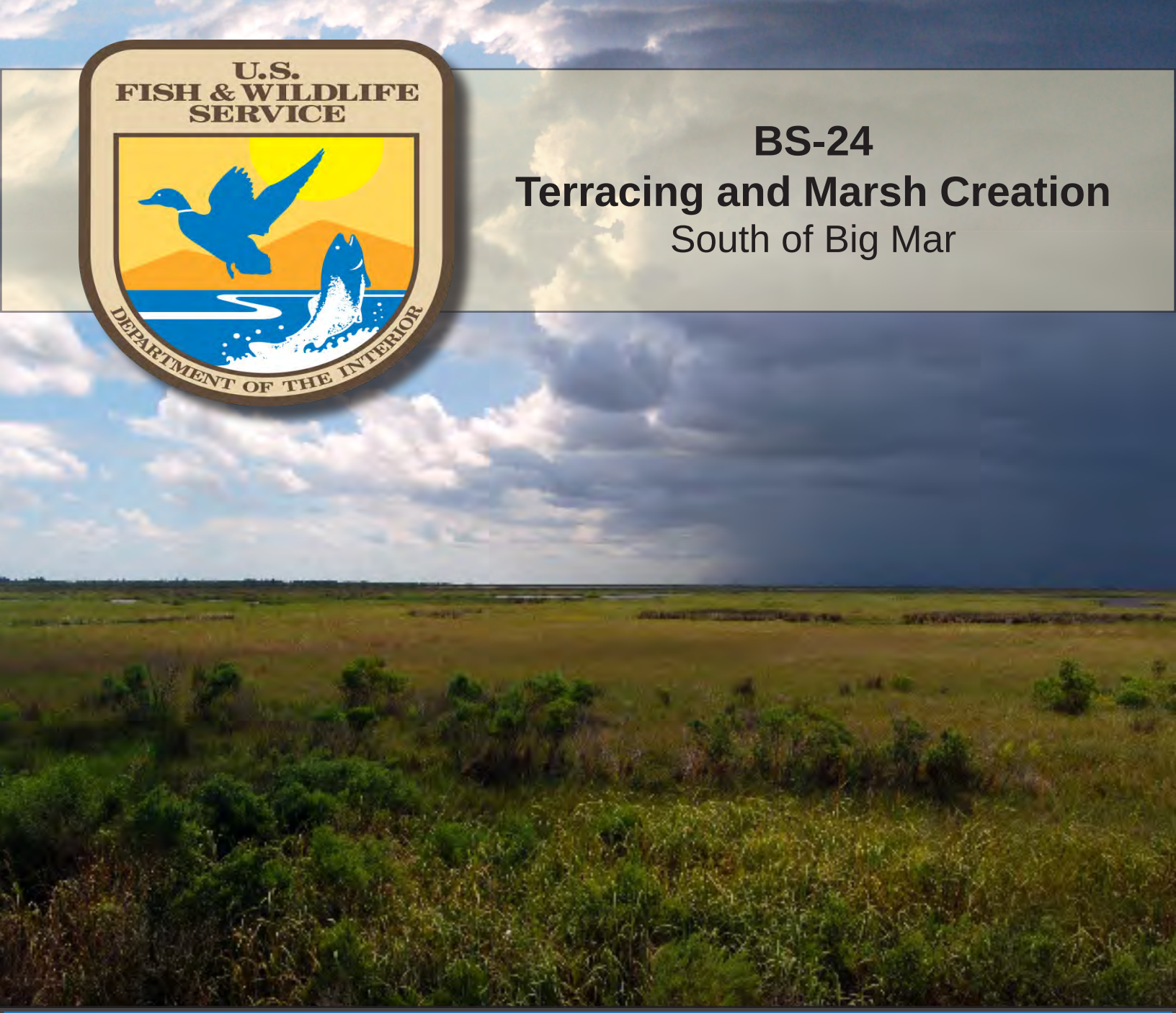

BS-24
Terracing and Marsh Creation
South of Big Mar

Prepared By:
Lonnie G. Harper & Associates, Inc.
2746 Highway 384
Sweetlake Community
Cameron Parish
Bell City, LA 70630

February, 2016

ADDITIONAL SURVEY & GEOTECHNICAL INVESTIGATION REPORT (SITE 2B)

Terracing and Marsh Creation South of Big Mar (BS-24)
Plaquemines Parish, Louisiana

February 2016

Prepared for:

Natural Resources Conservation Service
646 Cajundome Blvd., Suite 180
Lafayette, La 70506

Attention: Ms. Vicki Supler, Contracting Officer

Prepared by:

Lonnie G. Harper & Associates, Inc.
2746 Hwy 384
Bell City, La 70630
337.905.1079

Author: Christopher Wheat, PE

Reviewed: Leonard Harper, PE

Lonnie G. Harper & Associates, Inc.
CIVIL ENGINEERING AND LAND SURVEYING CONSULTANTS

Contents

Introduction

The purpose of this report is to briefly outline the results of the geotechnical investigation and describe the surveying methodology and equipment used to perform a topographic/bathymetric and magnetometer survey of a site to facilitate the construction of earthen terraces as part of the Terracing and Marsh Creation South of Big Mar (BS-24) project. The extent of this work scope was developed by the project designer, Lonnie G. Harper & Associates, Inc. (LHA) and their sub-consultant GeoEngineers, Inc. as outlined in the *Proposal for Additional Services* (See Appendix E) dated May 2012, and authorized by the Natural Resource Conservation Service (NRCS) in August 2015. All work performed under this task order is to aid the designer (LHA) in preparing construction drawings, specifications, and quantity estimations for the BS-24 project.

Overview

The following document is a brief summary of the additional work performed by LHA and GeoEngineers at the BS-24 project site. Based on the original survey data collected by T. Baker Smith, LLC (TBS) and NRCS, the presence of underground pipelines prohibited site access to one of the original project sites (Site 2); therefore a new site was selected by NRCS and USFWS to build the proposed terraces, which shall be referred to as "Site 2B" throughout the remainder of this report. All work described herein was required in order to proceed with the engineering design phase(s) of the Site 2B project features.

Site 2B is located between Site 2 and the proposed marsh creation area associated with the BS-24 project. (See Appendix A for vicinity map.) Using the survey plan and data provided by TBS and NRCS, LHA developed a similar survey plan which consisted of topographic survey lines extending across Site 2B, with a maximum shot spacing of approximately fifty feet along each transect. Topographic data was also collected at significant changes in elevation (where visible) along these transect lines. Topographic data along the proposed access routes was also collected at the same intervals. A magnetometer survey was also performed along the access routes and throughout Site 2B. Magnetometer survey lines were established at 500' intervals across the site and access routes as shown in Appendix C. All data was collected between the dates of Monday August 31 and Thursday September 04 of 2015. A complete copy of all topographic data and field notes have been include on a disc accompanying this report.

Survey Control & Data Collection

To ensure continuity between the original surveys performed by NRCS, all surveying activities completed for this task order was collected utilizing the control monument "BS16-SM-02", and its associated Geoid 12A Orthometric height as determined by T. Baker Smith in August 2013. Reference Appendix B for

monument data sheet. LHA utilized a Trimble R8 receiver on a fixed height tripod as a base station, setup on the referenced control monument. For quality control purposes, static files were logged at the base station on three separate days for approximately 8-10 hours per day. Static files were processed using OPUS to determine the horizontal and vertical position of the BS16-Sm-02 monument. These static files yielded a horizontal position with a variation of ±0.10' from the published data sheet and a difference of -0.07' in the orthometric height, which is an acceptable range given the nature of the work associated with this project. No adjustments to the collected data will be necessary based on the results of the static occupations.

All topographic/bathymetric data was collected manually using RTK surveying methodologies and utilizing Trimble R8 receivers and TSC3 data collectors. Elevation data was taken at the mudline at each of the predetermined locations along each survey transect line. Data was also collected along the access route centerlines and along adjacent transects offset a distance of fifty feet on each side; yielding topographic data for access routes 100 feet in width. Shot spacing along each transect did not exceed 50 feet. Survey transect lines are shown in Appendix C.

Magnetometer Survey

A Geometrics G-882 marine magnetometer with Trimble SPS461 differential positioning equipment and Hypack® navigation software was used to complete the geophysical surveys associated with this scope. The magnetometer sensor was suspended over the water off the front of an airboat using a custom made aluminum boom that attaches to the rake of the airboat. This allows the users to have better control of the sensor while navigating open water bodies and vegetated marshes. This configuration also allows for the sensor to be fixed directly to the sensor, which eliminates the need for an offset calibration synonymous with towing the sensor behind a watercraft. All data was viewed using an onboard laptop and processed using Hypack® to determine the geographical locations of all anomalies encountered. Anomalies are identified in Hypack® based on the magnitude of the gamma readings relative to baseline gamma readings at the site.

LHA performed a magnetometer survey of the entire site and the proposed access routes. Survey lines traversed the entire work area and were established on a grid spacing of 500'. The magnetometer was ran along each predetermined line and the data was evaluated for spikes in the gamma readings, which indicated the presence of a magnetic anomaly. All anomalies encountered were identified in the field by visual observation, probing, etc. Two pipelines were discovered along the northern boundary of Site 2B, both of which coincided with the Plains and Enterprise pipelines TBS located during their magnetometer survey in 2014. No other pipelines were discovered within the project site; however a large iron object was located

in the southeastern portion of Site 2B. The location of this anomaly does not appear in the State of Louisiana's digital database (sonris.com) as being any type of oil/gas well. The object is located at or slightly below the mudline and is approximately 2-3 feet in diameter. The object was submerged at the time of the survey; therefore a visual observation was not possible. The anomaly position was cross referenced with the Louisiana Department of Natural Resources online GIS database (SONRIS) for a possible oil/gas well or injection well, but yielded no results. LHA is confident that the anomaly is not a pipeline, as there were no adjacent hits with the magnetometer, but the identity of this object is still unknown. The location of this anomaly should not impact the terrace construction within site 2B, but the construction contractor will need to be aware of its presence and make provisions to avoid impact with object. Reference sheet 27 of Appendix C for the location of all magnetic anomalies encountered during this field survey. The unknown anomaly mentioned above is referenced as "MA-2" on the map found in the appendix.

Geotechnical Investigation

On December 22, 2015, GeoEngineers mobilized their airboat drilling rig to the project site and obtained soil samples at two different locations from within Site 2B. Samples were collected and tested to determine physical properties and projected settlement and consolidation rates of the native material, which will be used to calculate the constructed height of the proposed terraces. A summary of their findings can be found in the geotechnical investigation report in Appendix D.

Conclusion

In closing, with the new data collected under this task, LHA is confident that the amount and quality of the data is accurate and complete such that the next phase of the BS-24 project can commence. At this time, LHA is unaware of any site data limitations that would prevent any further delays in the preparation of preliminary and final construction drawings. Once all deliverables have been reviewed and accepted by NRCS personnel, LHA will finalize the Alternatives Design Report for the project and submit to the NRCS for review and acceptance.

APPENDIX A

Vicinity Map

LONNIE G. HARPER & ASSOCIATES, INC.
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PHONE: (337) 905-1079 FAX: (337) 905-1076

0 800' 1,600' 2,400'
Hor. Scale in Feet

Date	
Designed	Chris Wheet 02/5/16
Drawn	Chris Wheet 02/5/16
Checked	Leonard Harper 02/5/16
Approved	Lonnie Harper 02/5/16

VICINITY MAP
BS-24 TERRACING AND MARSH CREATION SOUTH OF BIG MAR
Page 01 of 01

Plaquemines Parish, Louisiana

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
VICINITY MAP.dwg
Drawing No.

2/5/16 8:34 AM
Sheet 01 of 01

APPENDIX B

Monument Data Sheet: BS16-SM-02

VICINITY MAP Not to Scale Reproduced from 2010 DOQQ Arial Photography

Station Name: "BS16-SM-02"

Monument Location: Monument is located on the western bank of a location canal south of Lake Lery. Monument is located approximately 0.25 miles south of the intersection of Lake Lery and the location canal. It is approximately 0.6 miles north of the intersection of the location canal with another canal. Monument is located in Plaquemines Parish, northwest of the town of Delacroix.

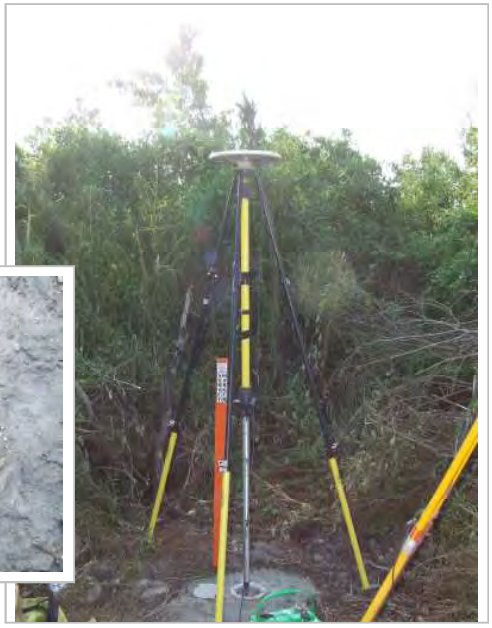
Monument Description: NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 84 feet to refusal, set in sand filled 6" PVC pipe with access cover set in concrete, flush with the ground.

Installation Date: August 2013

Date of Survey: August 2013

Monument Established By: T. Baker Smith, LLC

For: *Natural Resources Conservation Service*



Adjusted NAD 83 (2011) Geodetic Position
Lat. 29° 46' 31.97" N
Long. 89° 51' 50.31" W

Adjusted NAD 83 Datum LSZ (1702) Feet
N= 466,857.617
E= 3,746,965.627

Adjusted NAVD88 (2010.0) Height
Elevation = 1.761 feet (0.537 mtrs.) (Geoid12A)

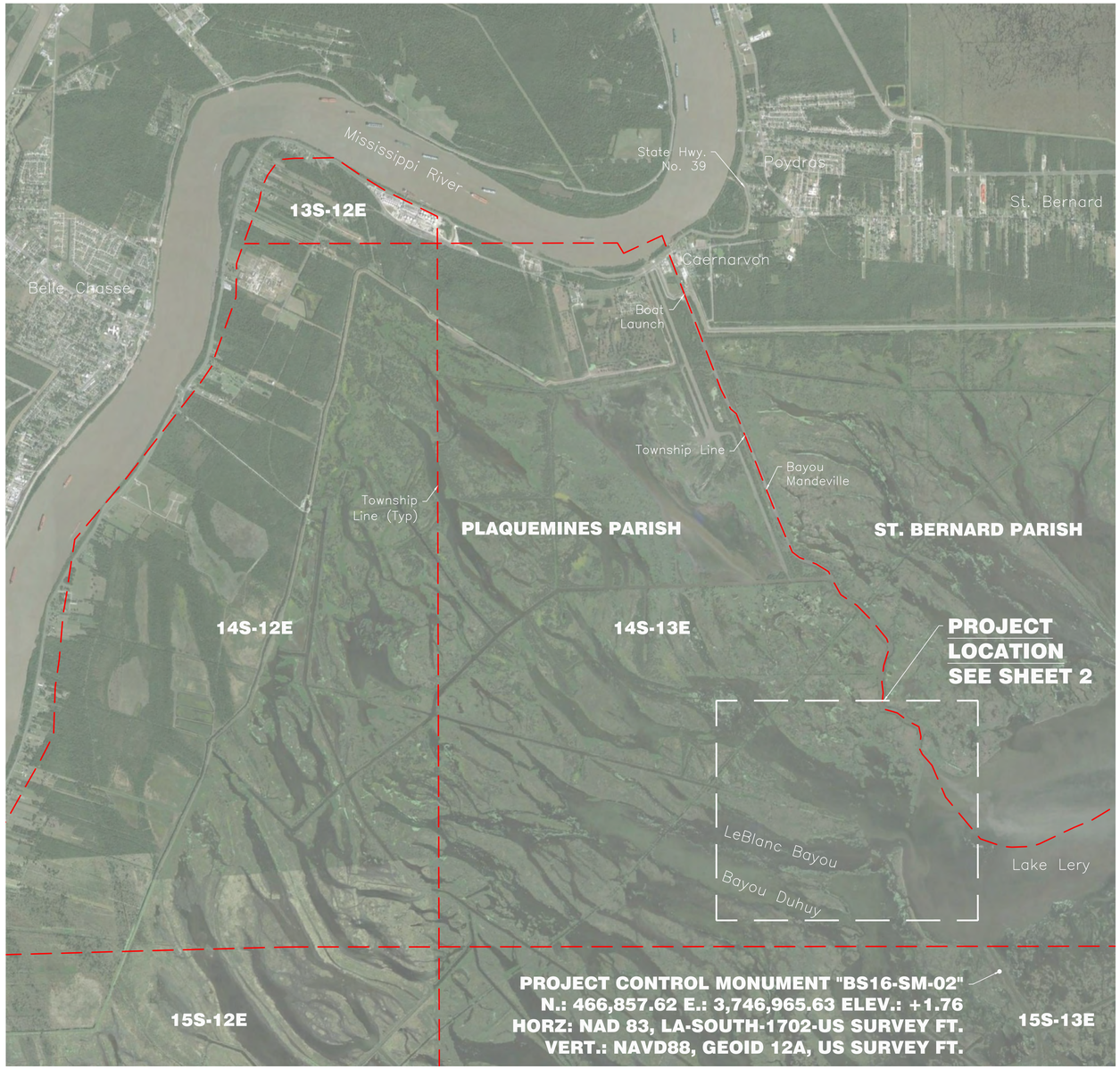
Ellipsoid Height = -24.924 mtrs.
Geoid12A Height = -25.461 mtrs.

FOR REFERENCE ONLY
Adjusted NAVD88 Height (2006.81) (Geoid03)
Elevation = 1.574 feet (0.480 mtrs)
Ellipsoid Height = -81.903 feet (-24.964 mtrs)
Geoid 03 Height = -83.477 feet (-25.444 mtrs) (2004.65)

Adjusted Position Established for Natural Resources Conservation Service, NRCS

APPENDIX C

Survey Plan Drawings, Contour Map, and Magnetometer Anomaly Map



0 3000' 6000' 9000'

HOR. SCALE

Project Access

Project Access / Township Line

Township Line

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BS-24 TERRACING & MARSH CREATION SOUTH OF BIG MAR

BUILT UNDER THE COASTAL WETLANDS PLANNING, PROTECTION, AND RESTORATION ACT PUBLIC LAW 101-646

BY THE NATURAL RESOURCES CONSERVATION SERVICE OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

WITH THE ASSISTANCE OF THE U.S. FISH & WILDLIFE SERVICE

INDEX OF DRAWINGS

GENERAL NOTES:

1. All distances and elevations are expressed in terms of feet unless otherwise denoted.

2. This survey is referenced to the National Geodetic NAD 83 horizontal datum Louisiana Lambert South Zone-1702, all coordinates are expressed in feet, and were derived by recent gps observations.

3. This survey is referenced to the National Geodetic NAVD 88 vertical datum using Geoid model 12A, all elevations are expressed in feet, and were derived by recent gps observations.

4. All coordinate conversions from NAD 83 to WGS84 lat. & long. were performed using NGS Nadcon Utility software.

5. This survey is referenced to NRCS Monument "BS16-SM-02" located along the west bank of a canal heading southeast from the southwest corner of Lake Leary in Caernavorn, La. the adjusted position is referenced to Cors2011 Epoch 2010, Geoid12a and has coordinates: N= 466,857.62, E = 3,746,965.63, and Elev = 1.76.

Date	
Designed	Chris Wheat 09/01/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

VICINITY MAP
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 1 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
01/26/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

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Sheet 1 of 28

N

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HOR. SCALE

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		Date
Designed	Chris Wheat	09/21/15
Drawn	Aaron Harper	09/17/15
Checked	Leonard Harper	09/21/15
Approved	Lonnie Harper	09/24/15

PROJECT LOCATION
TERRACING & MARSH CREATION
SOUTH OF BIG MAR
BS-24
Page 2 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
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09/28/2015
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NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
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4	476443.67	3735833.31	Transect "T2"
5	477660.08	3737183.01	Transect "T3"
6	476276.63	3736019.48	Transect "T3"
7	477490.68	3737367.20	Transect "T4"
8	476141.13	3736232.19	Transect "T4"
9	477303.63	3737536.55	Transect "T5"
10	475996.40	3736437.13	Transect "T5"
11	477111.81	3737701.89	Transect "T6"
12	475699.54	3736514.12	Transect "T6"
13	476936.61	3737881.20	Transect "T7"
14	475657.31	3736805.27	Transect "T7"
15	476780.05	3738076.19	Transect "T8"
16	475273.37	3736809.03	Transect "T8"
17	476676.63	3738315.87	Transect "T9"
18	474997.50	3736903.67	Transect "T9"
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26	474511.95	3737801.96	Transect "T13"
27	476199.41	3739547.83	Transect "T14"
28	474433.68	3738062.79	Transect "T14"
29	476079.08	3739773.28	Transect "T15"
30	474305.11	3738281.33	Transect "T15"
31	475958.41	3739998.46	Transect "T16"
32	474235.16	3738549.16	Transect "T16"
33	475837.91	3740223.78	Transect "T17"
34	474097.70	3738760.21	Transect "T17"
35	475694.44	3740429.78	Transect "T18"
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39	475334.77	3740780.61	Transect "T20"
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46	473494.19	3740212.61	Transect "T23"
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Date
Designed Chris Wheat 09/01/15
Drawn Aaron Harper 09/17/15
Checked Leonard Harper 09/21/15
Approved Lonnie Harper 09/24/15

TOPOGRAPHIC SURVEY GRID
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 3 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
07-24-2015
PROFESSIONAL LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

LONNIE G. HARPER & ASSOCIATES, INC.
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2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

1. All topographic data depicted was collected using Trimble R8 receivers and TSC3 data collectors with an RTK base station set at monument "BS16-SM-02", bearing NAD83 (2011) Lambert South Zone "LZ-1702" coordinates of N. 466,857.617 and E. 3,746,965.627 and a Geoid 12A orthometric height of 1.761 feet NAVD 88.

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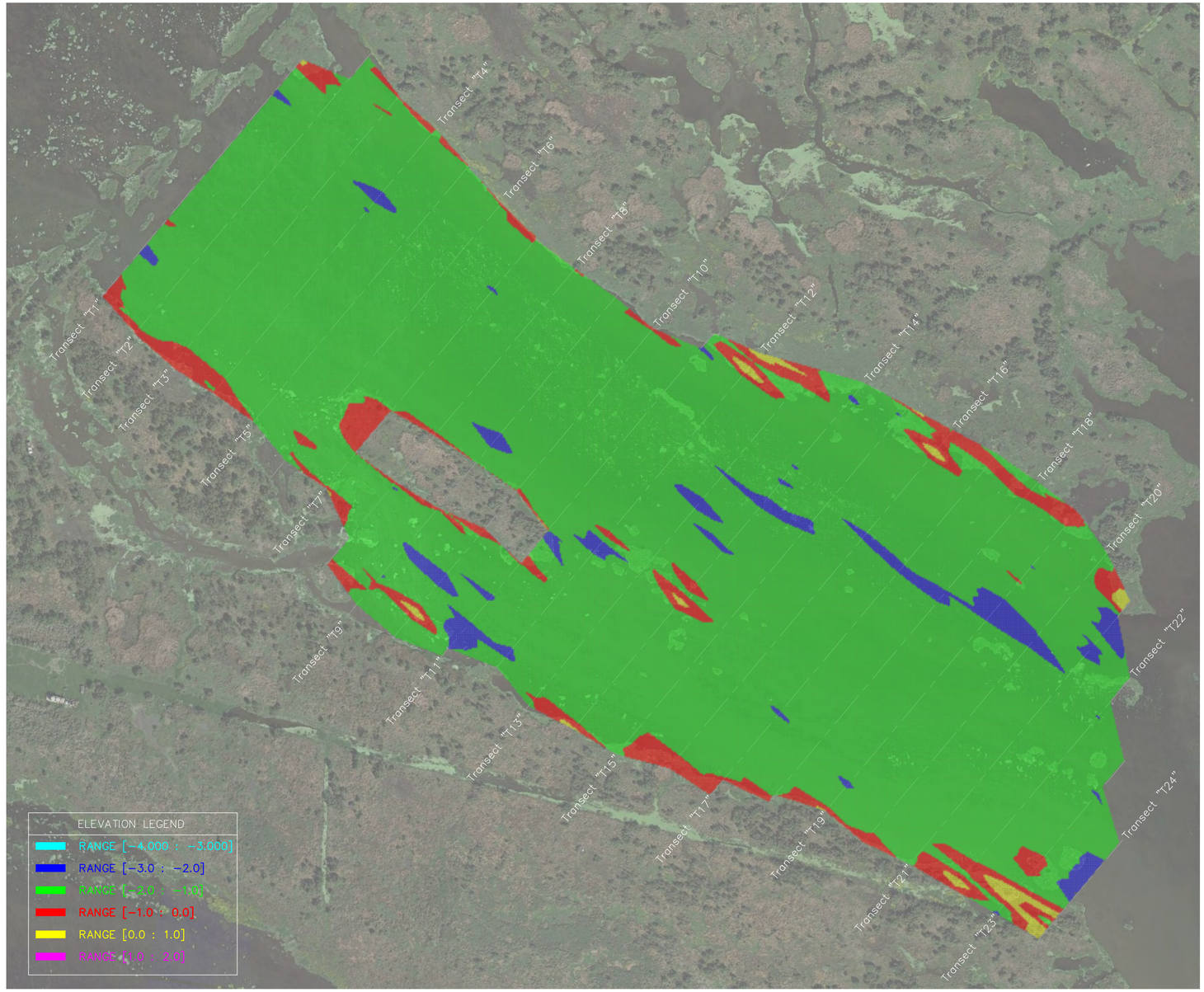

N

0 300' 600' 900'

HOR. SCALE

TOPOGRAPHIC SURFACE MAP
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 4 of 28

Plaquemines Parish, Louisiana

		Date
Designed	*Chris Wheat*	*09/21/15*
Drawn	*Aaron Harper*	*09/17/15*
Checked	*Leonard Harper*	*09/21/15*
Approved	*Lonnie Harper*	*09/24/15*

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO 4036
REGISTERED
09/28/2015
LAND SURVEYOR

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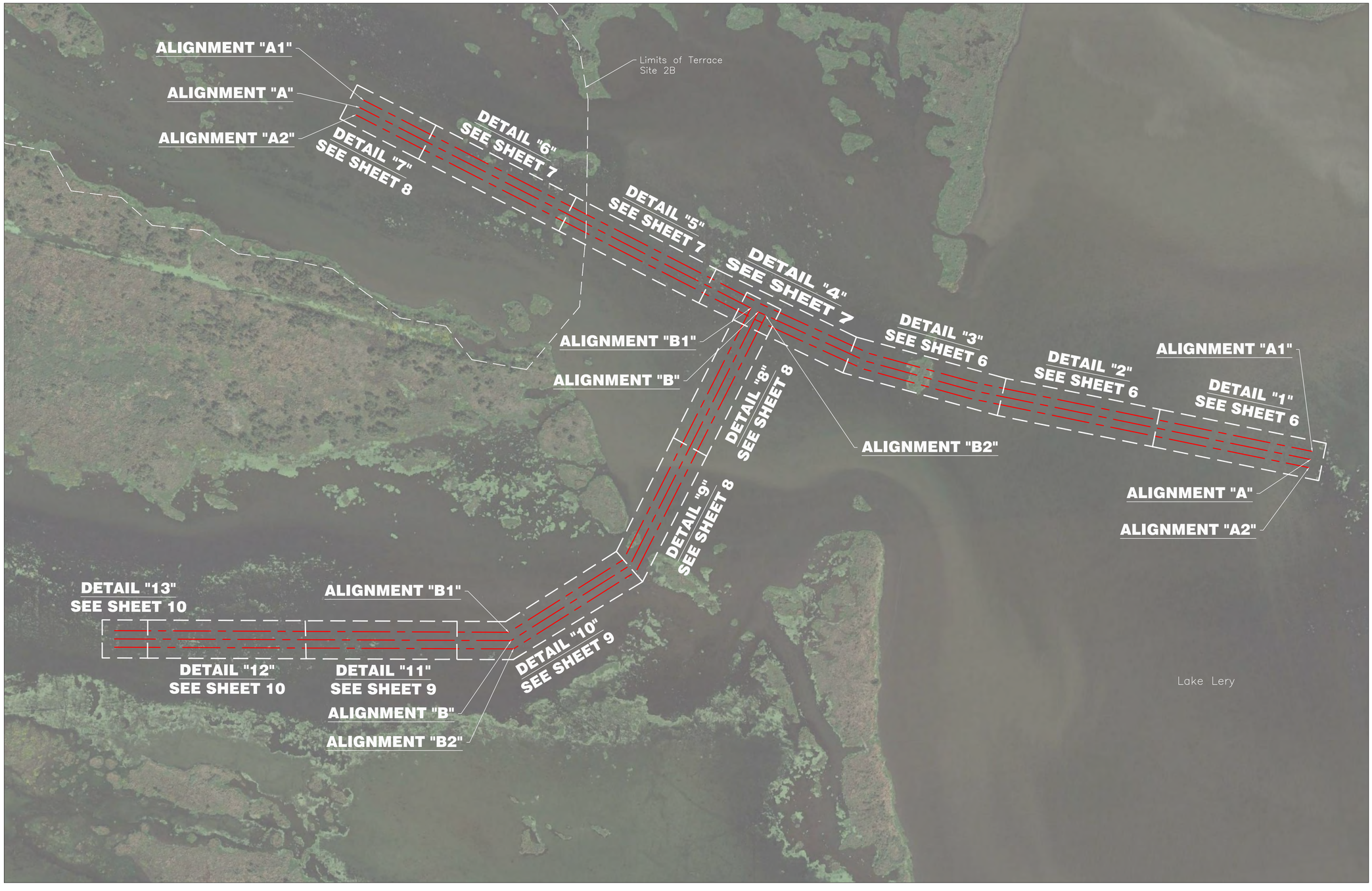

	Date
Designed Chris Wheat	09/01/15
Drawn Aaron Harper	09/17/15
Checked Leonard Harper	09/21/15
Approved Lonnie Harper	09/24/15

ACCESS ROUTE SITE PLAN
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 5 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
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HOR. SCALE

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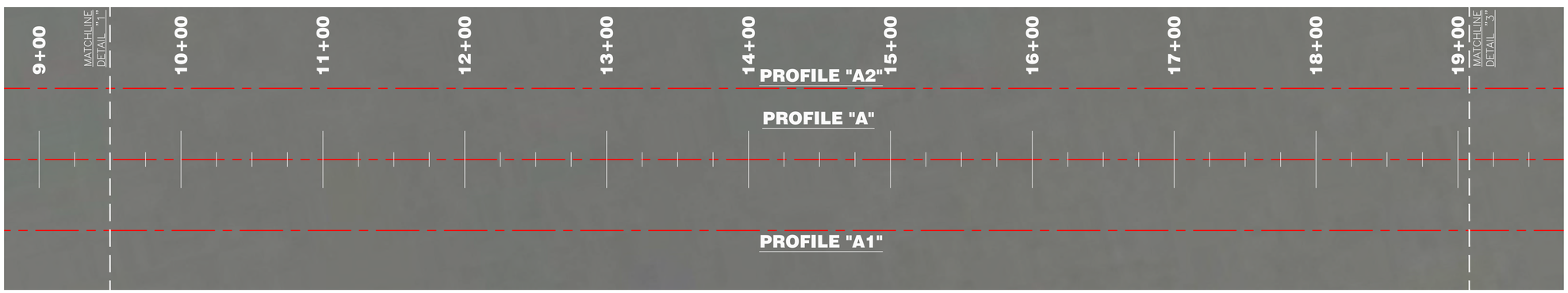

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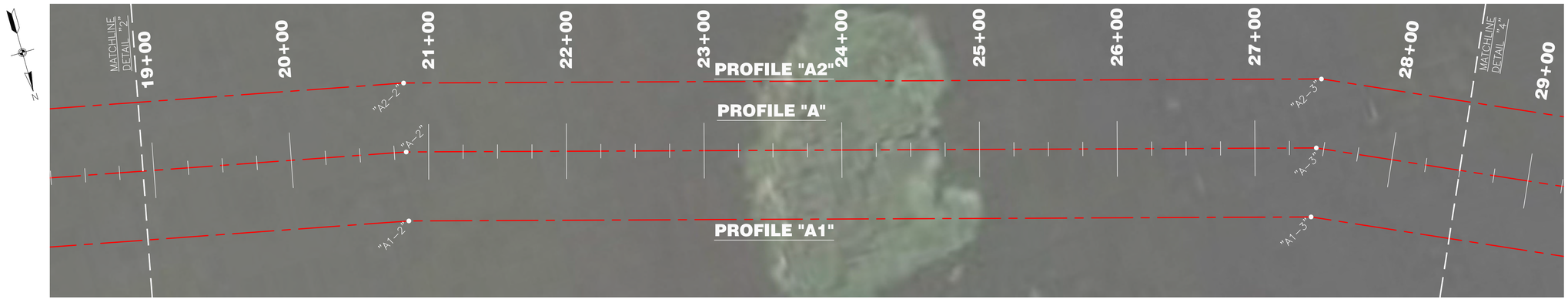

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PLAN VIEW

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0 40' 80' 120'

HOR. SCALE

	Date
Designed	Chris Wheat 09/21/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

DETAIL "1" THRU "3"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 6 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

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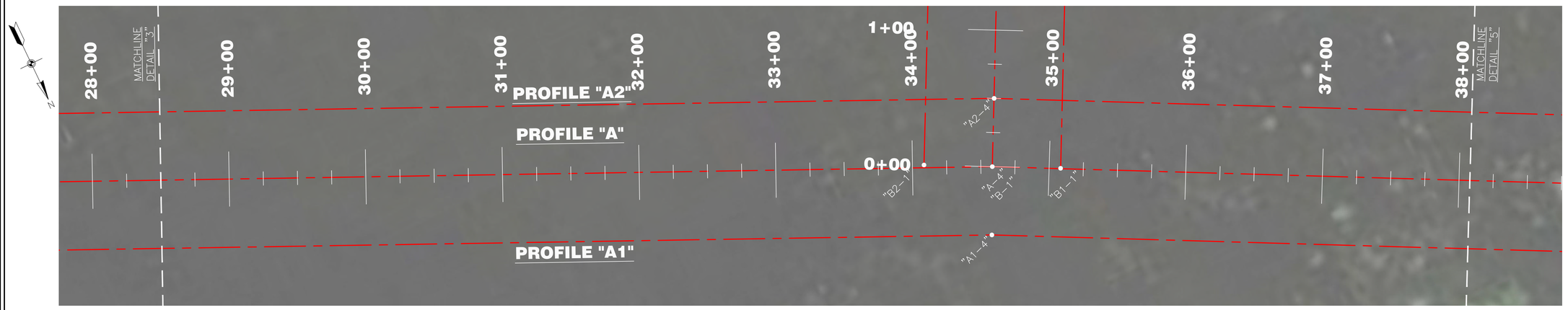

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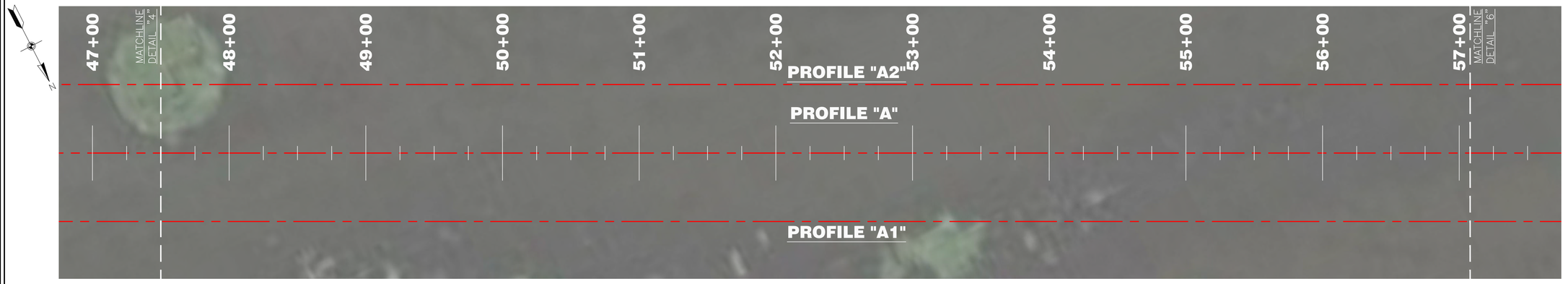

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PLAN VIEW

DETAIL "6"
PLAN VIEW

LONNIE G. HARPER & ASSOCIATES, INC.
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PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

1. All topographic data depicted was collected using Trimble R8 receivers and TSC3 data collectors with an RTK base station set at monument "BS16-SM-02", bearing NAD83 (2011) Lambert South Zone "LZ-1702" coordinates of N. 466,857.617 and E. 3,746,965.627 and a Geoid 12A orthometric height of 1.761 feet NAVD 88.

0 40' 80' 120'

HOR. SCALE

		Date
Designed	Chris Wheat	09/01/15
Drawn	Aaron Harper	09/17/15
Checked	Leonard Harper	09/21/15
Approved	Lonnie Harper	09/24/15

DETAIL "4" THRU "6"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 7 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
LAND SURVEYOR

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United States Department of Agriculture

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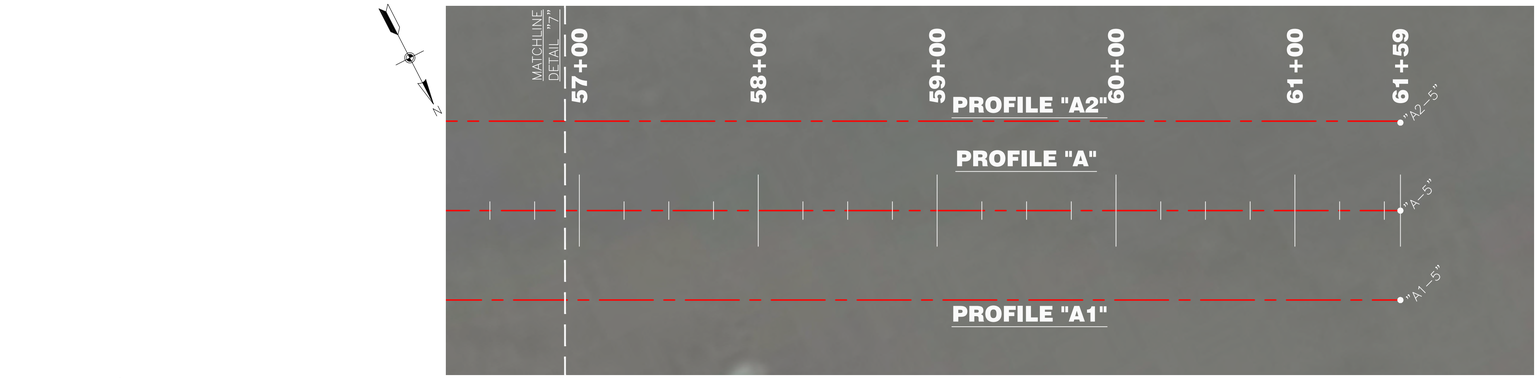

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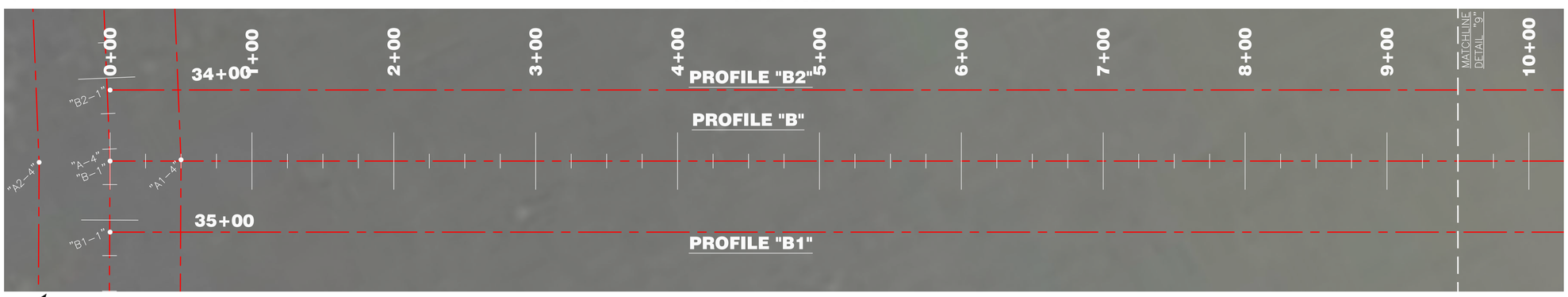

DETAIL "8"
PLAN VIEW

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

1. All topographic data depicted was collected using Trimble R8 receivers and TSC3 data collectors with an RTK base station set at monument "BS16-SM-02", bearing NAD83 (2011) Lambert South Zone "LZ-1702" coordinates of N. 466,857.617 and E. 3,746,965.627 and a Geoid 12A orthometric height of 1.761 feet NAVD 88.

DETAIL "9"
PLAN VIEW

0 40' 80' 120'
HOR. SCALE

Date	
Designed	Chris Wheat 09/21/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

DETAIL "7" THRU "9"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 8 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

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Drawing No.
2015-64
2/4/16 11:21 AM
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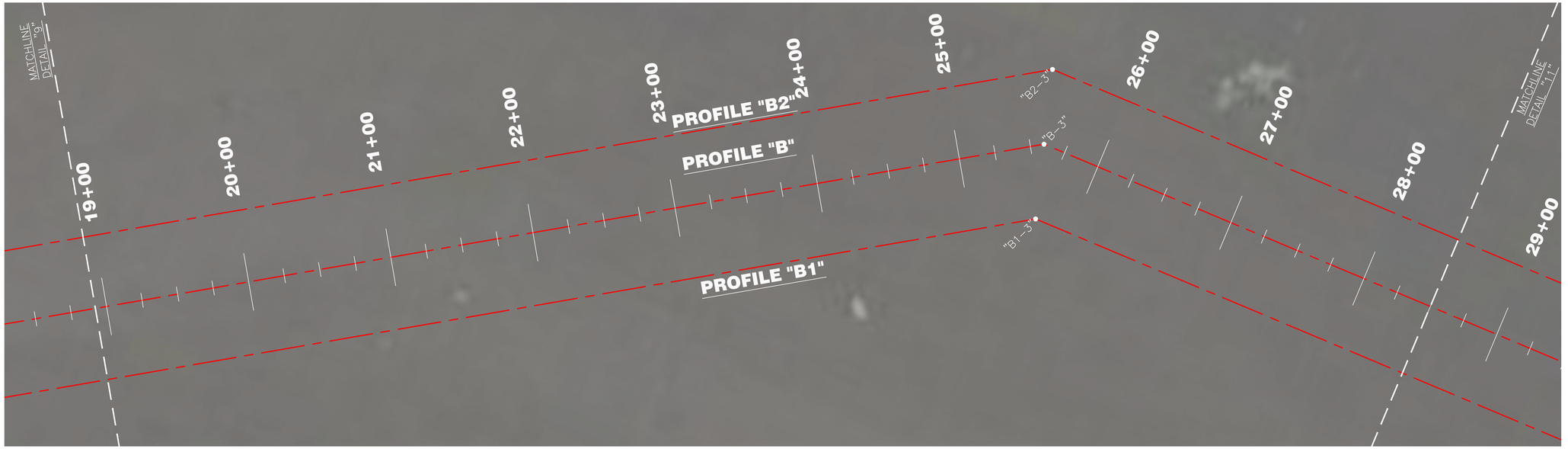
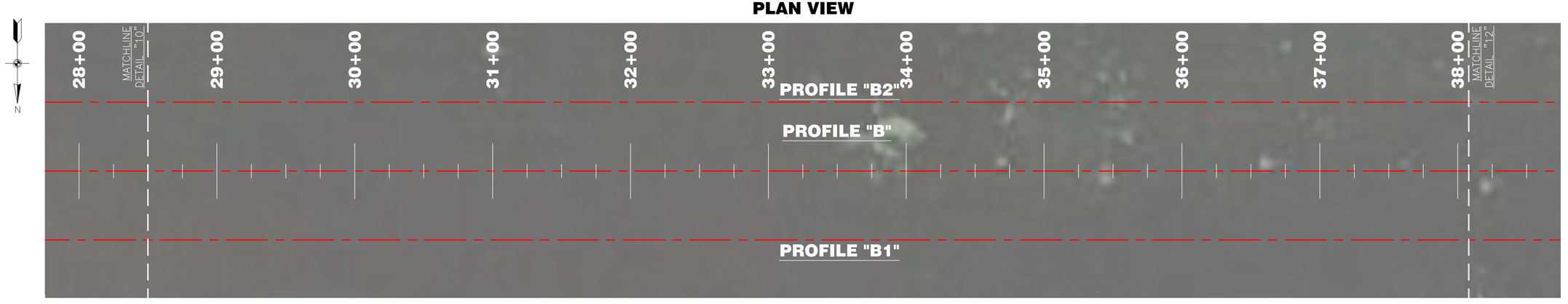


DETAIL "10"
PLAN VIEW



DETAIL "11"
PLAN VIEW

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

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0 40' 80' 120'

HOR. SCALE

Date	
Designed	Chris Wheat 09/01/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

DETAIL "10" THRU "11"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 9 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09-24-2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

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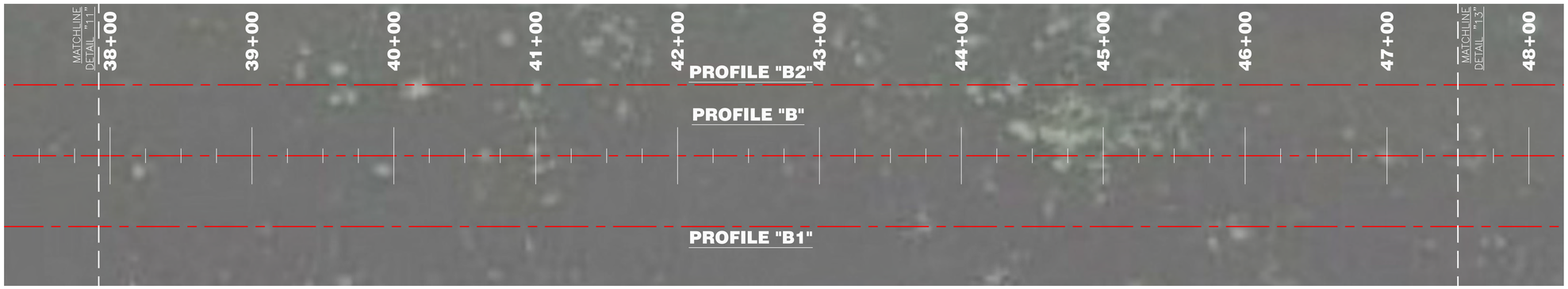

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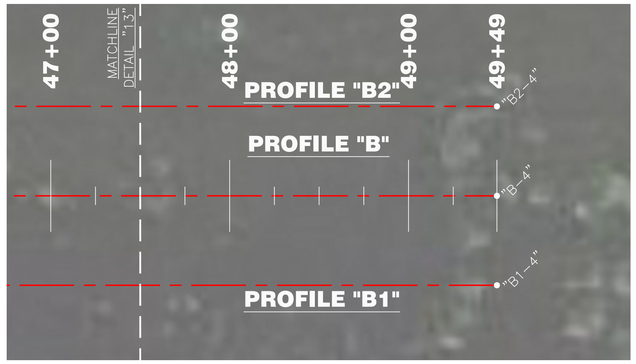

DETAIL "13"
PLAN VIEW

ACCESS ROUTE ALIGNMENT DATA

PT. NO.	NORTHING	EASTING	DESCRIPTION	STA.	PT. NO.	NORTHING	EASTING	DESCRIPTION	STA.
A-1	472846.55	3745239.64	BEGIN ALIGNMENT	0+00	A2-5	474923.59	3739485.80	END ALIGNMENT	61+73
A-2	473263.37	3743198.08	PI IN ALIGNMENT	20+84	B-1	473736.00	3741911.73	BEGIN ALIGNMENT	0+00
A-3	473439.37	3742561.05	PI IN ALIGNMENT	27+45	B-2	472208.58	3741138.10	PI IN ALIGNMENT	17+12
A-4	473736.00	3741911.73	PI IN ALIGNMENT	34+58	B-3	471755.46	3740422.01	PI IN ALIGNMENT	25+60
A-5	474968.09	3739508.62	END ALIGNMENT	61+59	B-4	471765.57	3738032.19	END ALIGNMENT	49+49
A1-1	472895.54	3745249.64	BEGIN ALIGNMENT	0+00	B1-1	473758.59	3741867.12	BEGIN ALIGNMENT	0+00
A1-2	473312.01	3743209.75	PI IN ALIGNMENT	20+82	B1-2	472243.46	3741099.72	PI IN ALIGNMENT	16+98
A1-3	473486.51	3742578.20	PI IN ALIGNMENT	27+37	B1-3	471805.52	3740407.62	PI IN ALIGNMENT	25+17
A1-4	473781.01	3741933.53	PI IN ALIGNMENT	34+46	B1-4	471815.57	3738032.40	END ALIGNMENT	48+93
A1-5	475012.58	3739531.43	END ALIGNMENT	61+45	B2-1	473713.41	3741956.33	BEGIN ALIGNMENT	0+00
A2-1	472797.56	3745229.64	BEGIN ALIGNMENT	0+00	B2-2	472173.69	3741176.48	PI IN ALIGNMENT	17+26
A2-2	473214.72	3743186.40	PI IN ALIGNMENT	20+85	B2-3	471705.40	3740436.40	PI IN ALIGNMENT	26+02
A2-3	473392.24	3742543.89	PI IN ALIGNMENT	27+51	B2-4	471715.58	3738031.98	END ALIGNMENT	50+06
A2-4	473690.99	3741889.92	PI IN ALIGNMENT	34+70					

LONNIE G. HARPER & ASSOCIATES, INC.
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GENERAL NOTES:

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0 40' 80' 120'

HOR. SCALE

Date	
Designed	Chris Wheat 09/21/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

DETAIL "12" THRU "13"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 10 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO 4036
REGISTERED
09/28/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

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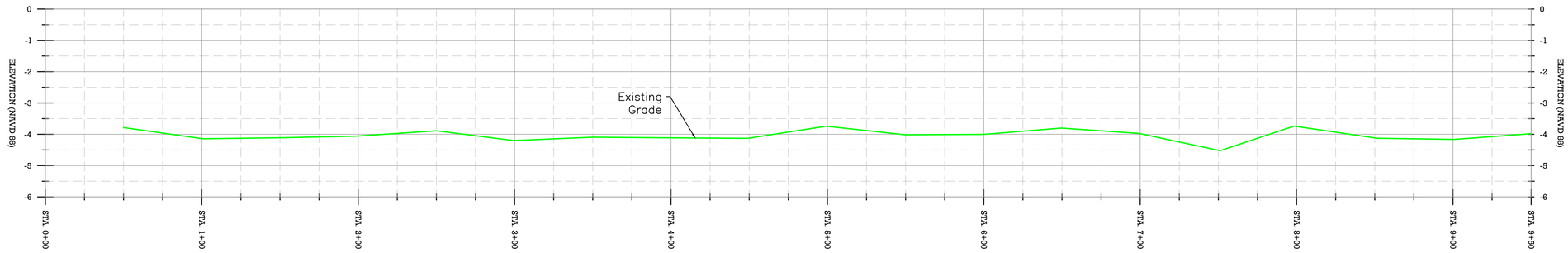
2015-64
2/4/16 11:22 AM
Sheet 10 of 28



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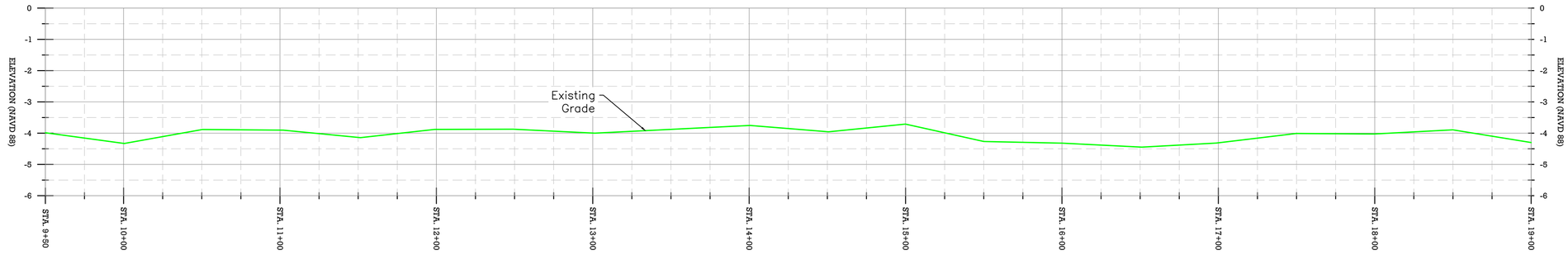

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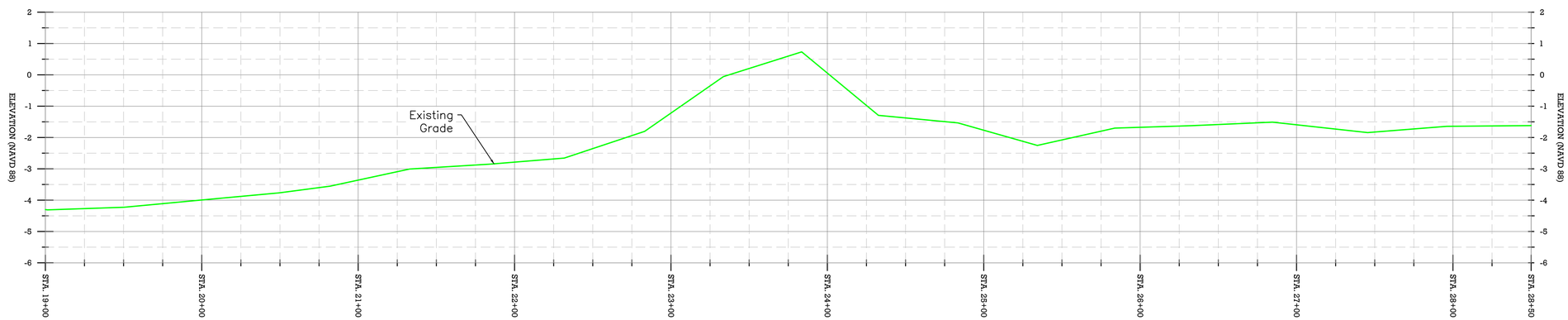

DETAIL "3"
PROFILE "A"

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

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0 40' 80' 120'
HOR. SCALE

0 2' 4' 6'
VERT. SCALE

Date
Designed Chris Wheat 09/01/15
Drawn Aaron Harper 09/17/15
Checked Leonard Harper 09/21/15
Approved Lonnie Harper 09/24/15

ACCESS PROFILE "A"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 11 of 28
Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
01/26/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No. 20156411.dwg
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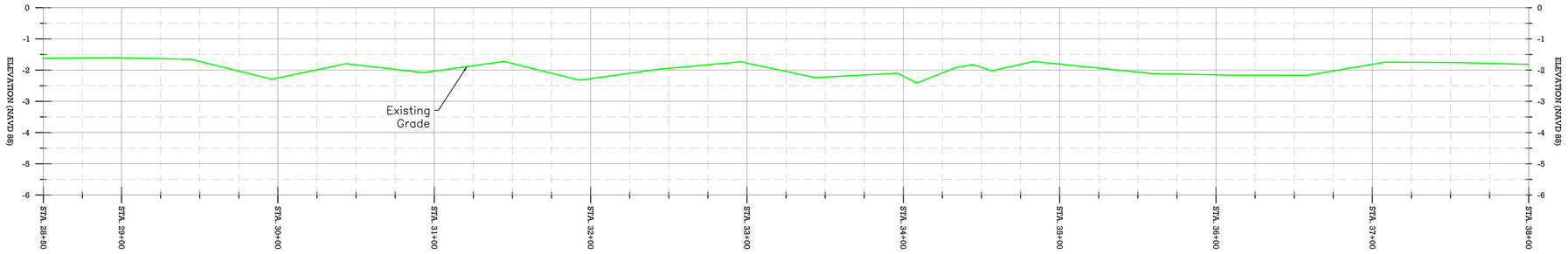
Sheet 11 of 28



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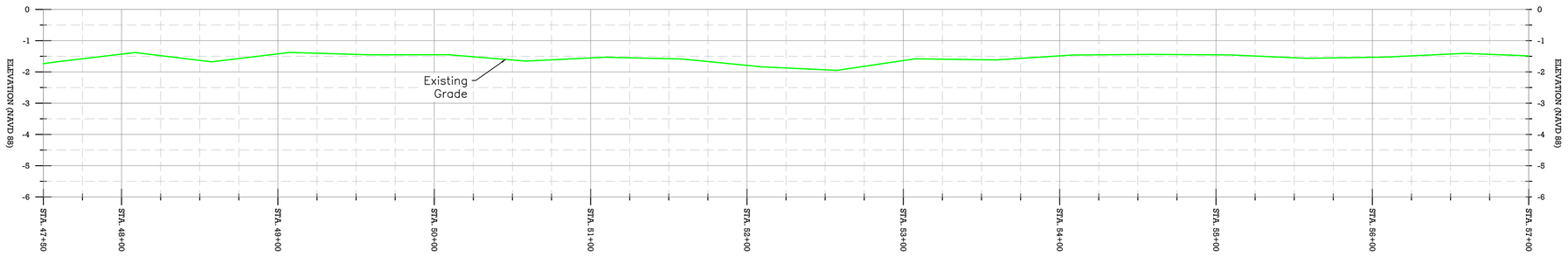

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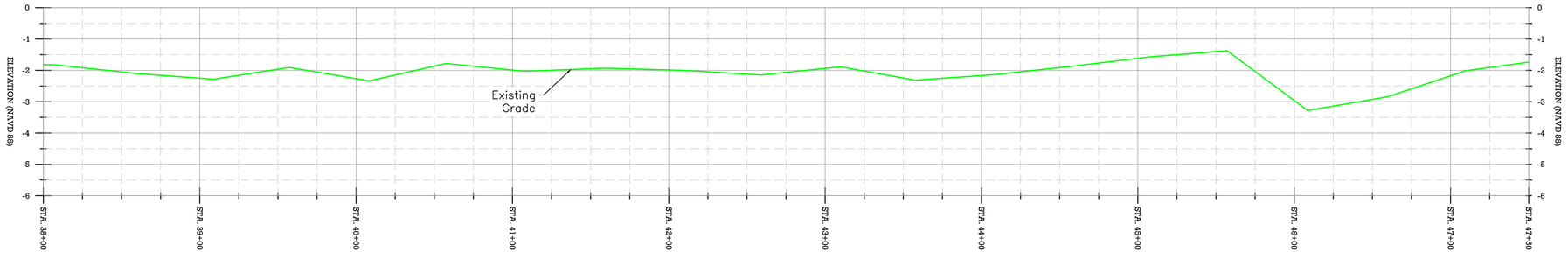

DETAIL "6"
PROFILE "A"

LONNIE G. HARPER & ASSOCIATES, INC.
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2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

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Date	
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Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "A"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 12 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4126
REGISTERED
09/28/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
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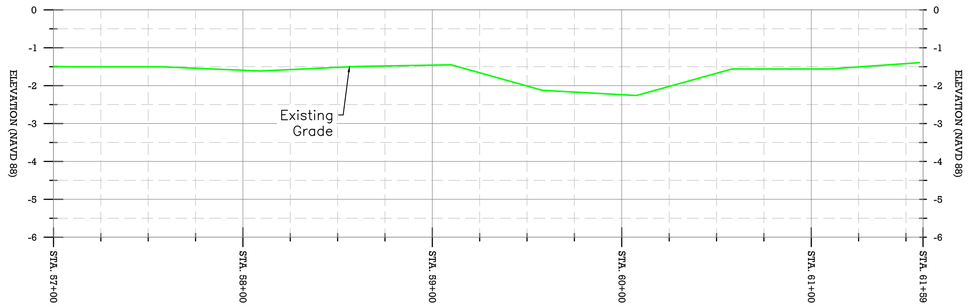
Sheet 12 of 28



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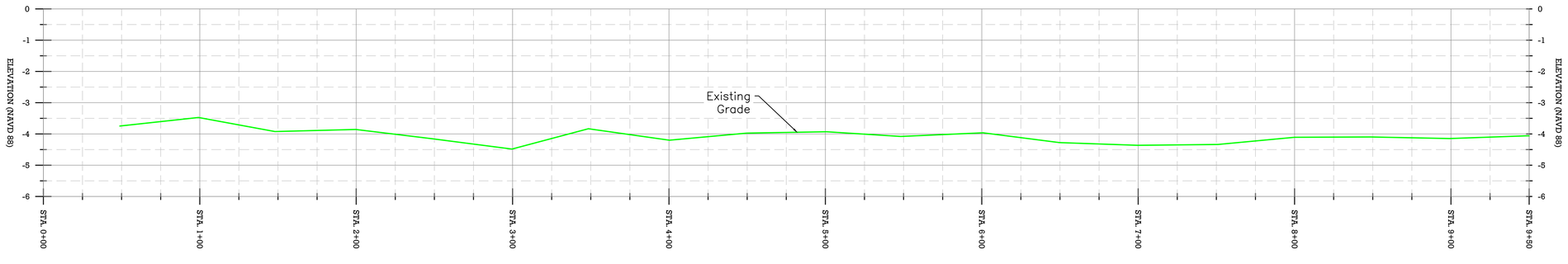

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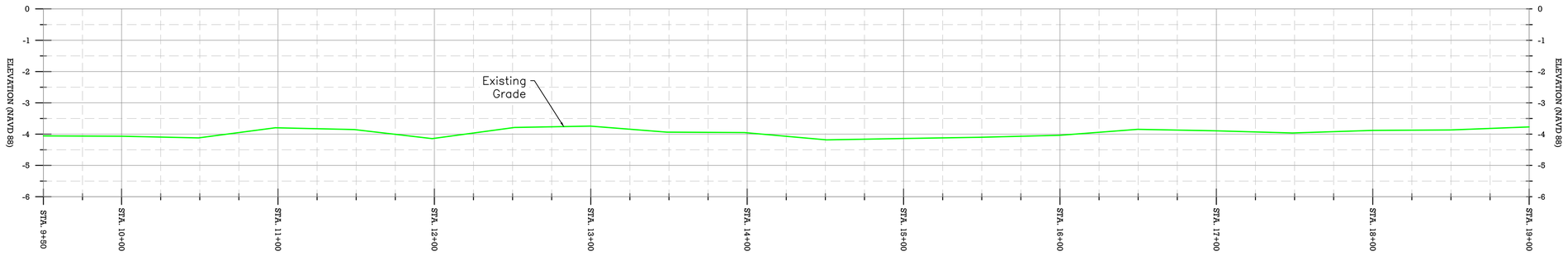

DETAIL "2"
PROFILE "A1"

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

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0 40' 80' 120'
HOR. SCALE

0 2' 4' 6'
VERT. SCALE

Date	
Designed	Chris Wheat 09/01/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "A" & "A1"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 13 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
LAND SURVEYOR
01/28/2015

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No. 20156413.dwg
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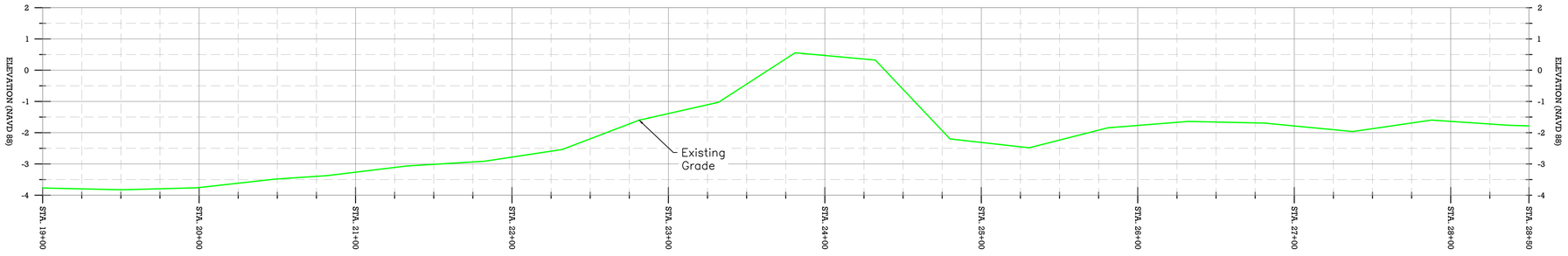
Sheet 13 of 28



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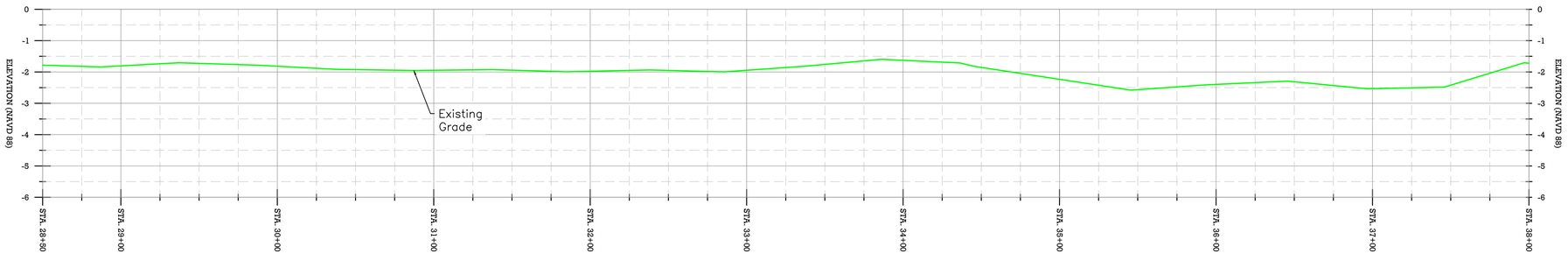

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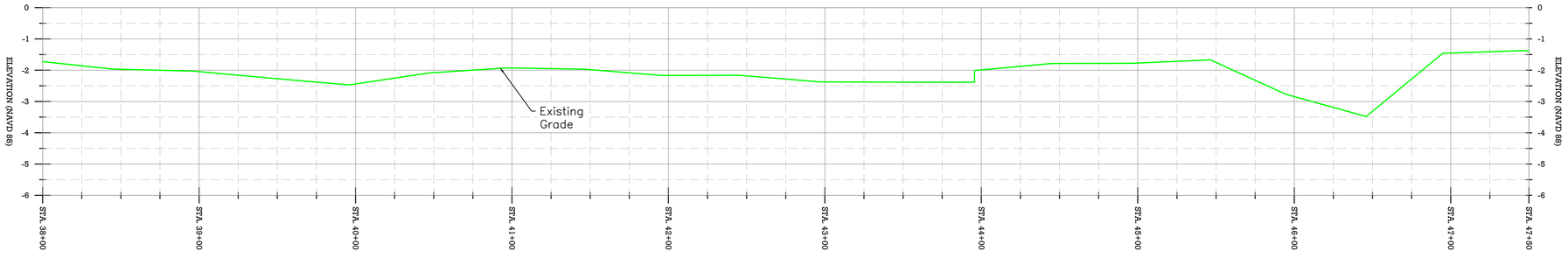

DETAIL "5"
PROFILE "A1"

LONNIE G. HARPER & ASSOCIATES, INC.
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Date	
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Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "A1"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 14 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4126
REGISTERED
04/28/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
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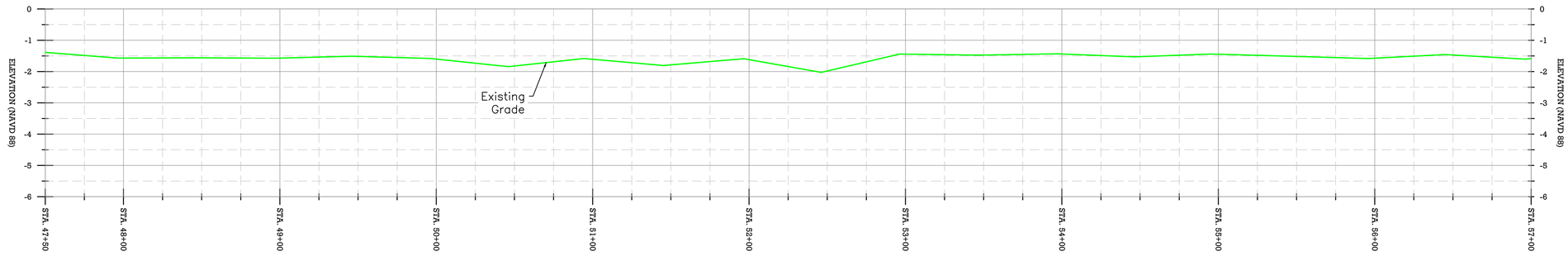
Drawing No.
2015-64
2/4/16 11:28 AM
Sheet 14 of 28



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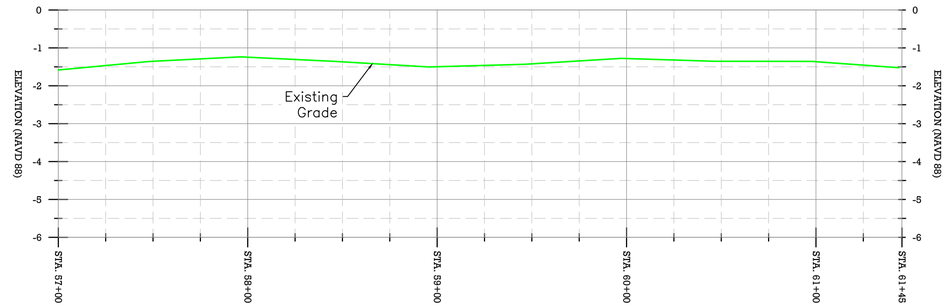

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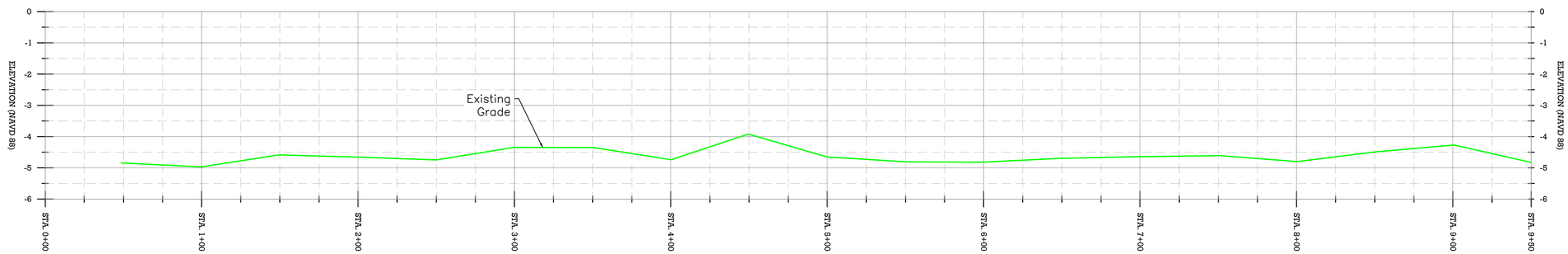

DETAIL "1"
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LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

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VERT. SCALE

Date	
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Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "A1" & "A2"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 15 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
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Natural Resources Conservation Service
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File No. *20156415.dwg*
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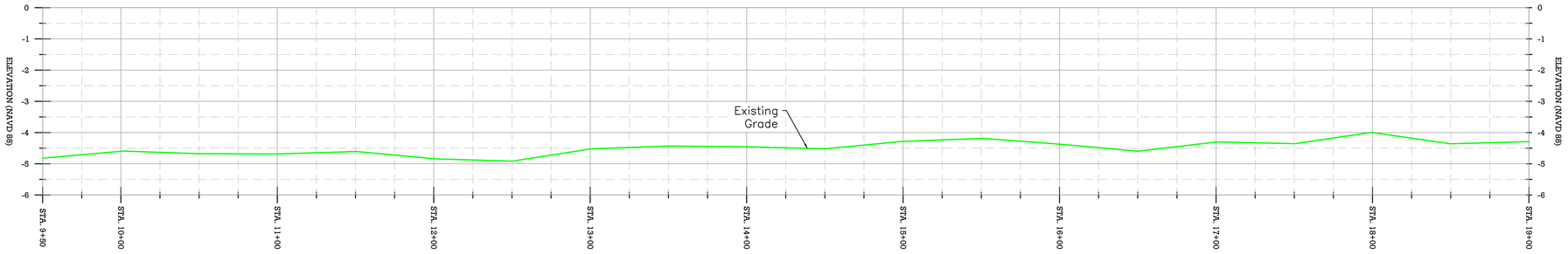

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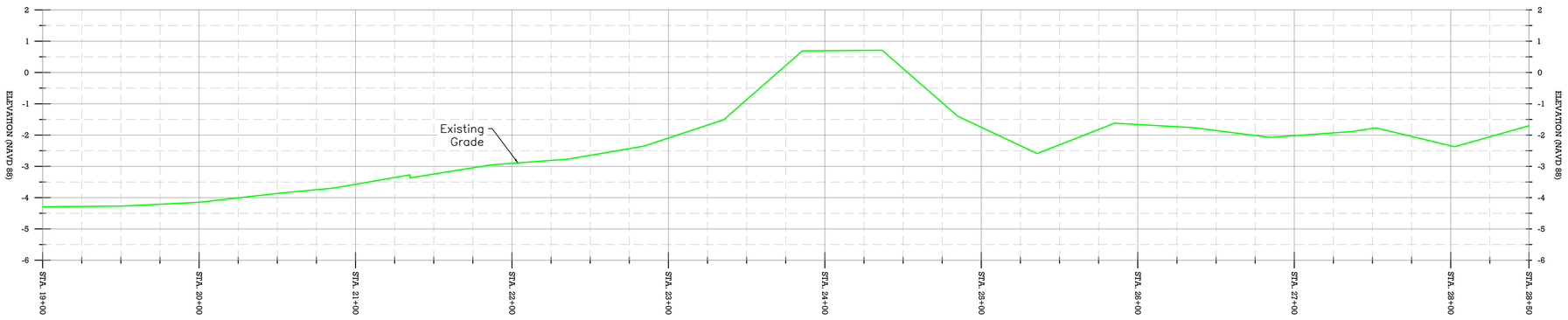

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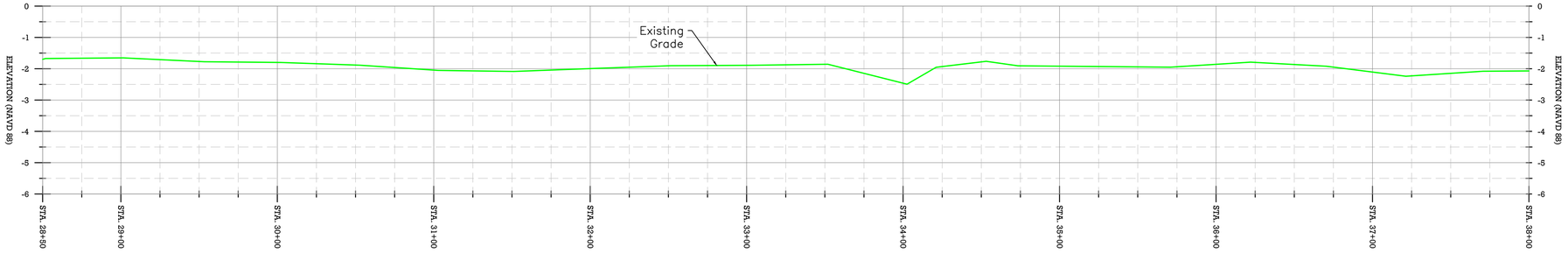

DETAIL "4"
PROFILE "A2"

LONNIE G. HARPER & ASSOCIATES, INC.
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2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
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VERT. SCALE

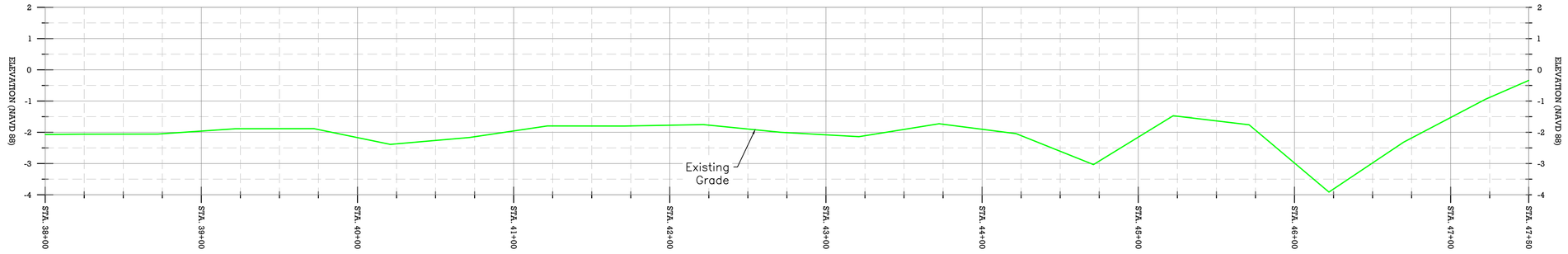
Date
Designed Chris Wheat 09/21/15
Drawn Aaron Harper 09/17/15
Checked Leonard Harper 09/21/15
Approved Lonnie Harper 09/24/15

ACCESS PROFILE "A2"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 16 of 28
Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/28/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
20156416.dwg
Drawing No.
2015-64
2/4/16 11:30 AM
Sheet 16 of 28



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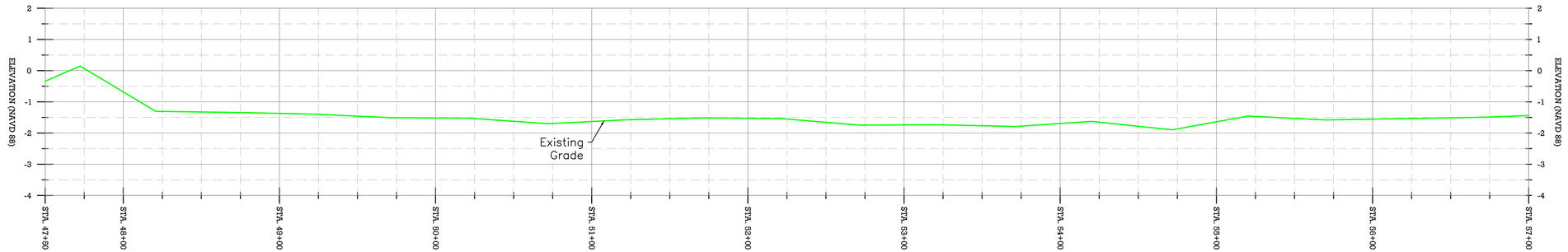

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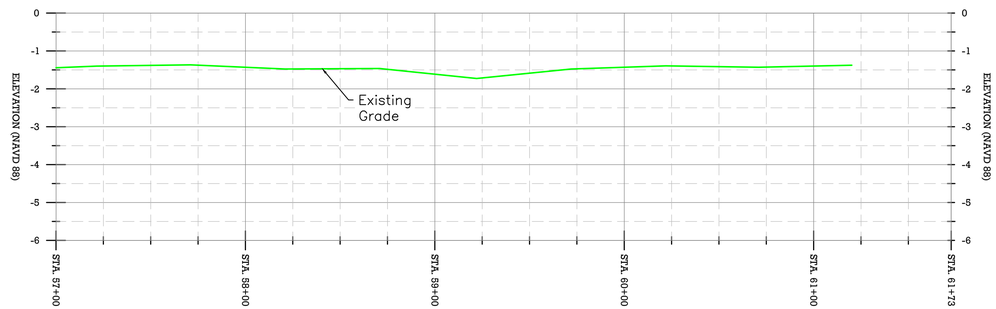

DETAIL "7"
PROFILE "A2"

LONNIE G. HARPER & ASSOCIATES, INC.
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2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

1. All topographic data depicted was collected using Trimble R8 receivers and TSC3 data collectors with an RTK base station set at monument "BS16-SM-02", bearing NAD83 (2011) Lambert South Zone "LZ-1702" coordinates of N. 466,857.617 and E. 3,746,965.627 and a Geoid 12A orthometric height of 1.761 feet NAVD 88.

0 40' 80' 120'
HOR. SCALE

0 2' 4' 6'
VERT. SCALE

Date	
Designed	Chris Wheat 09/01/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "A2"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 17 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
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United States Department of Agriculture

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Drawing No. *2015-64*
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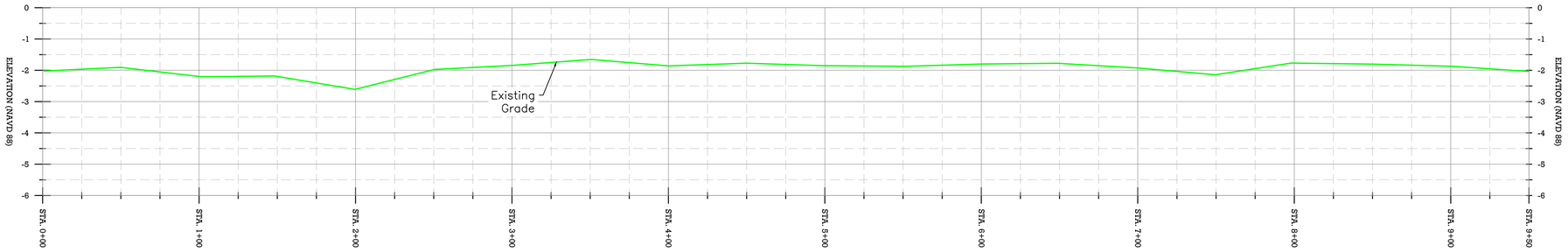
Sheet *17* of *28*



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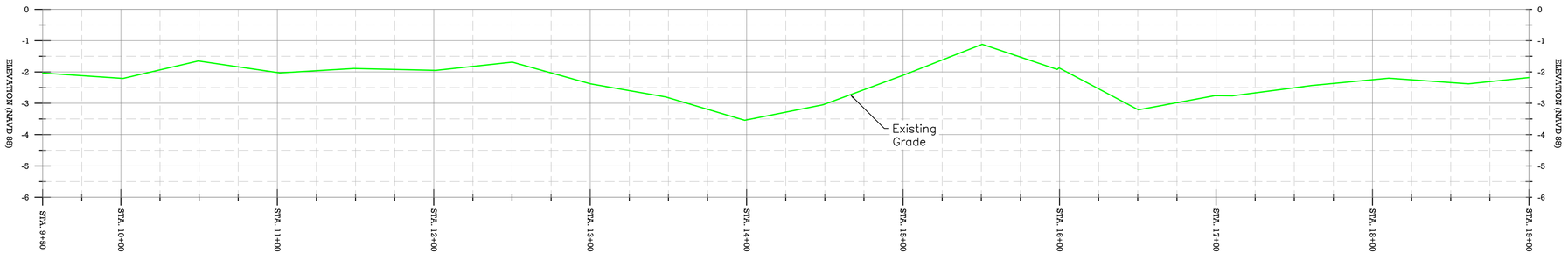

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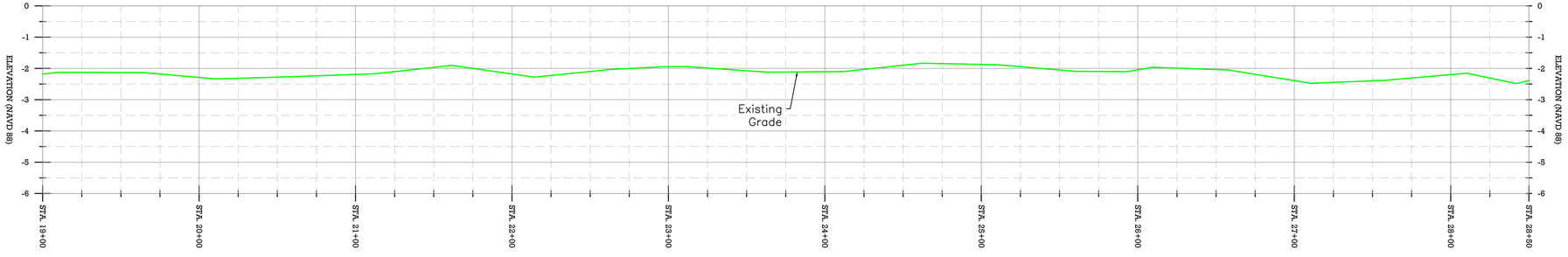

DETAIL "10"
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LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

1. All topographic data depicted was collected using Trimble R8 receivers and TSC3 data collectors with an RTK base station set at monument "BS16-SM-02", bearing NAD83 (2011) Lambert South Zone "LZ-1702" coordinates of N. 466,857.617 and E. 3,746,965.627 and a Geoid 12A orthometric height of 1.761 feet NAVD 88.

0 40' 80' 120'
HOR. SCALE

0 2' 4' 6'
VERT. SCALE

Date
Designed Chris Wheat 09/21/15
Drawn Aaron Harper 09/17/15
Checked Leonard Harper 09/21/15
Approved Lonnie Harper 09/24/15

ACCESS PROFILE "B"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 18 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4126
REGISTERED
09/28/2015
LAND SURVEYOR

NRCS
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File No.
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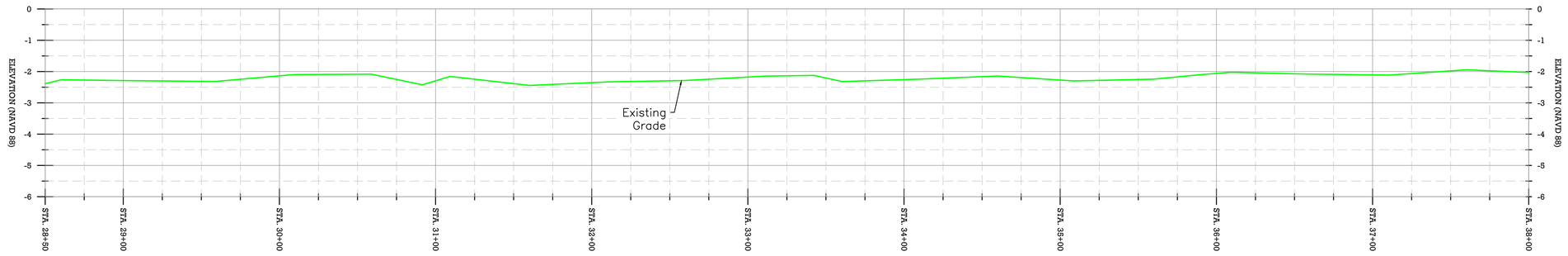
Sheet 18 of 28



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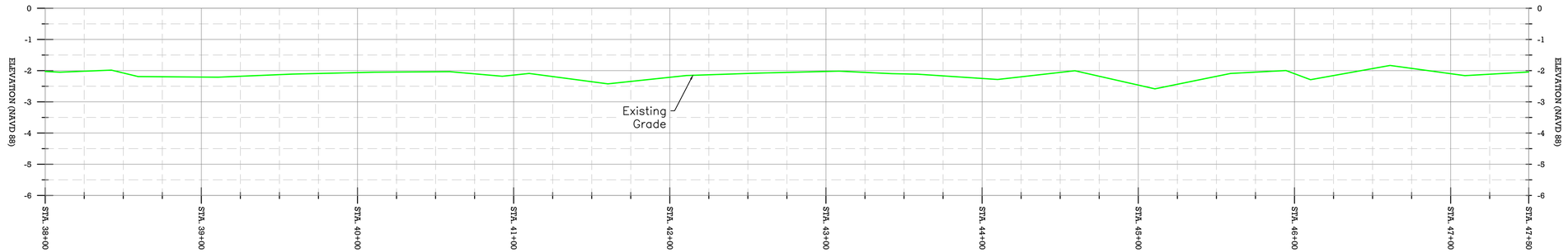

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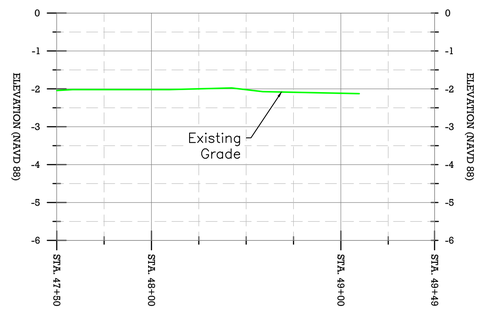

DETAIL "13"
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LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

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0 40' 80' 120'
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Date	
Designed	Chris Wheat 09/01/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "B"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 19 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
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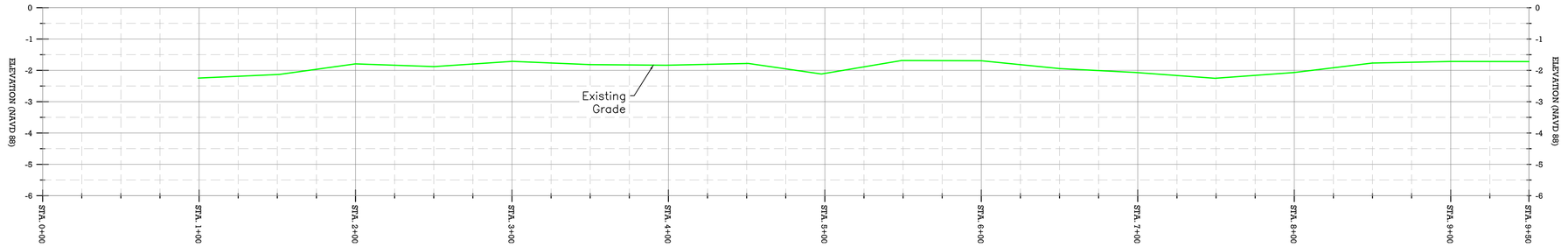
Sheet *19* of *28*



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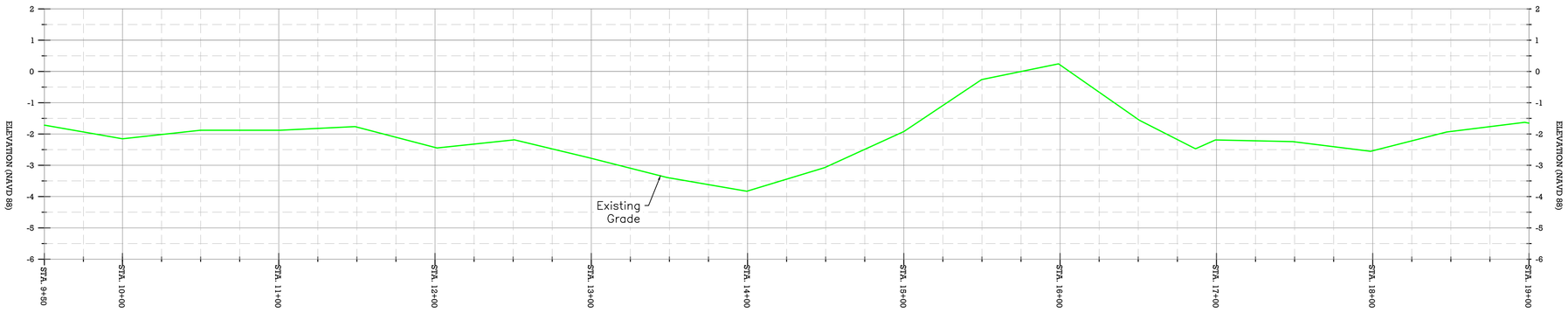

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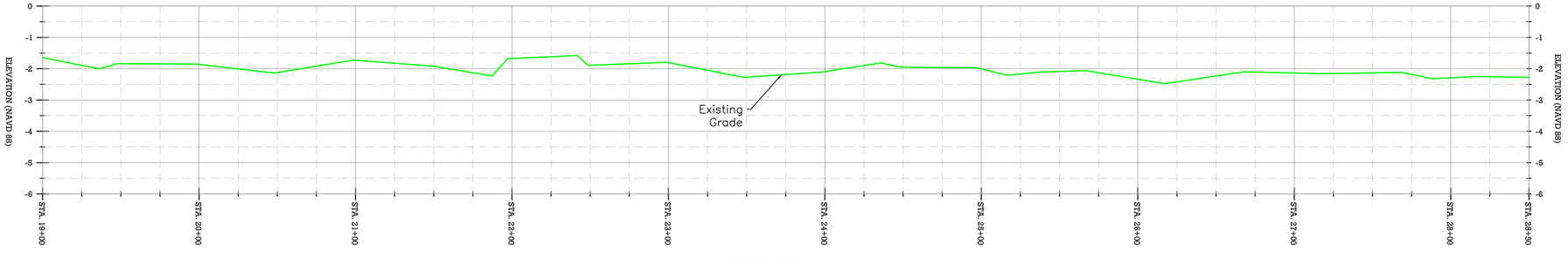

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PROFILE "B1"

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

GENERAL NOTES:

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0 40' 80' 120'
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0 2' 4' 6'
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Date	
Designed	Chris Wheat 09/21/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "B1"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 20 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/28/2015
LAND SURVEYOR

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Natural Resources Conservation Service
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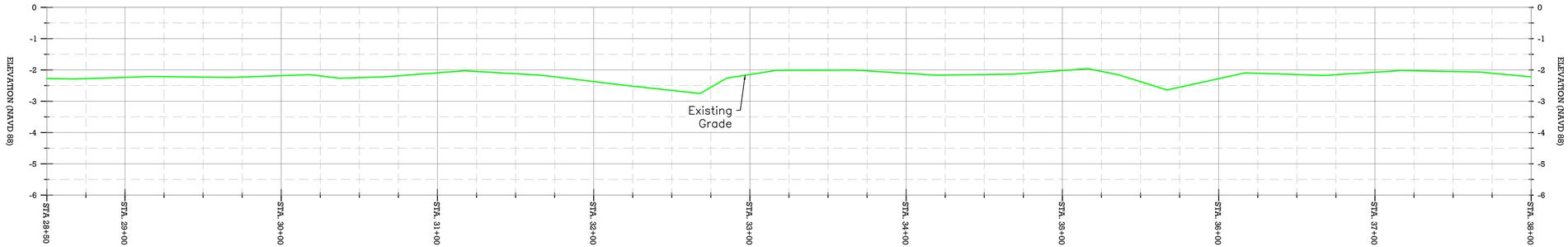
Sheet 20 of 28



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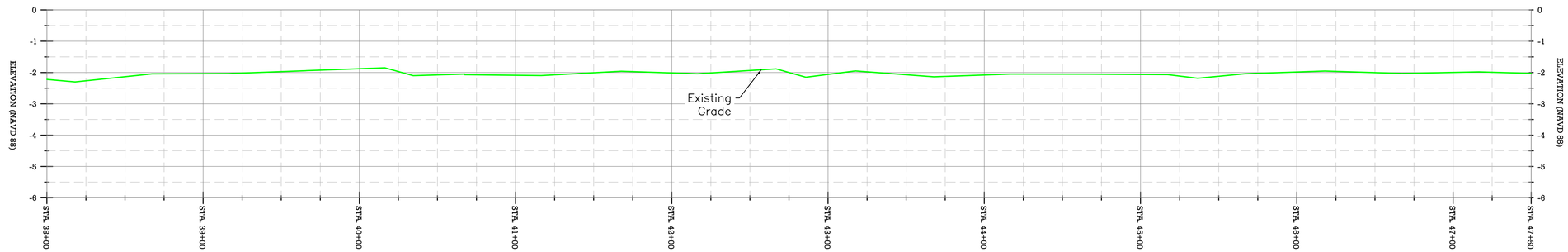

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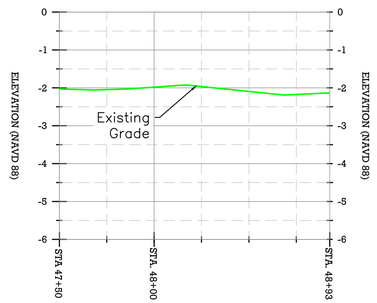

DETAIL "13"
PROFILE "B1"

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905–1079 FAX: (337) 905–1076

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Date	
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Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "B1"
BS–24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 21 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
LAND SURVEYOR

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File No. *20156421.dwg*
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Sheet *21* of *28*

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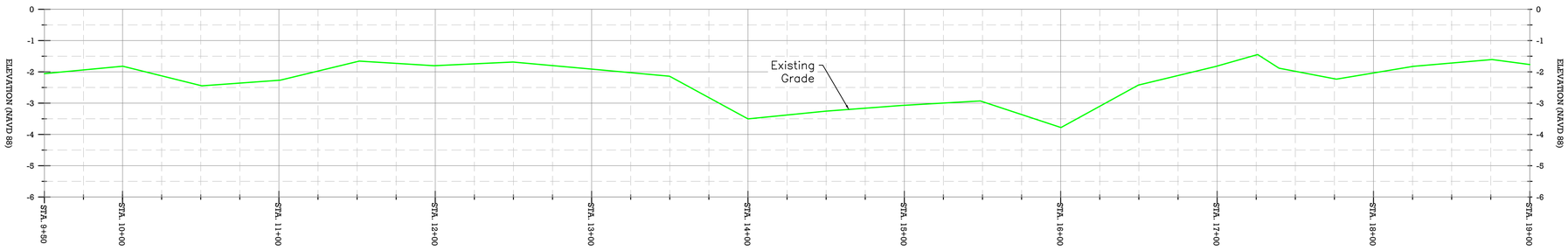

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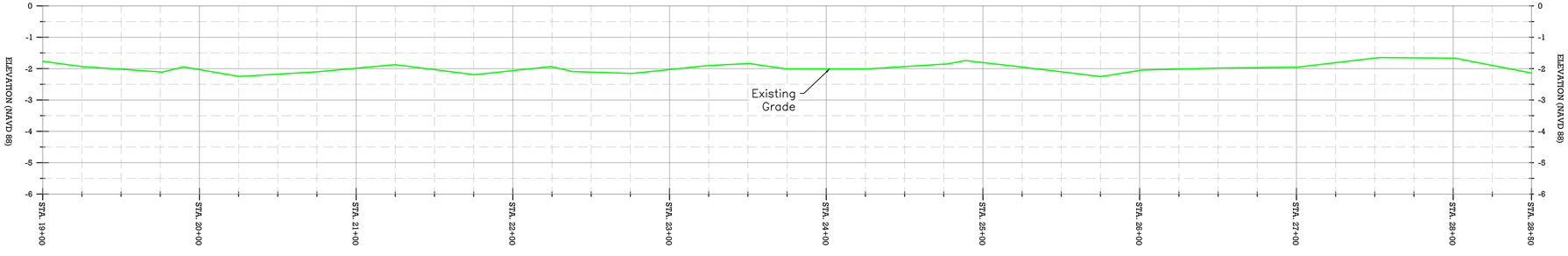

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LONNIE G. HARPER & ASSOCIATES, INC.
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2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

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Date	
Designed	Chris Wheat 09/21/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

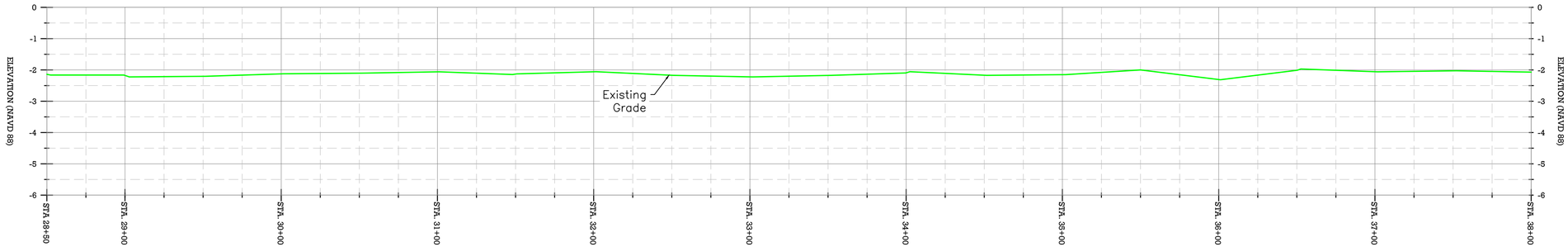
ACCESS PROFILE "B2"
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 22 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4126
REGISTERED
09/24/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
20156422.dwg
Drawing No.
2015-64
2/4/16 11:36 AM
Sheet 22 of 28



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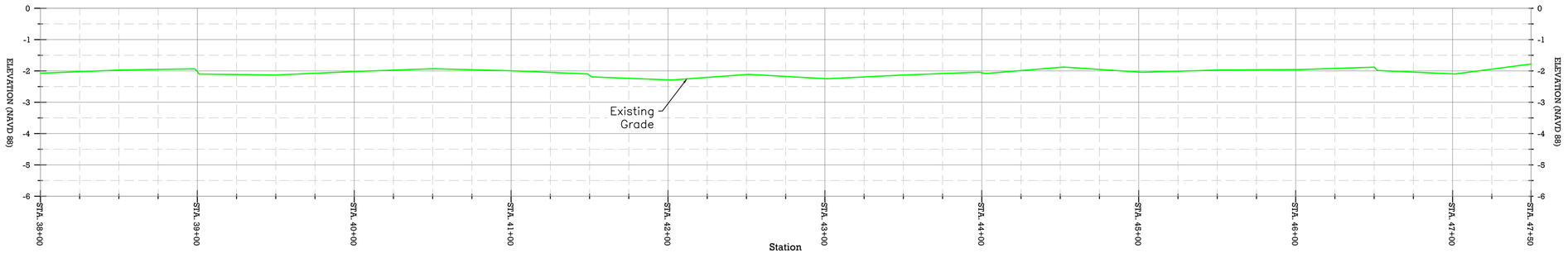

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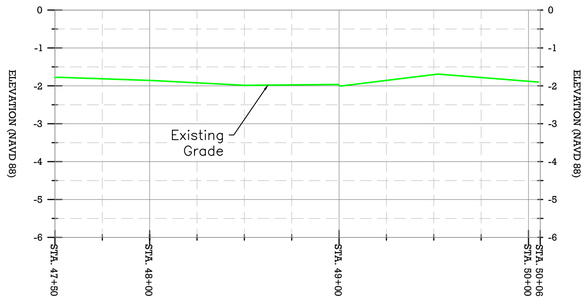

DETAIL "13"
PROFILE "B2"

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905–1079 FAX: (337) 905–1076

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0 40' 80' 120'
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0 2' 4' 6'
VERT. SCALE

Date	
Designed	Chris Wheat 09/01/15
Drawn	Aaron Harper 09/17/15
Checked	Leonard Harper 09/21/15
Approved	Lonnie Harper 09/24/15

ACCESS PROFILE "B2"
BS–24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 23 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
09/24/2015
LAND SURVEYOR

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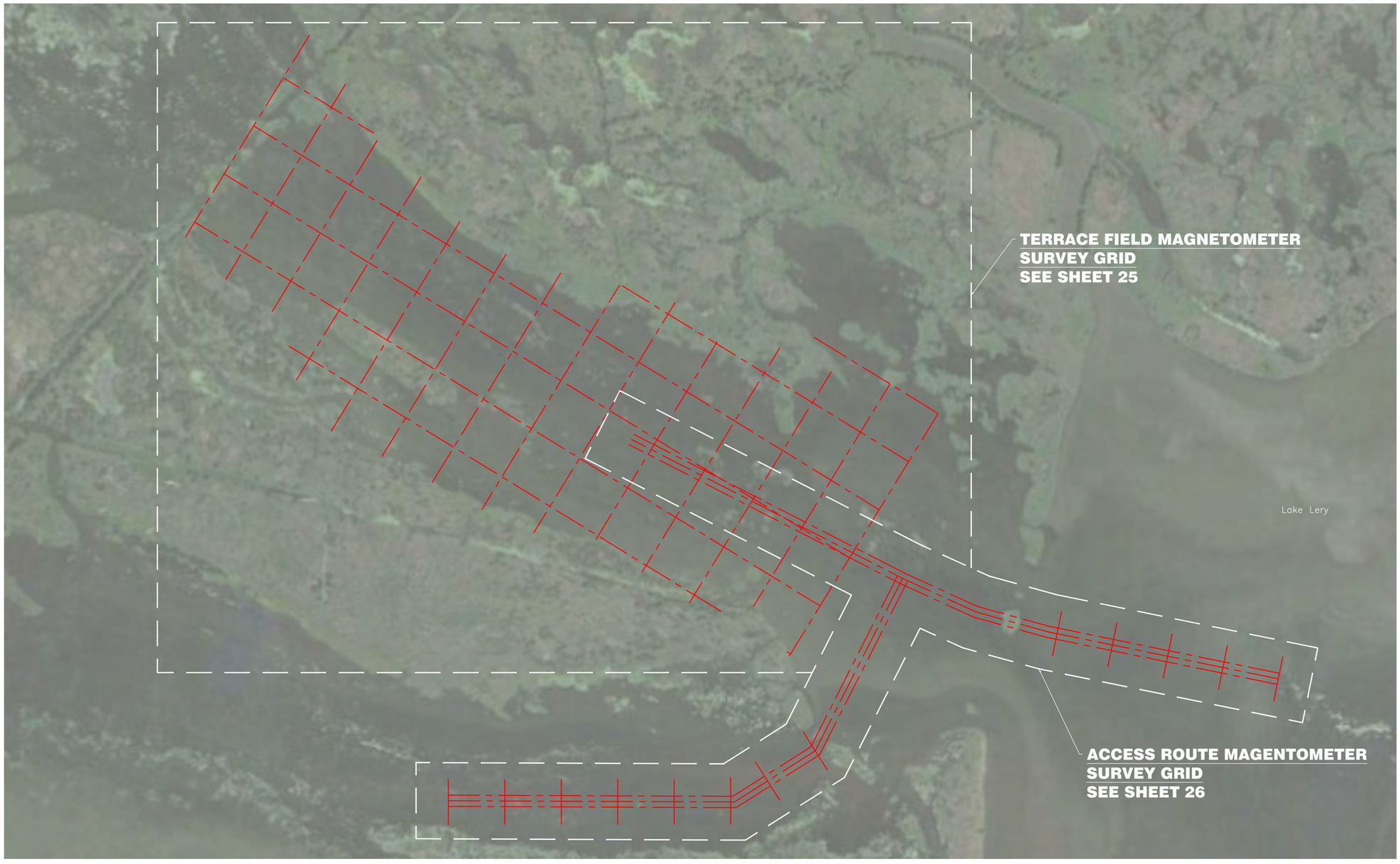
United States Department of Agriculture

File No. 20156423.dwg
Drawing No. 2015–64
2/4/16 11:35 AM
Sheet 23 of 28



N

0 450' 900' 1200'

HOR. SCALE

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

	Designed	Drawn	Checked	Approved
	Chris Wheat	Aaron Harper	Leonard Harper	Lonnie Harper
Date	09/21/15	09/17/15	09/21/15	09/24/15

MAGNETOMETER SURVEY SITE PLAN
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 24 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4036
REGISTERED
09/28/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
20156424.dwg
Drawing No.
2015-64
2/4/16 9:38 AM
Sheet *24* of *28*

Terrace Mag Line Table

Pt. No.	Northing	Easting	Transect No.
M-1	478550.64	3736658.58	Transect "M1"
M-2	476763.45	3735561.36	Transect "M1"
M-3	478115.94	3736978.41	Transect "M2"
M-4	476383.99	3735915.10	Transect "M2"
M-5	477615.66	3737257.98	Transect "M3"
M-6	476098.85	3736326.76	Transect "M3"
M-7	477293.12	3737646.68	Transect "M4"
M-8	475495.46	3736543.02	Transect "M4"
M-9	476898.23	3737990.95	Transect "M5"
M-10	475040.43	3736850.37	Transect "M5"
M-11	476609.05	3738400.12	Transect "M6"
M-12	474817.59	3737300.28	Transect "M6"
M-13	476442.33	3738884.48	Transect "M7"
M-14	474583.78	3737743.44	Transect "M7"
M-15	476333.02	3739404.08	Transect "M8"
M-16	474348.45	3738185.68	Transect "M8"
M-17	476179.54	3739896.56	Transect "M9"
M-18	474139.50	3738644.10	Transect "M9"
M-19	475831.35	3740269.51	Transect "M10"
M-20	474082.47	3739195.80	Transect "M10"
M-21	475778.78	3740823.95	Transect "M11"
M-22	473791.60	3739603.93	Transect "M11"
M-23	475568.19	3741281.36	Transect "M12"
M-24	473517.79	3740022.54	Transect "M12"
M-25	475458.71	3741800.87	Transect "M13"
M-26	473488.10	3740591.03	Transect "M13"
M-27	475197.11	3742226.97	Transect "M14"
M-28	473046.46	3740906.60	Transect "M14"
M-29	475873.20	3741125.74	Transect "M15"
M-30	474771.01	3741965.37	Transect "M16"
M-31	476328.34	3739428.74	Transect "M16"
M-32	477681.01	3737225.48	Transect "M17"
M-33	478171.83	3736426.02	Transect "M17"
M-34	474344.91	3741703.77	Transect "M18"
M-35	477745.73	3736164.42	Transect "M18"
M-36	473918.80	3741442.16	Transect "M19"
M-37	477319.63	3735902.81	Transect "M19"
M-38	473492.70	3741180.56	Transect "M20"
M-39	476893.52	3735641.21	Transect "M20"
M-40	473066.59	3740918.96	Transect "M21"
M-41	473087.02	3740885.69	Transect "M21"
M-42	473444.79	3740302.95	Transect "M22"
M-43	475794.28	3736476.04	Transect "M22"

GENERAL NOTES:

1. A magnetometer survey was performed using a Geometrics G882 Magnetometer, Trimble SPS461 differential gps system and Hypack data collection software over all lines depicted above.
2. Magnetometer data was collected in a 50 feet & 25 feet radius around each boring location.
3. Upon completion of data collection all magnetic fields 50 gamma higher or lower than the baseline (47235) were inspected to determine the type of anomaly.

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

0 400' 800' 1200'

HOR. SCALE

Date
Designed Chris Wheat 09/01/15
Drawn Aaron Harper 09/17/15
Checked Leonard Harper 09/21/15
Approved Lonnie Harper 09/24/15

TERRACE FIELD MAGNETOMETER SURVEY GRID
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR

Page 25 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
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REG. NO. 4326
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09/24/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No. 20156425.dwg
Drawing No. 2015-64
2/4/16 9:36 AM
Sheet 25 of 28

Access Mag Line Table

Pt. No.	Northing	Easting	Transect No.	Pt. No.	Northing	Easting	Transect No.
M-44	475012.58	3739531.43	Transect "M23"	M-70	472243.46	3741099.72	Transect "M31"
M-45	473781.01	3741933.53	Transect "M23"	M-71	471805.52	3740407.62	Transect "M31"
M-46	473486.51	3742578.20	Transect "M23"	M-72	471816.18	3737888.73	Transect "M31"
M-47	473312.01	3743209.75	Transect "M23"	M-73	472208.58	3741138.10	Transect "M32"
M-48	472895.54	3745249.64	Transect "M23"	M-74	471755.46	3740422.01	Transect "M32"
M-49	474968.09	3739508.62	Transect "M24"	M-75	471766.18	3737888.73	Transect "M32"
M-50	473736.00	3741911.73	Transect "M24"	M-76	473713.41	3741956.33	Transect "M33"
M-51	473439.37	3742561.05	Transect "M24"	M-77	472173.69	3741176.48	Transect "M33"
M-52	473263.37	3743198.08	Transect "M24"	M-78	471705.40	3740436.40	Transect "M33"
M-53	472846.55	3745239.64	Transect "M24"	M-79	471716.18	3737888.73	Transect "M33"
M-54	474923.59	3739485.80	Transect "M25"	M-80	472377.58	3741031.16	Transect "M34"
M-55	473690.99	3741889.92	Transect "M25"	M-81	472039.57	3741245.04	Transect "M34"
M-56	473392.24	3742543.89	Transect "M25"	M-82	472110.23	3740608.64	Transect "M35"
M-57	473214.72	3743186.40	Transect "M25"	M-83	471772.21	3740822.52	Transect "M35"
M-58	472797.56	3745229.64	Transect "M25"	M-84	471971.08	3740388.73	Transect "M36"
M-59	473442.58	3743320.07	Transect "M26"	M-85	471555.46	3740388.73	Transect "M36"
M-60	473050.67	3743240.06	Transect "M26"	M-86	471955.46	3739888.73	Transect "M37"
M-61	473342.57	3743809.97	Transect "M27"	M-87	471555.46	3739888.73	Transect "M37"
M-62	472950.65	3743729.95	Transect "M27"	M-88	471955.46	3739388.73	Transect "M38"
M-63	473242.55	3744299.86	Transect "M28"	M-89	471555.46	3739388.73	Transect "M38"
M-64	472850.63	3744219.84	Transect "M28"	M-90	471955.46	3738888.73	Transect "M39"
M-65	473142.53	3744789.75	Transect "M29"	M-91	471555.46	3738888.73	Transect "M39"
M-66	472750.61	3744709.74	Transect "M29"	M-92	471955.46	3738388.73	Transect "M40"
M-67	473042.51	3745279.65	Transect "M30"	M-93	471555.46	3738388.73	Transect "M40"
M-68	472650.59	3745199.63	Transect "M30"	M-94	471955.46	3737888.73	Transect "M41"
M-69	473758.59	3741867.12	Transect "M31"	M-95	471555.46	3737888.73	Transect "M41"

N

0 300' 600' 900'

HOR. SCALE

GENERAL NOTES:

1. A magnetometer survey was performed using a Geometrics G882 Magnetometer, Trimble SPS461 differential gps system and Hypack data collection software over all lines depicted above.
2. Magnetometer data was collected in a 50 feet & 25 feet radius around each boring location.
3. Upon completion of data collection all magnetic fields 50 gamma higher or lower than the baseline (47235) were inspected to determine the type of anomaly.

LONNIE G. HARPER & ASSOCIATES, INC.
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Date
Designed Chris Wheat 09/21/15
Drawn Aaron Harper 09/17/15
Checked Leonard Harper 09/21/15
Approved Lonnie Harper 09/24/15

ACCESS ROUTE MAGNETOMETER SURVEY GRID
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR

Page 26 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
on 12/8/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No. 20156426.dwg
Drawing No. 2015-64
2/4/16 9:39 AM
Sheet 26 of 28

GENERAL NOTES:

1. A magnetometer survey was performed using a Geometrics G882 Magnetometer, Trimble SPS461 differential gps system and Hypack data collection software over all lines depicted above.
2. Magnetometer data was collected in a 50 feet & 25 feet radius around each boring location.
3. Upon completion of data collection all magnetic fields 50 gamma higher or lower than the baseline (47235) were inspected to determine the type of anomaly.

LEGEND:

▲ BHT LOCATION
⬢ MA-1 MAGNETIC ANOMALY
□ MAGNETIC LOCATION

0 450' 900' 1200'

HOR. SCALE

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MAGNETOMETER DATA PLAN VIEW
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR

Page 27 of 28

Plaquemines Parish, Louisiana

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
on 2/2/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
20156427.dwg

Drawing No.
2015-64

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Sheet *27* of *28*

HIT # ☐	DURATION			PEAK/INFLECTION				
	START POINT	END POINT	DURATION (SEC)	POINT	POLAR	GAMMA	NORTHING	EASTING
200	4782	4950	11	4893	MONOPOLAR	4546	476822.72	3735708.15
201	3560	3386	18	3464	MONOPOLAR	1123	477224.03	3736068.07
202	4448	4506	12	4506	MONOPOLAR	1527	477619.73	3736405.66
203	4987	4951	4	4970	DIPOLAR	218	478128.28	3736604.44
204	4826	4904	4	4854	MONOPOLAR	304	477695.31	3736236.09
205	4435	4447	3	4435	MONOPOLAR	384	477579.69	3736135.76
206	3040	3093	6	3065	DIPOLAR	164	477284.53	3735897.71
207	5097	5089	2	5093	DIPOLAR	87	478118.4392	3736724.167
208	5102	5121	2	5112	MONOPOLAR	109	478000.85	3736732.44
209	5098	5100	1	5099	MONOPOLAR	91	476128.51	3736927.4
210	3569	3575	1	3572	MONOPOLAR	103	475835.56	3738282.85
211	5122	5130	1	5126	MONOPOLAR	106	476503.03	3738978.96
212	5131	5151	3	5137	DIPOLAR	720	475565.4	3740549.04
213	5163	5167	1	5166	MONOPOLAR	66	475333.39	3740943.54
214	3021	3023	1	3022	MONOPOLAR	93	475018.17	3740943.88
215	3000	3020	3	3006	DIPOLAR	145	474177.4823	3741048.802
216	3561	3568	1	3565	MONOPOLAR	69	473272.25	3742968.84
217	5152	5162	1	5156	MONOPOLAR	94	473097.15	3744009.36

BORING LOCATIONS ▲

BORING DESIGNATION	NORTHING	EASTING	WATER DEPTH	WATER BOTTOM ELEV.
BHT13	476259.21	3737015.86	2.42	-1.47
BHT14	474813.39	3739291.21	2.54	-1.59

FIELD VERIFIED MAGNETIC ANOMALIES ⬢

PO. NO.	NORTHING	EASTING	ITEM FOUND
MA-1	476129.38	3736909.98	CLUSTER OF CRAB POTS
MA-2	475566.15	3740548.47	UNKNOWN LARGE METAL OBJECT
MA-3	474175.25	3741051.10	RUSTED METAL PIPE (FALLING APART)
MA-4	473235.27	3742983.94	CABLE
MA-5	473088.75	3743476.54	CRAB POT
MA-6	473094.62	3744018.07	UNKNOWN METAL OBJECT
MA-7	472944.43	3743947.56	CRAB POT
MA-8	475333.39	3740943.54	NOTHING FOUND
MA-9	475018.17	3740943.88	NOTHING FOUND

GENERAL NOTES:

1. A magnetometer survey was performed using a Geometrics G882 Magnetometer, Trimble SPS461 differential gps system and Hypack data collection software over all lines depicted above.
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3. Upon completion of data collection all magnetic fields 50 gamma higher or lower than the baseline (47235) were inspected to determine the type of anomaly.

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Approved Lonnie Harper 09/24/15

Plaquemines Parish, Louisiana

MAGNETOMETER DATA TABLES
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 28 of 28

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4026
REGISTERED
09/28/2015
LAND SURVEYOR

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
20156428.dwg
Drawing No.
2015-64
2/4/16 11:12 AM
Sheet 28 of 28

APPENDIX D

Geotechnical Investigation Report

Prepared by: GeoEngineers, Inc.

Geotechnical Engineering Services Addendum No. 1

BS-24 Terracing and Marsh Creation
South of Big Mar
Plaquemines Parish, Louisiana

for

Lonnie G. Harper & Associates

February 12, 2016

GeoEngineers
Earth Science + Technology

Geotechnical Engineering Services
Addendum No. 1

BS-24 Terracing and Marsh Creation
South of Big Mar
Plaquemines Parish, Louisiana

for
Lonnie G. Harper & Associates, Inc.

February 12, 2016

GeoEngineers

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Baton Rouge, Louisiana 70809
225.293.2460

Geotechnical Engineering Services
Addendum No. 1

BS-24 Terracing and Marsh Creation
South of Big Mar
Plaquemines Parish, Louisiana
File No. 10883-020-02

February 12, 2016

Prepared for:

Lonnie G. Harper & Associates
2746 Highway 384
Bell City, LA 70630

Attention: Mr. Chris Wheat, PE

Prepared by:

GeoEngineers, Inc.
11955 Lakeland Park Boulevard, Suite 100
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PRELIMINARY

Joshua M. Pruett, PE
Geotechnical Engineer

PRELIMINARY

David S. Eley, PE
Principal

JMP:DSE:lb

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APPENDICES

INTRODUCTION

This report presents the results of GeoEngineers, Inc.'s (GeoEngineers) geotechnical engineering services for the Terracing and Marsh Creation South of Big Mar Project (BS-24) located in Plaquemines Parish, Louisiana. Our services have been completed under contract with Lonnie G. Harper & Associates, Inc. (LGH) task order AG-7217-D-13-0001, dated May 8, 2015. The project is located south of Big Mar, and west of Lake Lery, as shown on Figure 1. Relevant site features are shown on Figure 2.

All elevations described in this report, including figures and appendices, are referenced to the North American Vertical Datum of 1988 (NAVD 88), Geoid 12A.

PROJECT UNDERSTANDING

Our understanding of the project is based on the Scope of Services for Geotechnical Investigation, defined scope of work by LGH dated May 8, 2015 and revised August 8, 2015, and our August 19, 2015 proposal.

GeoEngineers understands the primary goal of this project is to create earthen terraces in shallow open water areas within the Caernarvon Diversion outfall area. The earthen terraces will reduce wave fetch in open water areas and promote conditions conducive to growth of marsh vegetation and submerged aquatic vegetation. Approximately 334 acres of marsh creation is also proposed to re-establish the western shoreline of Lake Lery in association with the Lake Lery West Shoreline Restoration and Marsh Creation project (BS-16).

The earthen terrace component of the project will most likely be constructed with marsh buggy long reach excavators. The marsh creation area will be designed as a traditional marsh creation area utilizing earthen dikes to contain fill material hydraulically dredged and pumped from a borrow area in Lake Lery.

PURPOSE AND SCOPE OF SERVICES

GeoEngineers completed a geotechnical investigation and engineering evaluations for the BS-24 project in 2014. However, LGH and NRCS realized construction access to Terrace Cells 1 and 2 are blocked by a pipeline that cuts through the project area. Terrace Cell 2 was relocated closer to Lake Lery in an accessible area that did not have existing geotechnical explorations. This document focuses on the new Terrace Cell 2 location. Our specific scope of services included the following:

1. Visited the site to observe field conditions and better understand the project conditions.
2. Contacted Louisiana "One-Call" to notify them of our intent to perform soil borings at this site and to clear the boring locations of potential underground utilities.
3. 3.Performed a field investigation that including two (2) undisturbed soil borings to a depth of 30 feet below the mudline in the new Terrace Cell 2 location.
4. Performed laboratory testing on select soil specimens.
5. Evaluated subsurface data and identified appropriate design profiles representing different sections along the project alignment.

6. Completed the following evaluations for each design profile as appropriate:
    a. Earthen Terraces:
        i. Evaluated stability of terraces with a 15-foot top width and with a lower borrow area excavation limit of elevation -10 feet (El. -10 feet) adjacent to the terraces. The side slopes for a stable terrace configuration were 5 horizontal feet to each vertical foot (5H:1V).
        ii. Evaluated constructed terrace top elevations of +2 feet, +3 feet, +4 feet and +5 feet. Note that after determining a stable elevation, GeoEngineers did not run lower elevations, since they will be more stable;
        iii. Performed settlement analyses for stable terrace configuration determined in stability analyses. Initial settlement at construction and settlement at 0.5, 1, 3, 5, 10 and 20 years after construction were estimated;
        iv. Completed bearing capacity analyses for stable terrace configurations determined from the slope stability analysis. Note that once a stable bearing capacity was determined, GeoEngineers did not run bearing capacity for lower elevation terraces; and
        v. Provided general construction and maintenance recommendations.
7. Submitted a list of equipment used and names of personnel involved in the drilling activities and a package including all field soil boring logs and notes.
8. Prepared this report of geotechnical findings and analysis results.

FIELD EXPLORATION

Field exploration was performed on December 21, 2015. Two soil borings were completed to a depth of 30 feet below existing mudline using an airboat-mounted drill rig. Each soil boring was sampled continuously for the top 20 feet, and then at 5-foot centers to the boring completion depths. Soil boring locations are shown on Figure 2 and detailed soil boring logs are included in Appendix A.

Borehole sampling was conducted in general accordance with applicable ASTM specifications. High-quality, undisturbed, cohesive and semi-cohesive soil (clay/clayey silt) specimens suitable for laboratory strength testing were obtained using a 30-inch-long, 3-inch outside diameter, thin-walled steel Shelby tube sampler.

At each soil boring, the sampler was hydraulically pushed into the ground a distance not exceeding 24 inches per specimen using an Osterberg piston sampler. Soil borings were grouted upon completion in accordance with Louisiana requirements.

Immediately upon recovery, each sample was classified in the field by a GeoEngineers field representative based on soil exposed on either end of the Shelby tube. Each Shelby tube was then sealed and stored/transported in a vertical position. Shelby tubes were secured bottom down during transportation to minimize sample disturbance.

Vane shear tests using a GEONOR H-10 vane borer instrument were attempted in general accordance with ASTM D 2573. We were unable to establish torque readings in the very soft subsurface soils and

suspect the equipment was not functioning correctly. As there are no test results to report, we will not discuss field vane use any further in this document.

LABORATORY TESTING

Intact semi-cohesive and cohesive samples were subjected to laboratory miniature vane (mini vane) shear testing prior to extrusion. Upon extrusion, each sample was examined to confirm or modify field classifications. Representative samples were selected for laboratory testing consisting of moisture content, unit weight, unconsolidated undrained compression, organic content, fiber content, grain size analysis, consolidation testing and Atterberg limits. The test results are presented on the boring logs and figures included in Appendix A and Appendix B, respectively.

SITE CONDITIONS

Project Location

The project is located in Plaquemines Parish, Louisiana south of Big Mar and west of Lake Lery, as shown on Figure 1.

Surface Conditions

Water depths ranged from approximately 1.5 to 2.5 feet at soil boring locations BHT-13-30 and BHT-14-30 at the time of drilling. Weather, wind, and tides can substantially affect water levels. Wind can make the open water rough and make it difficult to operate equipment that is sensitive to wave action.

The surrounding area is generally undeveloped but pipelines and other features were noted during our field visit and drilling. Land adjacent to canals is typically elevated relative to the surrounding area and supports growth of trees, shrubs, and marsh grasses. Wildlife flourishes in these marsh lands and was often seen during our site visit and field investigation.

The Caernarvon Diversion structure, designed to release water from the Mississippi River influences this area. When the diversion structure is open, water from the river flows through structure to, and through, the project area.

Subsurface Conditions

The subsurface conditions discussed below are based on the soil borings completed for this project and survey information provided by the LGH. No artifacts or material other than that noted on the soil boring logs was observed by GeoEngineers during our field investigation, or during laboratory testing; however, GeoEngineers personnel are not trained to recognize such items.

A subsurface profile was created based on a combination of terrace soil borings BHT-3-30 and BHT-4-30 from the original investigation at the site, BHT-13-30 and BHT-14-30 from this investigation, and BHMC-2-30 from the original investigation and is shown on Figure 3. Although undetected anomalies, (sand layers, logs, etc.) beyond the soil borings may exist, the generalized subsurface conditions can be described as follows.

Earthen Terrace Area

As shown in the subsurface profile on Figure 3, the proposed earth terrace area soil predominantly consists of layers of very soft peat and organic clay in the upper 3 to 18 feet. The thickness and depth of these deposits varied in each soil boring. Below the near-surface organic layer, soil boring BHT-13-30 encountered a transitional zone of inorganic and organic clay between 14 and 18 feet below mudline, followed by silt with sand layers and lenses. We were unable to retrieve a sample from the 23 to 25 feet below mudline sample interval, which sometimes occurs when attempting to collect non-plastic material in a Shelby tube, so we have assumed the silt layer continues to about 25 feet below mudline. From about 25 feet below mudline to the termination depth of soil boring BHT-13-30, we encountered clayey sand.

Alternating layers of silt and silty clay were encountered below the near surface organic deposits at BHT-14-30 from about 12 feet below mudline to about 18 feet below mudline, followed by very soft clay with silt pockets to about 23 feet below mudline, after which loose sand was encountered to the termination depth of the boring.

Appendix C contains design profiles (shear strength, unit weight, and moisture content) based on laboratory testing results for earthen terrace soil borings BHT-13-30 and -14-30. In these profiles, peat moisture content ranges from about 350% to about 900%, and organic clay moisture content ranges from about 100% to about 375%. These high moisture, highly compressible organic materials were found in the upper 12 to 18 feet in the two new borings, which is generally consistent with the 3 to 15 feet observed in our original investigation for the marsh area where earthen terraces will be constructed. In the layers below these organic deposits, moisture contents vary from about 20% to about 120%.

Soil boring logs are provided in Appendix A. Appendix B contains laboratory test results, and Appendix C presents the design soil properties vs. elevation based on field and laboratory test results.

CONCLUSIONS AND RECOMMENDATIONS

General

Soil conditions for this project are generally similar to those encountered in our previous BS-24 investigation. Based on our engineering evaluations, the proposed improvement area is generally suitable for earthen terrace construction. The results of the slope stability and settlement analyses are presented in tables below. Details of the analysis methods are presented in Appendix D for slope stability and bearing capacity and Appendix E for earthen terrace settlement.

Earthen Terrace Slope Stability and Bearing Capacity

GeoEngineers evaluated slope stability and bearing capacity for the earthen terraces with a crown elevation of +5 feet, 5 horizontal to 1 vertical (5H:1V) side slopes and a 15-foot crown width. The borrow excavation was assumed to be excavated to El. -10.0 feet with a 3H:1V cut slope.

The slope stability failure modes evaluated are shown on Figure 4 and the recommended section is shown on Figure 5. In general, earthen terraces built to El. +5 feet have an adequate factor of safety for slope stability.

As evidenced by the results presented below, soil conditions vary across the site. Table 1 summarizes the slope stability factor of safety results for the earthen terraces without reinforcement.

Table 1. Earthen Terrace Slope Stability Analysis Results – Without Reinforcement

Boring ID	Terrace Dimension				Bench Width (feet)	Slope Stability FOS				Global Bearing FOS
						Condition			Appendix D Figure #	
	Crown Elevation (feet)	Crown Width (feet)	Side Slopes (H:V)	Mudline Elevation (feet)		1	2	3		
BHT-13	+5	15	5:1	-2.0 assumed	25	1.78	1.38	1.30	D-26	1.92
BHT-14	+5	15	5:1	-2.0 assumed	25	2.03	1.78	1.56	D-27	1.95

Condition 1 –Marsh to Excavation
Condition 2 –Terrace to Excavation
Condition 3 –Terrace to Marsh

A bench width of 25 feet was modeled for the earthen terrace to provide sufficient space for marsh buggy excavator access and improve terrace stability. The factor of safety given in Table 1 includes an assumed load of 260 pounds per square foot (psf) under each marsh buggy pontoon during construction in situations where the excavator load reduces the factor of safety.

Earthen terrace geometries that have flatter side slopes and/or wider benches than the section shown on Figure 5 will be more stable. Higher crown elevations, shorter benches, or a deeper borrow channel will have to be re-evaluated for stability. No geotextile reinforcement was necessary to achieve stability for earthen terraces.

Earthen terrace configurations from Table 1 were also checked against global bearing failure and found to be stable. Appendix D contains results of the most critical slope stability section for each completed earthen terrace evaluation and the bearing evaluation.

Earthen Terrace Settlement

GeoEngineers evaluated settlement for the earthen terraces constructed for crown elevations of +2, +3, +4 and +5 feet. Table 2 provides a summary of the settlement estimates. Appendix E (Figures E-18 and E-19) contains graphical and tabular summaries of settlement.

Settlement for earthen terraces has three components; 1) consolidation of underlying soil due to the additional loading imposed by the earthen terrace; 2) immediate construction (elastic) settlement of soil during construction; and 3) shrinkage within the terrace earthen fill. All three components must be added to obtain the total settlement.

Construction, or elastic, settlement is the result of immediate compression of the underlying soils during placement of fill (i.e. during construction).

Elastic settlement has been estimated as 20% of the long term consolidation settlement. This estimated number is educated guess based on professional judgment. It is difficult to distinguish construction settlement from consolidation settlement because they both occur during construction and there is little, or no, data that GeoEngineers is aware of for coastal Louisiana organic soil. Construction settlement will be offset by fill placement during construction and is not likely to be directly observed. It will, however, increase the fill quantity required to reach the design elevation and should be considered for fill quantity estimates.

Settlement or shrinkage of fill materials is likely to be significant for the earthen terraces. Shrinkage of terrace fill is a function of many variables, including fill material, construction practices, weather, and fill height. There are also off-setting effects. For example, as fill loses water and shrinks, it becomes lighter and smaller reducing the amount of consolidation settlement of the underlying soils as compared to the full initial load. Shrinkage will not be uniform; the exterior of the terrace, especially at higher elevations, is expected to shrink more than the interior, especially near the water level. This is a very difficult number to predict, but GeoEngineers recommends estimating shrinkage settlement as 20% of the earthen terrace height above the mean water design level. We have assumed that soil between El. 0 feet and El. -10 feet will be utilized to construct the earthen terrace. Soil to El. -10 feet typically has a considerable amount of organics with high moisture content (generally greater than 250%). Hence, GeoEngineers assumed 20% volume shrinkage in addition to the estimated consolidation and construction settlement. GeoEngineers conducted experiments wherein we exposed core samples of various types to the open air while keeping the sample bottom in water. We observed that organic clay indeed experiences significant shrinkage, as we expected. However, observed shrinkage in peat soils was small, presumably because capillary action along the fibers carried moisture to the top of the sample and maintained sufficient moisture to sustain the sample volume. Because the foundation soils within the top 10 feet of the terrace area are a mix of organic clay and peat, we have assumed a shrinkage will be significant.

Based on a mean water elevation of 0 feet and an earthen terrace elevation of +5 feet, GeoEngineers recommends allowing for up to 1 foot (12 inches) of elevation loss due to shrinkage, in addition to consolidation settlement. It is expected that shrinkage will occur within 3 to 6 months after construction depending upon the season. Dry and sunny weather will speed the shrinkage process, while wet and cloudy weather will slow the process. Shrinkage due to drying will also vary within the fill; fill exposed to sun and air at the exterior of the terrace will dry more than fill near the center of the dike near the water level (which is likely to remain moist after draining excess water during initial excavation from a submerged condition).

TABLE 2. EARTHEN TERRACE SETTLEMENT ESTIMATES

Boring ID.	Crown Elevation [3] (feet)	Estimated Shrinkage Settlement [1](inches)	Estimated Construction Settlement[2] (inches)	Estimated Foundation Soil Consolidation Settlement (inches)				
				6 Mo.	1 Yr.	3 Yrs.	10 Yrs.	Long-term (20 Years)
BHT-13	+2	5	1 ¾	7	8	8	8	8
	+3	7	2 ¼	9	10	11	11	11
	+4	10	2 ½	11	11	12	13	13
	+5	12	2 ¾	12	13	14	14	14
BHT-14	+2	5	1 ¾	8	9	9	9	9
	+3	7	2 ½	12	12	13	13	13
	+4	10	3 ¼	15	15	16	16	16
	+5	12	3 ¾	17	18	18	18	18

(1) Shrinkage settlement = (Initial construction elevation-Assumed water elevation)*20%; Water at El. 0 feet.

(2) Estimated construction settlement is not included in the estimated consolidation settlement.

(3) Crown elevation at end of earthen terrace construction.

CONSTRUCTION CONSIDERATIONS

Based on the site work and evaluations completed for this project, the following are offered with respect to construction.

- For construction of the earthen terrace, a minimum bench width of 25 feet must be provided between the toe of the terrace and the excavation cut slope. To maintain excavation and overall embankment stability, we recommend marsh buggies remain as close to the toe as practical without disturbing the terrace fill.
- Surficial soil at this site is predominantly peat and organic clay; both highly organic soil. These materials will be more difficult to use for construction purposes when compared to clay, silt, or sand; however, a pilot study with similar soil, completed by the NRCS suggests these materials can be used successfully. LGH should be aware that contractors are likely to try to excavate clay from beneath these organic soils, which will require a different evaluation by GeoEngineers to correctly model deeper excavations and heavier fill materials for dikes and terraces. Heavier fill is also likely to settle more, and cause more displacement of shallow organic material (i.e. mud waves).
- Water levels can significantly affect construction and terrace stability. High water levels may increase erosion, while low water levels reduce fill buoyancy and can cause failures.
- Pipeline markers were observed in the project vicinity. Precautions must be taken to prevent pipeline damage during construction.
- There are property owner restrictions on the type of equipment that can access the site. Contractors may need to take extra precaution while performing the work to reduce impacts to local wildlife.

LIMITATIONS

We have prepared this report for the exclusive use of Lonnie G. Harper & Associates, Inc. in support of design of the proposed BS-24 Terracing and Marsh Creation South of Big Mar located in Plaquemines Parish, Louisiana.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

Please refer to Appendix F titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

FIGURES

GeoEngineers

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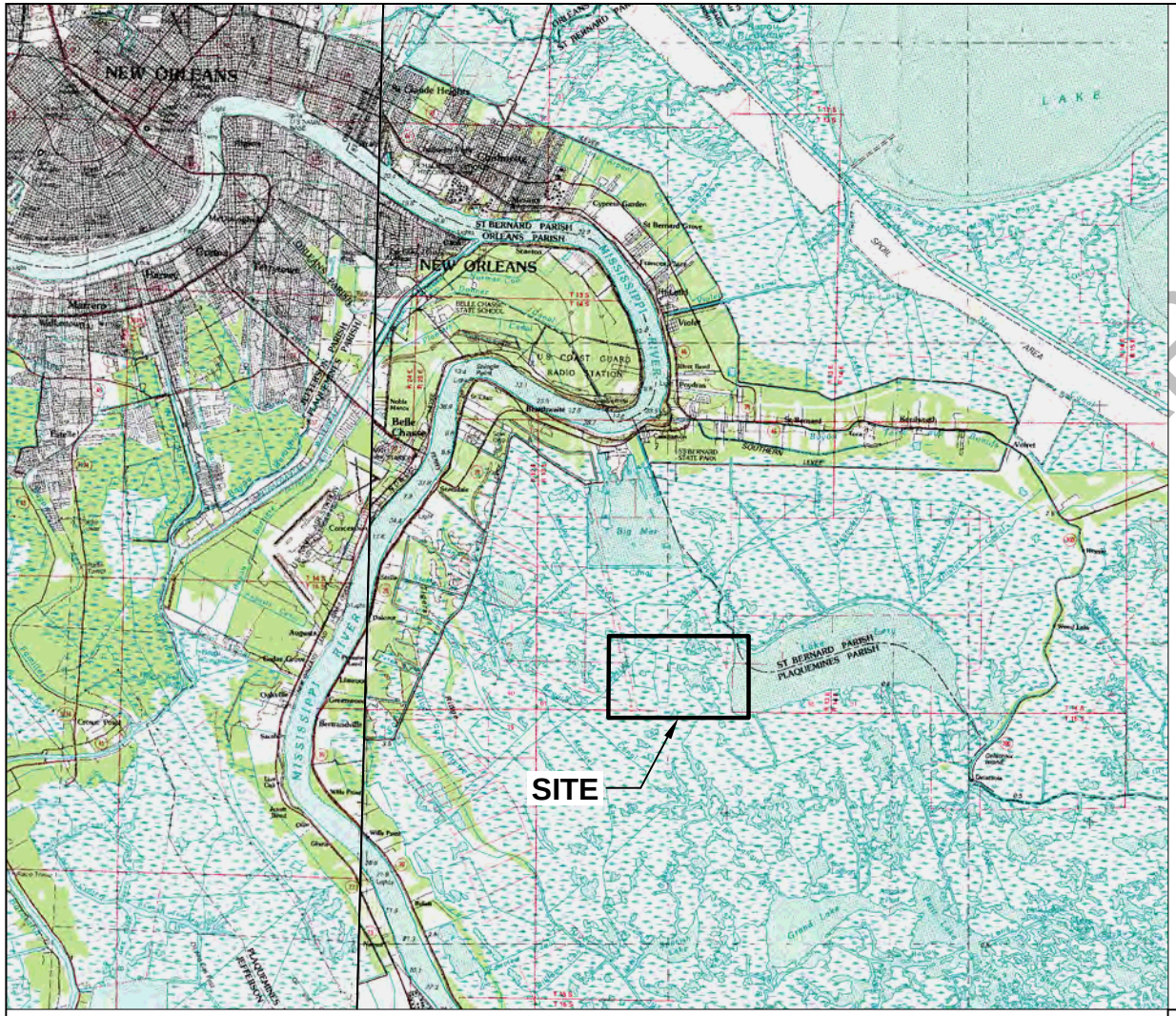

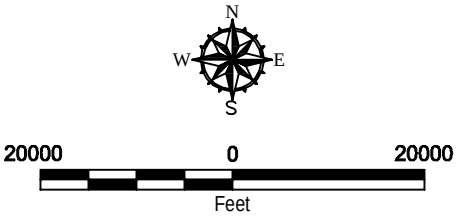

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Topographic image taken from USGS, DRG-100k Template, Quad Black Bay & Gulfport, Dated 9/22/2005

VICINITY MAP

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

GeoEngineers

Figure 1

BOREHOLE DETAILS			
BORING #	LATITUDE	LONGITUDE	DEPTH (FT)
BHT-13-30	N29° 48' 06.3"	W89° 53' 41.8"	30'
BHT-14-30	N29° 47' 51.6"	W89° 53' 16.4"	30'

LEGEND

- BHT-13-30 — Approximate Soil Borehole Location
- BHT-01-30 — Previously Completed BS-24 Borings
- BHLR-01-50 — Approximate Location of Previously Completed Soil Boring for BS-16 Project
- Access Route
- Cross Section

N
W E
S

2000 0 2000
Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Aerial image was taken from Google Earth Pro., Licensed to GeoEngineers Inc., Imagery dated: 3/5/2013

SOIL BORING LOCATION PLAN

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

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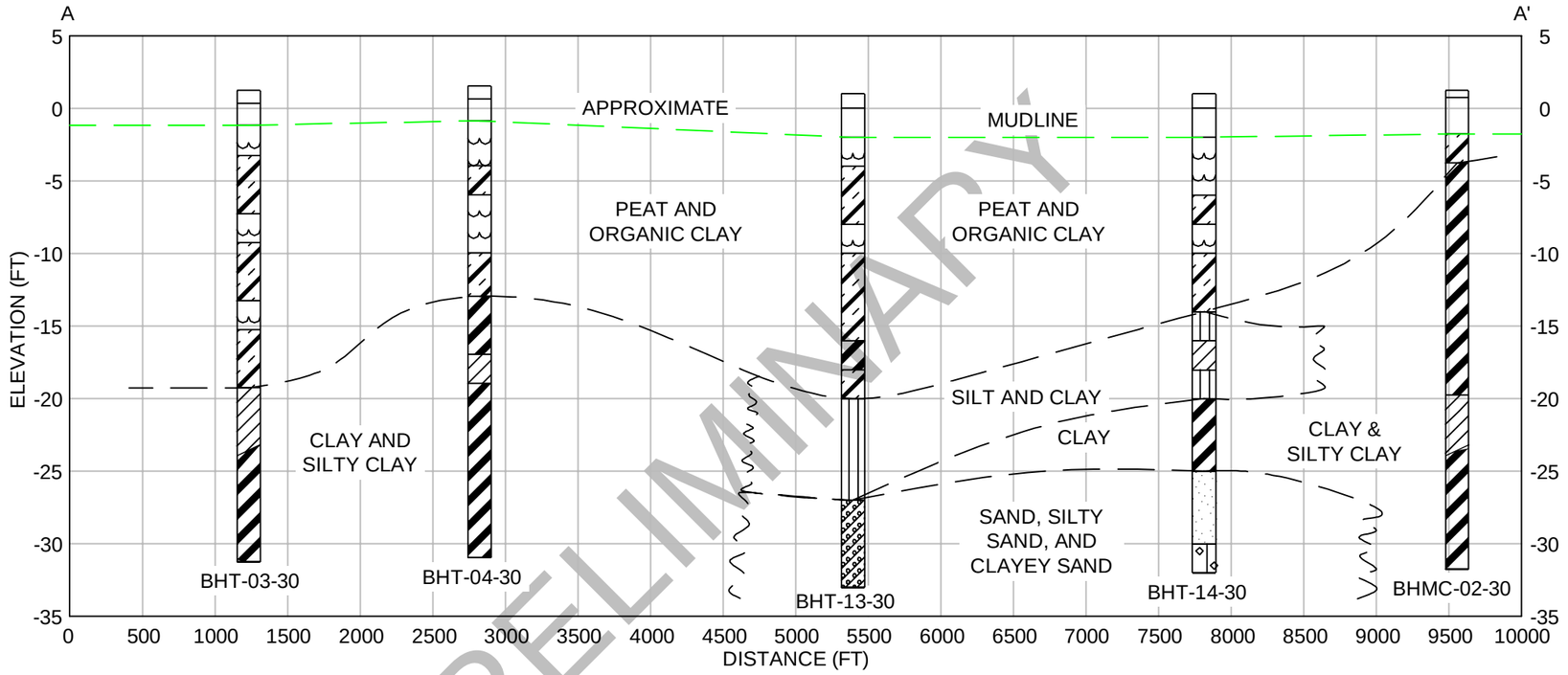
Figure 2

DPS : KMC

P:\10\10883020\02\CAD\BLP.dwg\TAB1.layout1 modified on Feb 05, 2016 - 3:54pm



LEGEND

SAND WITH SILT

SILTY CLAY

SILT

PEAT

CLAY

SILTY SAND WITH CLAY

CLAYEY SAND

ORGANIC CLAY

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

TERRACE SUBSURFACE PROFILE

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

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Figure 3

DPS : KMC

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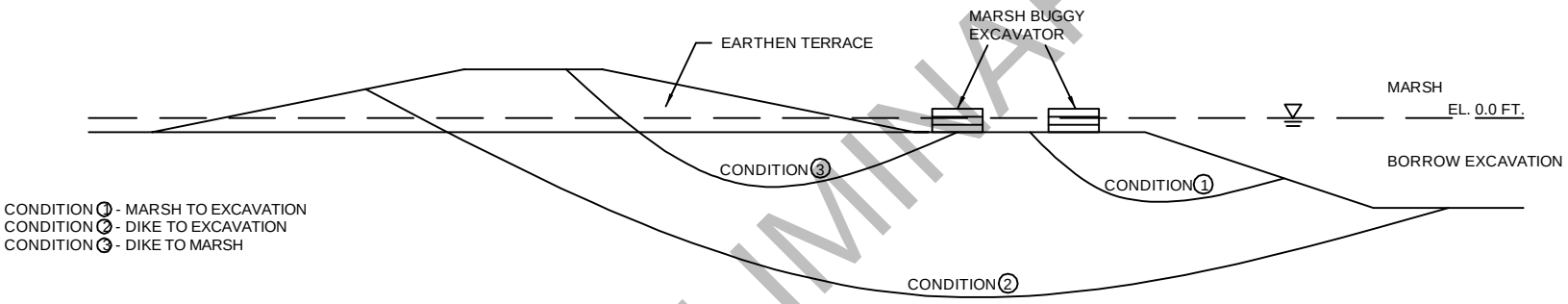
EARTHEN TERRACE INTERIOR MARSH



SCALE

20 0 20

Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

SLOPE STABILITY FAILURE SURFACES

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

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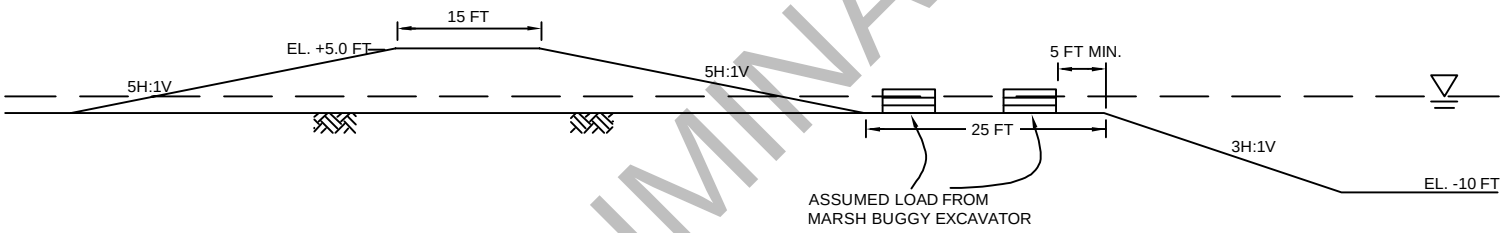
Figure 4

EARTHEN TERRACE WITHOUT REINFORCEMENT



SCALE

20 0 20

Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

EARTHEN TERRACE DETAILS

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

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Figure 5

APPENDICES

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APPENDIX A
Log of Borings

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	CC	Cement Concrete
	AC	Asphalt Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

Measured groundwater level in exploration, well, or piezometer

Groundwater observed at time of exploration

Perched water observed at time of exploration

Graphic Log Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Material Description Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Sampler Symbol Descriptions

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	Percent fines
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

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FIGURE A-1

Drilled Start	End	Total Depth (ft)	Logged By / Checked By	Driller	Drilling Method
12/21/2015	12/21/2015	34	DAS/KK / MJK	Faucheux	Wet Rotary

Surface Elevation (ft) / Vertical Datum	Hammer Data	Drilling Equipment
-1.5 NAVD88	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Airboat Mounted Rig

Latitude / Longitude	System Datum	Groundwater: Date Measured	Depth to Water (ft)	Elevation (ft)
N29° 48' 06.3" / W89° 53' 41.8"	Geographic NAD83 (feet)		N/A	

Notes: See Figure A-1 for explanation of symbols.
Cement-bentonite grout backfill full depth.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample: Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	LABORATORY DATA: Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF)	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Minivane Shear Strength (Ksf)	Passing No. 200 Sieve, %
	0							Zero (0) feet at top of boat deck Deck to water surface = 1 foot Water depth = 2 feet Mudline at 3 foot depth									
-5		14	<0.25	1			PT	Very soft black peat with organic clay seams	469	11.5	0.06	0.72	15			.173	
	5	17	<0.25	2			OH	Very soft gray organic clay	144	36.8	0.06	0.72	8	114	87	.124	
		17	<0.25	3				Very soft gray organic clay	165	26.8						.189	
-10		17	<0.25	4			PT	Very soft black peat with clay	357	16.3				254	191	.197	
	10	12	<0.25	5			OH	Very soft gray organic clay with peat and 0.5-inch silty clay layer	259	20.6	0.09	0.72	13			.185	
-15		6	<0.25	6				Very soft dark gray organic clay	375	16.3	0.03	0.81	7				
	15	8	<0.25	7				Very soft gray organic clay with silty clay layer	196	24.9	0.07	0.92	10				
-20		11	0.5	8			CH	Very soft gray clay with 4-inch layer of sand with clay seams at bottom	69								
		7	<0.25	9			OH	Very soft dark gray organic clay with peat pockets (Specific Gravity = 2.41)	167	31.8				156	115		
	20	7.5	0.25	10			ML	Loose dark gray silt with sand layers and lenses	24	96.1	0.87	1.27	14				
-25																	
	25							No sample recovered									
-30		12	1.25	11			SC	Loose gray clayey sand with 1-inch clay layer	31								35
	30																
-35		18	0.5	12				Loose gray clayey sand with sandy silt layer	31	89.6	0.30	1.9	15	28	2		

*Remolded sample used for strength testing.

Log of Boring BHT-13-30

GeoEngineers

Project: USDA/NRCS BS-24 Terracing & Marsh Creation South of Big Mar
Project Location: Plaquemines Parish, Louisiana
Project Number: 10883-020-02

Figure A-17
Sheet 1 of 1

Drilled	Start	End	Total Depth (ft)	Logged By / Checked By	Driller	Drilling Method
	12/21/2015	12/21/2015	33	DAS/KK / MJK	Faucheux	Wet Rotary

Surface Elevation (ft) / Vertical Datum	-1.6 NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop
Drilling Equipment	Airboat Mounted Rig		
Latitude / Longitude	N29° 47' 51.6" / W89° 53' 16.4"	System Datum	Geographic NAD83 (feet)
Groundwater: Date Measured	Depth to Water (ft): N/A	Elevation (ft)	

Notes: See Figure A-1 for explanation of symbols.
Cement-bentonite grout backfill full depth.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample: Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	LABORATORY DATA: Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF)	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Minivane Shear Strength (Ksf)	Passing No. 200 Sieve, %
	0							Zero (0) feet at top of boat deck Deck to water surface = 1 foot Water depth = 2 feet Mudline at 3 foot depth									
-5		14	<0.25	1			PT	Very soft black peat with clay layers	861	6.6	0.12	0.72	14			.278	
	5	8	<0.25	2				Very soft black peat	903		0.06	0.72	15	863	321	.063	
-10		12	<0.25	3			OH	Very soft dark gray organic clay with peat pockets (Specific Gravity = 2.26)	111	42.9	0.1	0.72	15	206	147	.103	
		11	<0.25	4			PT	Very soft dark gray peat	369	16.4	0.1	0.72	7			.159	
	10	11	<0.25	5			OH	Very soft dark gray organic clay with peat pockets	291	20	0.11	0.72	11	243	187	.147	
-15		11	<0.25	6				Very soft dark gray organic clay with 3-inch gray clay layer	93	40	0.07	0.81	15			.129	
	15	9	0.8	7			ML	Loose gray silt with 2-inch organic clay layer at top	29	90.5	3.43	0.92	10				90
-20		3	<0.25	8			CL	Very soft gray silty clay	32								
		<.5	<0.25	9			ML	Loose gray silt	32								
	20	14	<0.25	10			CH	Very soft gray clay with silt pockets	65					73	47		88
-25	25	18	0.5	11			SP	Loose gray sand with clay pockets	24								3
-30	30	19	<0.25	12			SM	Loose gray silty sand with clay	32	86.1	0.38	1.67	14				50

*Remolded sample used for strength testing.

Log of Boring BHT-14-30

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Project: USDA/NRCS BS-24 Terracing & Marsh Creation South of Big Mar
Project Location: Plaquemines Parish, Louisiana
Project Number: 10883-020-02

Figure A-18
Sheet 1 of 1

APPENDIX B
Laboratory Testing

GeoEngineers
Earth Science + Technology

Laboratory Test Results

Project Name: USDA NRCS - BS-24 Terracing and Marsh Creation Additional Geotechnical Services

Project ID: 10883-020-02

Technical Responsibility: Karen Allen **Date:** 2-11-16

Title: Quality Manager

BORING NUMBER	DEPTH (FT) FROM - TO	SOIL DESCRIPTION	MOISTURE %	UNIT WEIGHT (PCF) WET	UNIT WEIGHT (PCF) DRY	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	COMPRESSION TEST TSF	COMPRESSION TEST STRAIN %	COMPRESSION TEST CONFINING PRESSURE (KSF)	COMPRESSION TEST TYPE FAILURE	TEST TYPE	COMMENTS
BHT-13-30	3.0 - 5.0	Very soft black peat with organic clay seams (PT)	469	65.6	11.5				0.06	15	0.72	Bulge	MC,UU	MV: 0.173
BHT-13-30	5.0 - 7.0	Very soft gray organic clay (OH)	144	89.6	36.8	114	27	87	0.06	8	0.72	Bulge	MC,UU,AL	MV: 0.124
BHT-13-30	7.0 - 9.0	Gray organic clay (OH)	165	70.9	26.8								MC,UC	MV: 0.189
BHT-13-30	9.0 - 11.0	Black peat with clay (PT)	357	74.5	16.3	254	63	191					MC,UC,AL	MV: 0.197
BHT-13-30	11.0 - 13.0	Very soft gray organic clay with peat and 0.5" silty clay layer (OH)	259	74.1	20.6				0.09	13	0.72	Multiple Shear	MC,UU	MV: 0.185
BHT-13-30	13.0 - 15.0	Very soft dark gray organic clay (OH)	375	77.5	16.3				0.03	7	0.81	Bulge	MC,UU	
BHT-13-30	15.0 - 17.0	Very soft gray organic clay with silty clay layer (OH)	196	73.8	24.9				0.07	10	0.92	Multiple Shear	MC,UU	
BHT-13-30	17.0 - 19.0	Gray clay with 4" layer of sand with clay seams at bottom (CH)	69										MC	
BHT-13-30	19.0 - 21.0	Dark gray organic clay with peat pockets (OH)	167	84.9	31.8	156	41	115					MC,AL	SG: 2.406 ; Consolidation
BHT-13-30	21.0 - 23.0	Dark gray silt with sand layers and lenses (ML)	24	118.8	96.1				0.87	14	1.27	Multiple Shear	MC,UU	
BHT-13-30	28.0 - 30.0	Gray clayey sand with 1" clay layer (SC)	31										MC	Sieve: 65.1% sand / 34.9% fines
BHT-13-30	32.0 - 34.0	Gray clayey sand with sandy silt layer (SC)	31	117.3	89.6	28	26	2	0.30	15	1.90	Bulge	MC,UU,AL	

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Soil Description: ASTM(D2487) AASHTO(M145) **Moisture Content:** ASTM(D2166) AASHTO(T265)
Unit Weight: ASTM(D2166) AASHTO(T310) **Atterberg Limit:** ASTM(D4318) AASHTO(T89,T90)
Compression: ASTM(D2166,D2850) AASHTO(T208,T296)

GeoEngineers
Earth Science + Technology

Laboratory Test Results

Project Name: USDA NRCS - BS-24 Terracing and Marsh Creation Additional Geotechnical Services

Project ID: 10883-020-02

Technical Responsibility: Karen Allen **Date:** 2-11-16

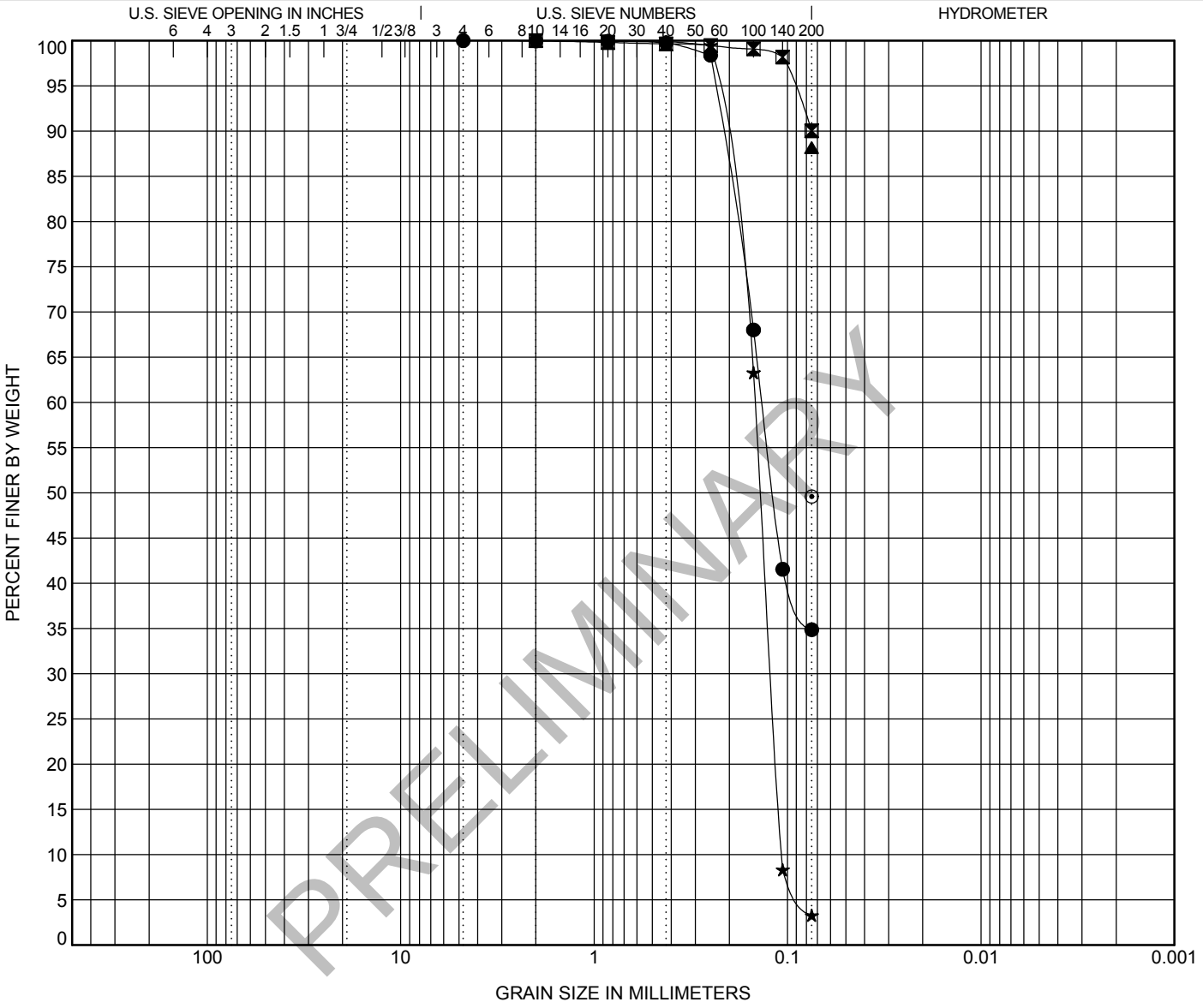
Title: Quality Manager

BORING NUMBER	DEPTH (FT) FROM - TO	SOIL DESCRIPTION	MOISTURE %	UNIT WEIGHT (PCF) WET	UNIT WEIGHT (PCF) DRY	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	COMPRESSION TEST TSF	COMPRESSION TEST STRAIN %	COMPRESSION TEST CONFINING PRESSURE (KSF)	COMPRESSION TEST TYPE FAILURE	TEST TYPE	COMMENTS
BHT-14-30	3.0 - 5.0	Very soft black peat with clay layers (PT)	861	63.4	6.6				0.12	14	0.72	Bulge	MC,UU	MV: 0.278
BHT-14-30	5.0 - 7.0	Very soft black peat (PT)	903			863	542	321	0.06	15	0.72	Bulge	MC,UU,AL	MV: 0.063
BHT-14-30	7.0 - 9.0	Very soft dark gray organic clay with peat pockets (OH)	111	90.4	42.9	206	59	147	0.10	15	0.72	Bulge	MC,UU,AL	MV: 0.103 ; SG: 2.256 ; Consolidation
BHT-14-30	9.0 - 11.0	Very soft dark gray peat (PT)	369	77.1	16.4				0.10	7	0.72	Bulge	MC,UU	MV: 0.159
BHT-14-30	11.0 - 13.0	Very soft dark gray organic clay with peat pockets (OH)	291	78.1	20.0	243	56	187	0.11	11	0.72	Bulge	MC,UU,AL	MV: 0.147
BHT-14-30	13.0 - 15.0	Very soft dark gray organic clay with 3" gray clay layer (OH)	93	77.0	40.0				0.07	15	0.81	Bulge	MC,UU	MV: 0.129
BHT-14-30	15.0 - 17.0	Gray silt with 2" organic clay layer (ML)	29	116.8	90.5				3.43	10	0.92	Multiple Shear	MC,UU	Sieve: 10.0% sand / 90.0% fines
BHT-14-30	17.0 - 19.0	Gray silty clay (CL)	32										MC	
BHT-14-30	19.0 - 21.0	Gray silt (ML)	32										MC	Low recovery
BHT-14-30	21.0 - 23.0	Gray clay with silt pockets (CH)	65			73	26	47					MC,AL	#200: 11.8% sand / 88.2% fines ; Disturbed
BHT-14-30	26.0 - 28.0	Gray sand with clay pockets (SP)	24										MC	Sieve: 96.7% sand / 3.3% fines
BHT-14-30	31.0 - 33.0	Gray silty sand with clay (SM)	32	113.3	86.1				0.38	14	1.67	Bulge	MC,UU	#200: 50.4% sand / 49.6% fines

GRAIN SIZE DISTRIBUTION
ASTM D422/D1140/D6913/C136

PROJECT NAME: BS-24 Terrace and Marsh Creation

PROJECT NUMBER: 10883-020-02 **PROJECT LOCATION:**

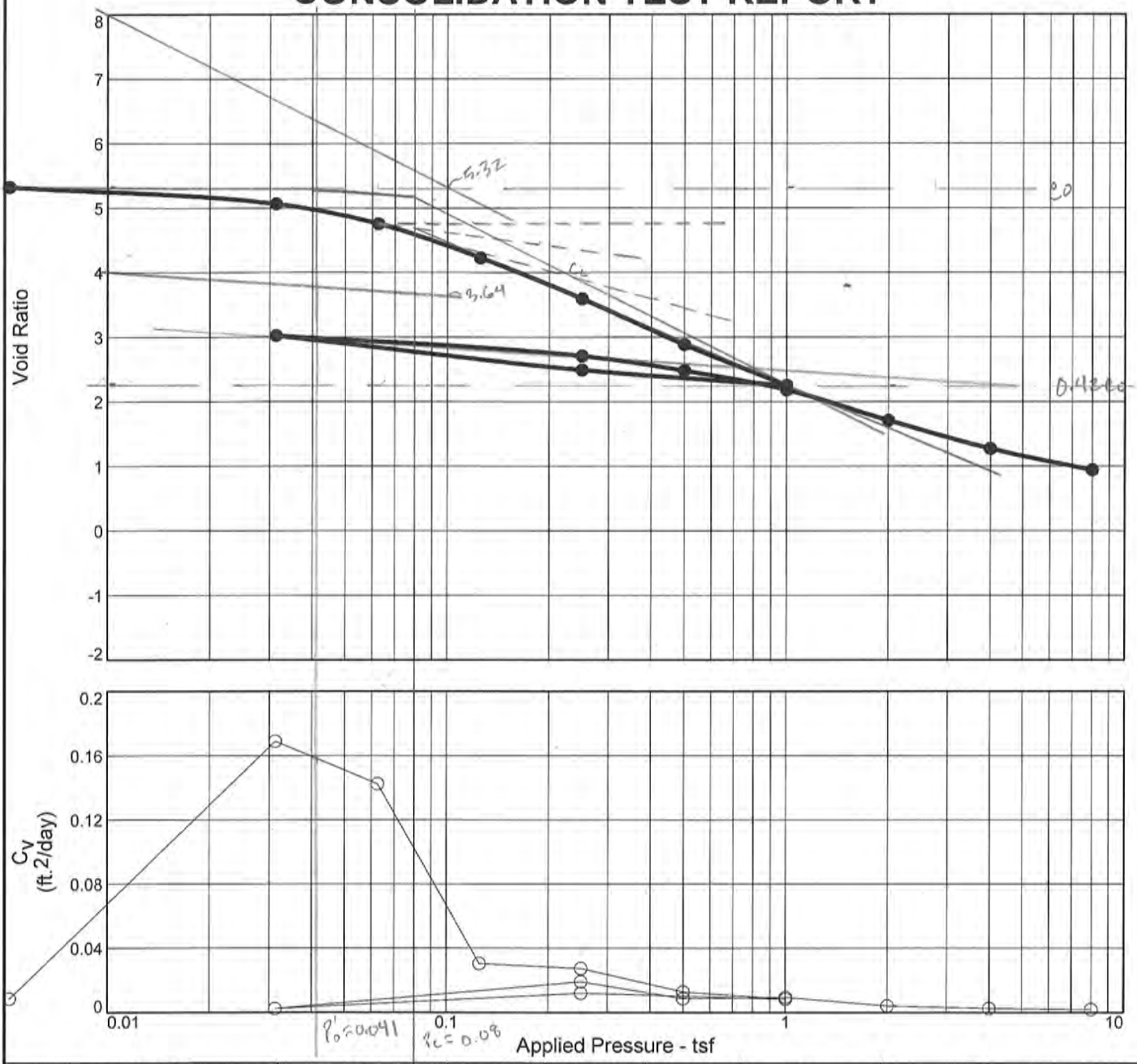


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	BHT-13-30	28.0	Gray clayey sand (SC)					
⊠	BHT-14-30	15.0	Gray clayey silt with 2" organic clay layer at top (CL-ML)					
▲	BHT-14-30	21.0	Very soft gray clay with sand pockets (CH)	73	26	47		
★	BHT-14-30	26.0	Gray sand with clay layers (SP)				0.94	1.37
⊙	BHT-14-30	31.0	Gray silty sand with clay (SM)					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BHT-13-30	28.0	4.75	0.135			0.0	65.1	34.9	
⊠	BHT-14-30	15.0	2				0.0	10.0	90.0	
▲	BHT-14-30	21.0							88.2	
★	BHT-14-30	26.0	0.85	0.147	0.122	0.107	0.0	96.7	3.3	
⊙	BHT-14-30	31.0							49.6	

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
95.5 %	225.0 %	22.3	206	147	2.256	~~0.1~~ 0.08	2.39	5.316

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft dark gray organic clay with peat pockets (OH)	OH	

Project No. 10883-020- **Client:** NRCS

Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 **Depth:** 7.0' - 9.0'

$C_v = \frac{4 - 3.64}{\log(0.1/0.01)} = 0.36$

$C_c = \frac{8 - 5.32}{\log(0.1/0.01)} = 2.68$

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Remarks:

Cv at t90

$p'_o = 2(63.4 + 97.5) + 72.48 - 62.4(5)$

$= 82.3$ psf

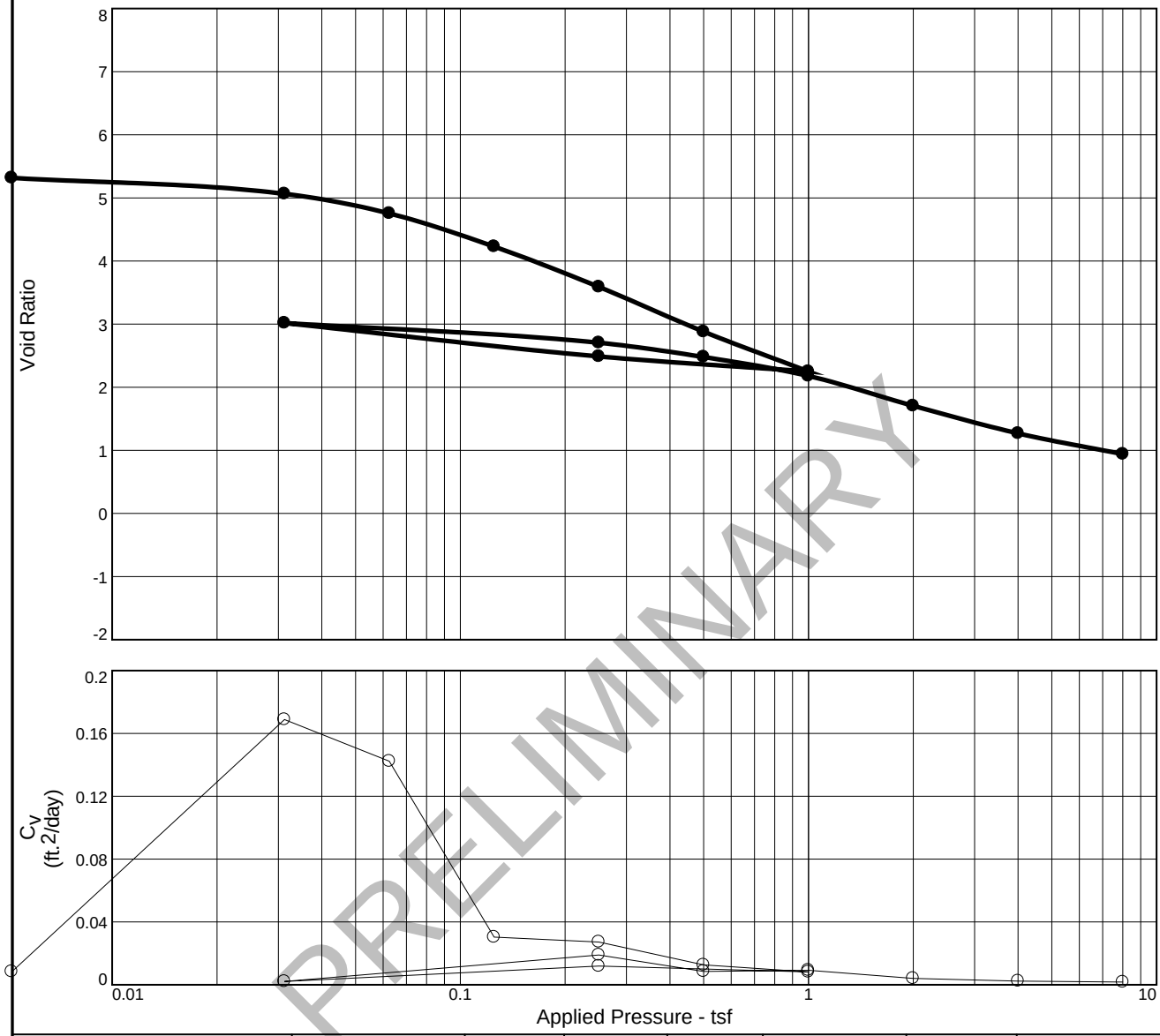
$= 0.041$ tsf

$C_{v_{t90}} \approx 0.16$ @ p'_o

Figure

Tested By: KLA **Checked By:** JMP

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
95.5 %	225.0 %	22.3	206	147	2.256	0.1	2.39	5.316

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft dark gray organic clay with peat pockets (OH)	OH	

Project No. 10883-020- **Client:** NRCS

Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 **Depth:** 7.0' - 9.0'

Remarks:
Cv at t90

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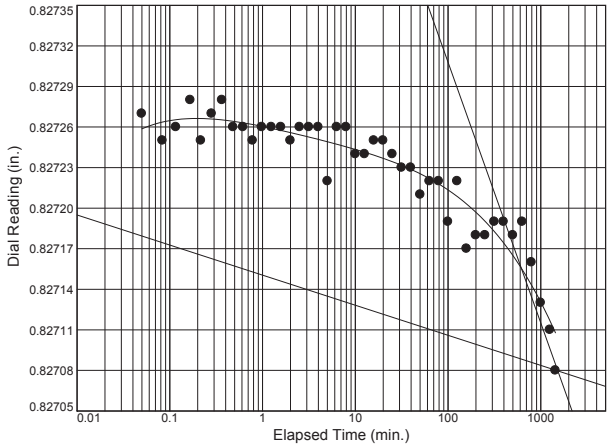
Figure

Tested By: KLA **Checked By:** JMP

Dial Reading vs. Time

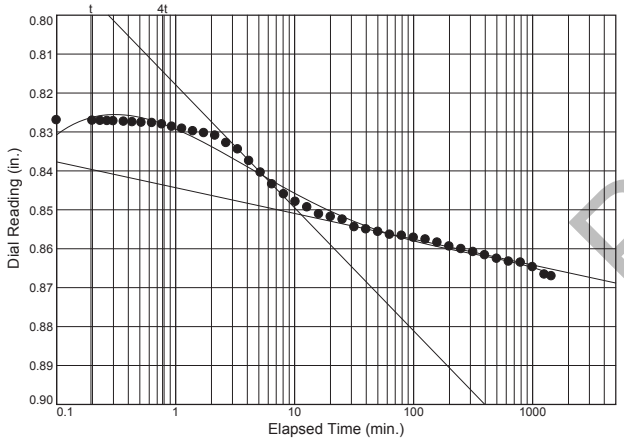
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 1
Load= 0.01 tsf
D_0 = 0.8273
D_{50} = 0.8272
D_{100} = 0.8271
T_{50} = 445.75 min.

C_v @ T_{50}
0.001 ft.^{2}/day



Load No.= 2
Load= 0.03 tsf
D_0 = 0.8247
D_{50} = 0.8380
D_{100} = 0.8513
T_{50} = 3.54 min.

C_v @ T_{50}
0.133 ft.^{2}/day

C_α = 0.042

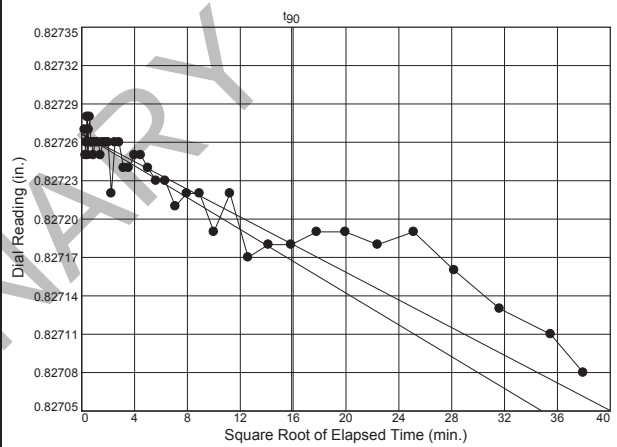
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

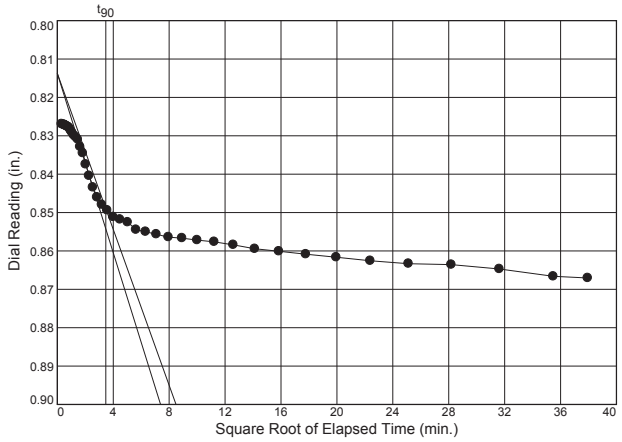
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 1
Load= 0.01 tsf
D_0 = 0.8273
D_{90} = 0.8272
D_{100} = 0.8272
T_{90} = 252.30 min.

C_v @ T_{90}
0.008 ft.^{2}/day



Load No.= 2
Load= 0.03 tsf
D_0 = 0.8138
D_{90} = 0.8490
D_{100} = 0.8529
T_{90} = 12.02 min.

C_v @ T_{90}
0.169 ft.^{2}/day

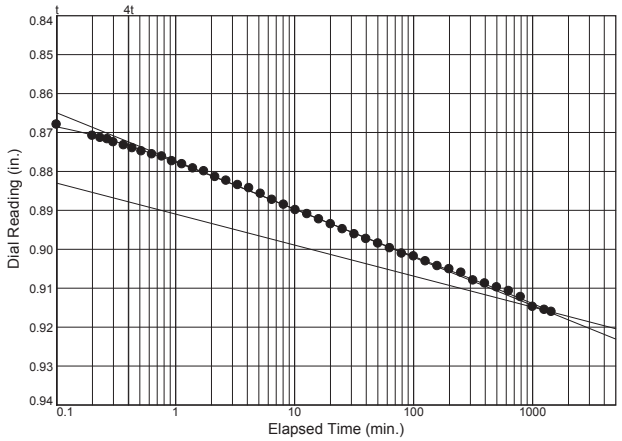
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

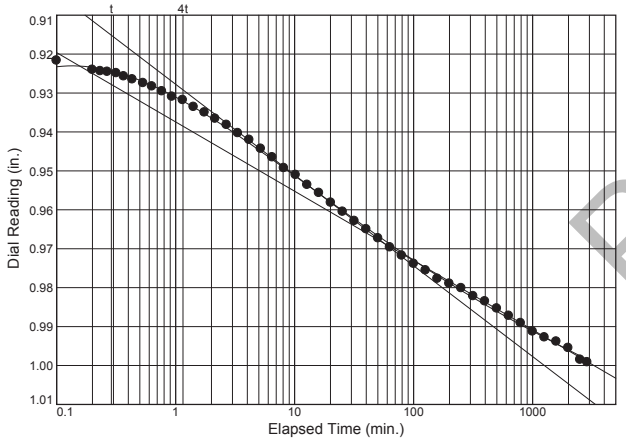
Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 3
Load= 0.06 tsf
D_0 = 0.8637
D_{50} = 0.8897
D_{100} = 0.9156
T_{50} = 9.98 min.

C_v @ T_{50}
0.043 ft.^{2}/day

C_α = 0.050



Load No.= 4
Load= 0.13 tsf
D_0 = 0.9166
D_{50} = 0.9427
D_{100} = 0.9687
T_{50} = 4.06 min.

C_v @ T_{50}
0.091 ft.^{2}/day

C_α = 0.113

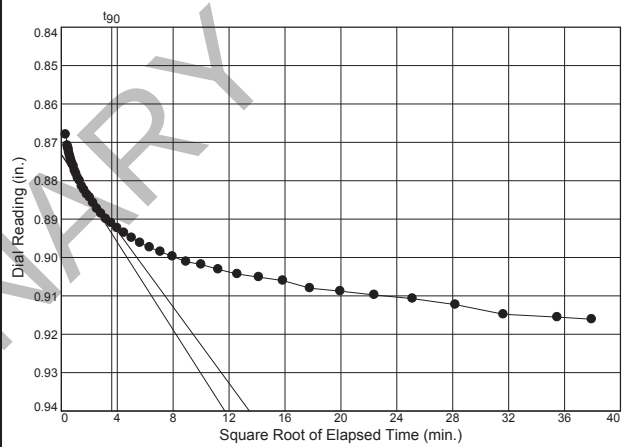
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

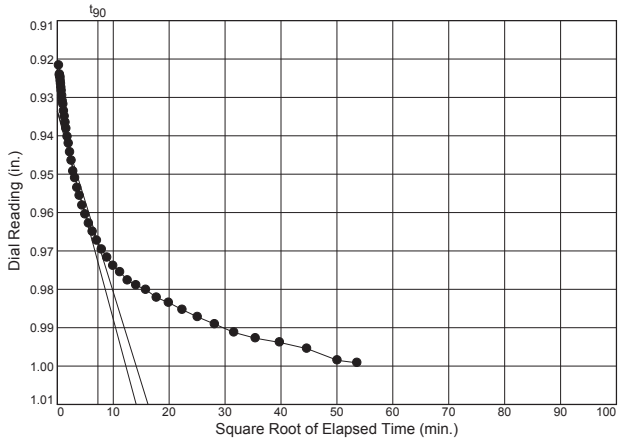
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 3
Load= 0.06 tsf
D_0 = 0.8732
D_{90} = 0.8911
D_{100} = 0.8931
T_{90} = 12.99 min.

C_v @ T_{90}
0.142 ft.^{2}/day



Load No.= 4
Load= 0.13 tsf
D_0 = 0.9336
D_{90} = 0.9677
D_{100} = 0.9715
T_{90} = 52.61 min.

C_v @ T_{90}
0.030 ft.^{2}/day

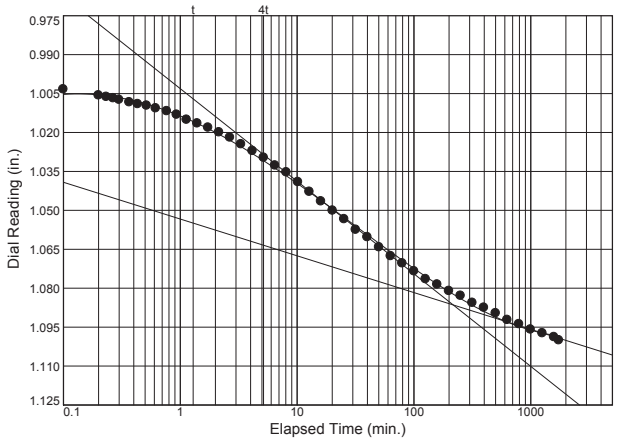
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

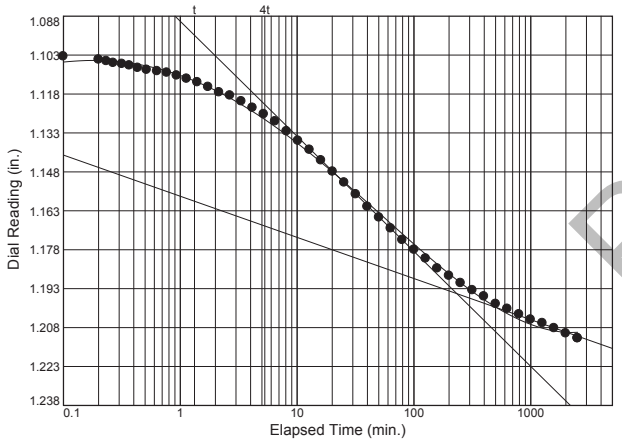
Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 5
Load= 0.25 tsf
D_0 = 1.0007
D_{50} = 1.0436
D_{100} = 1.0864
T_{50} = 13.30 min.

C_v @ T_{50}
0.022 ft.^{2}/day

C_α = 0.090



Load No.= 6
Load= 0.50 tsf
D_0 = 1.0981
D_{50} = 1.1465
D_{100} = 1.1949
T_{50} = 18.32 min.

C_v @ T_{50}
0.012 ft.^{2}/day

C_α = 0.100

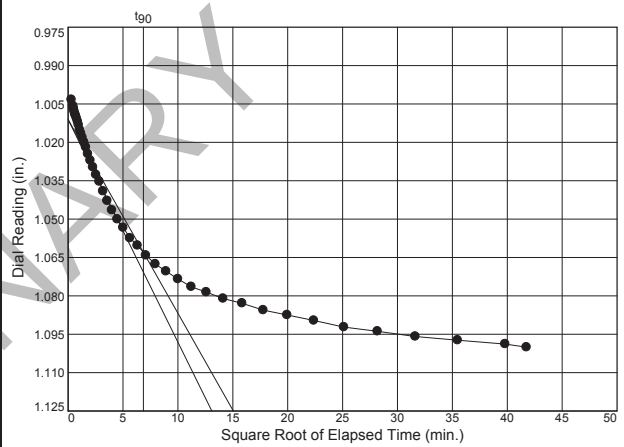
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

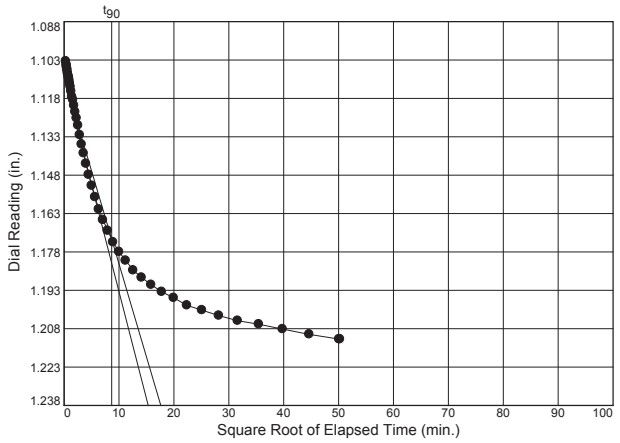
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 5
Load= 0.25 tsf
D_0 = 1.0111
D_{90} = 1.0630
D_{100} = 1.0687
T_{90} = 46.95 min.

C_v @ T_{90}
0.027 ft.^{2}/day



Load No.= 6
Load= 0.50 tsf
D_0 = 1.1101
D_{90} = 1.1730
D_{100} = 1.1800
T_{90} = 75.10 min.

C_v @ T_{90}
0.013 ft.^{2}/day

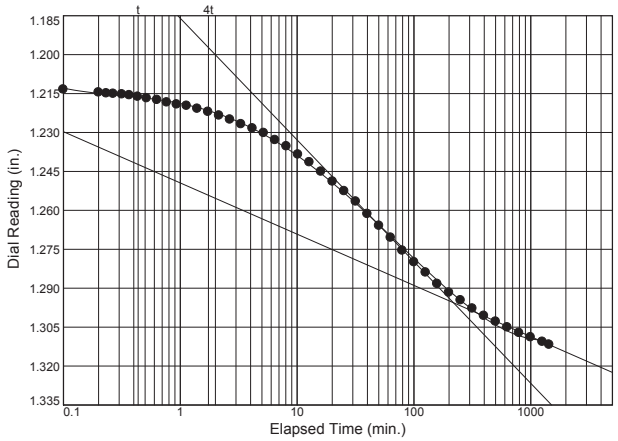
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

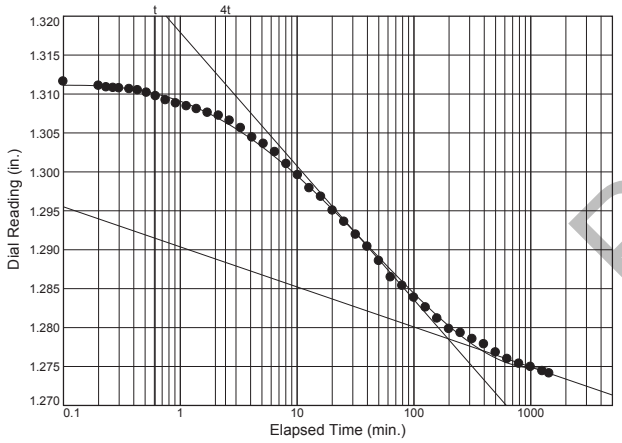
Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 7
Load= 1.00 tsf
D_0 = 1.2112
D_{50} = 1.2534
D_{100} = 1.2956
T_{50} = 25.45 min.

C_v @ T_{50}
0.006 ft.^{2}/day

C_α = 0.125



Load No.= 8
Load= 0.25 tsf
D_0 = 1.3137
D_{50} = 1.2962
D_{100} = 1.2786
T_{50} = 17.27 min.

C_v @ T_{50}
0.008 ft.^{2}/day

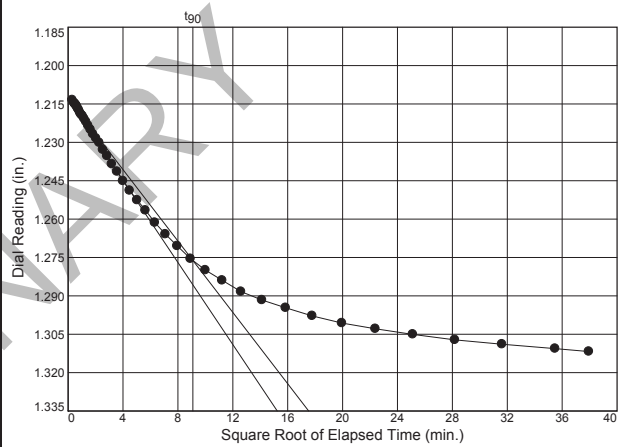
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

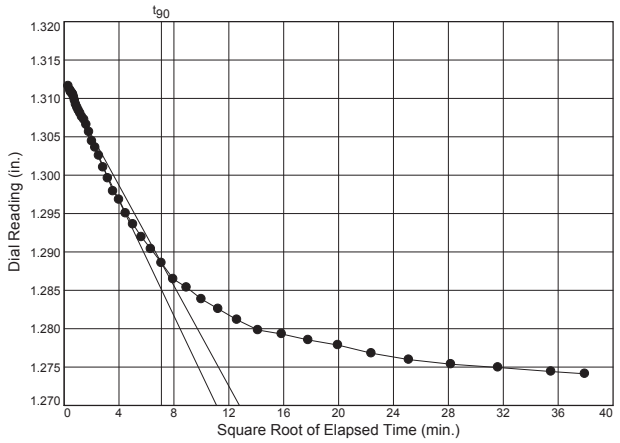
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 7
Load= 1.00 tsf
D_0 = 1.2128
D_{90} = 1.2762
D_{100} = 1.2832
T_{90} = 82.58 min.

C_v @ T_{90}
0.008 ft.^{2}/day



Load No.= 8
Load= 0.25 tsf
D_0 = 1.3117
D_{90} = 1.2886
D_{100} = 1.2860
T_{90} = 50.20 min.

C_v @ T_{90}
0.012 ft.^{2}/day

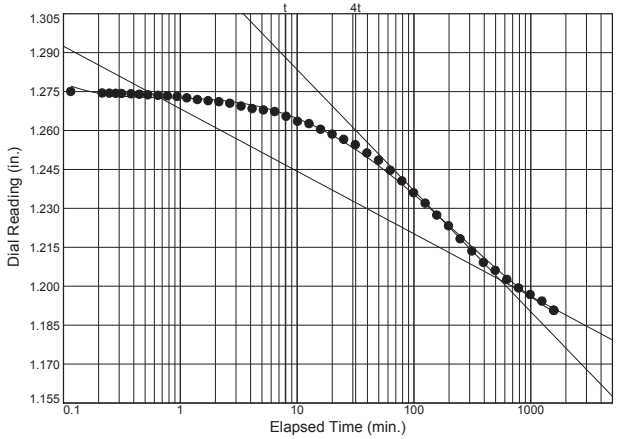
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

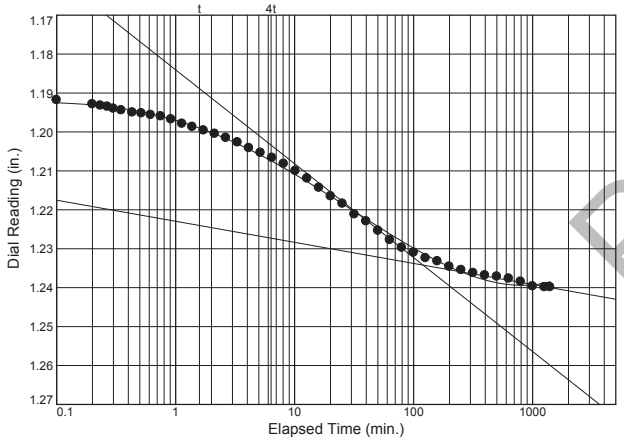
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 9
Load= 0.03 tsf
D_0 = 1.2800
D_{50} = 1.2412
D_{100} = 1.2025
T_{50} = 70.05 min.

C_v @ T_{50}
0.002 ft.^{2}/day



Load No.= 10
Load= 0.25 tsf
D_0 = 1.1906
D_{50} = 1.2124
D_{100} = 1.2342
T_{50} = 12.17 min.

C_v @ T_{50}
0.015 ft.^{2}/day

C_α = 0.034

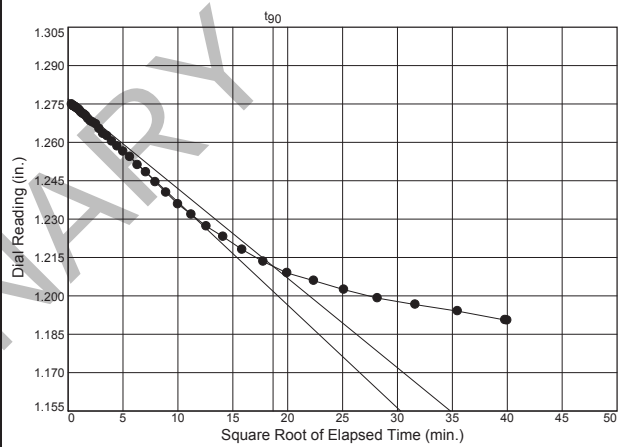
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

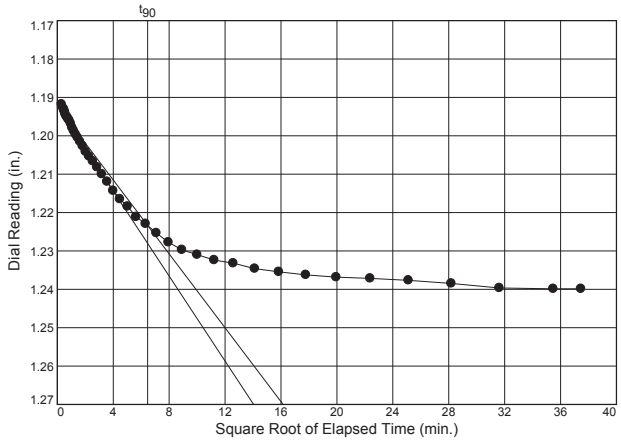
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 9
Load= 0.03 tsf
D_0 = 1.2769
D_{90} = 1.2116
D_{100} = 1.2043
T_{90} = 348.39 min.

C_v @ T_{90}
0.002 ft.^{2}/day



Load No.= 10
Load= 0.25 tsf
D_0 = 1.1923
D_{90} = 1.2234
D_{100} = 1.2268
T_{90} = 41.72 min.

C_v @ T_{90}
0.019 ft.^{2}/day

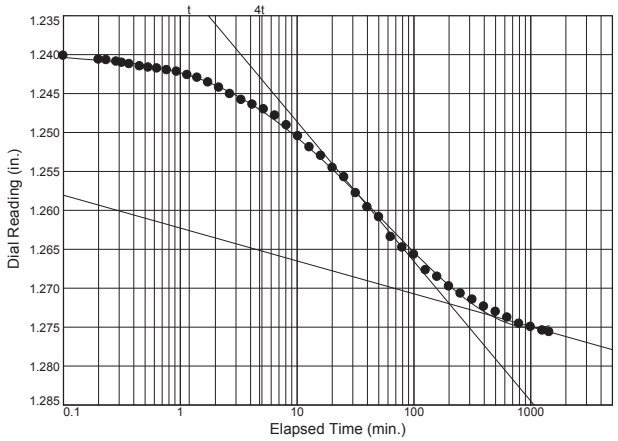
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

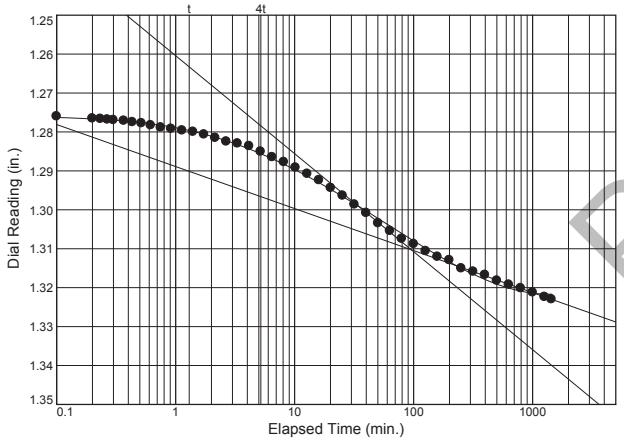
Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 11
Load= 0.50 tsf
D_0 = 1.2383
D_{50} = 1.2551
D_{100} = 1.2720
T_{50} = 21.38 min.

C_v @ T_{50}
0.007 $ft.^2$/day

C_α = 0.027



Load No.= 12
Load= 1.00 tsf
D_0 = 1.2737
D_{50} = 1.2920
D_{100} = 1.3103
T_{50} = 13.88 min.

C_v @ T_{50}
0.010 $ft.^2$/day

C_α = 0.068

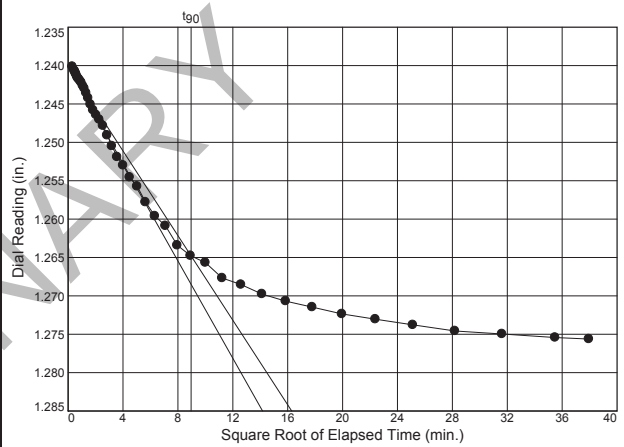
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

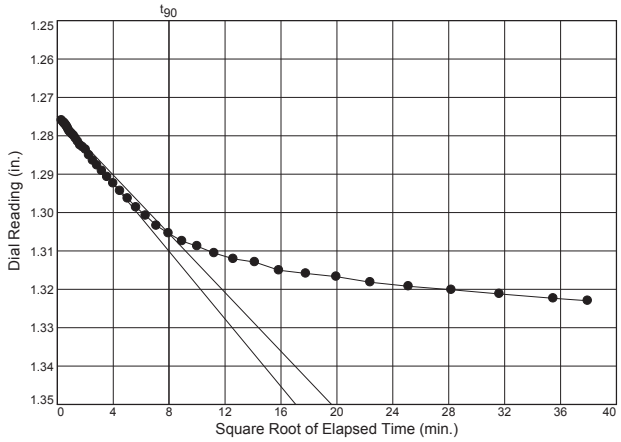
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 11
Load= 0.50 tsf
D_0 = 1.2401
D_{90} = 1.2648
D_{100} = 1.2675
T_{90} = 80.31 min.

C_v @ T_{90}
0.009 $ft.^2$/day



Load No.= 12
Load= 1.00 tsf
D_0 = 1.2749
D_{90} = 1.3054
D_{100} = 1.3088
T_{90} = 63.59 min.

C_v @ T_{90}
0.009 $ft.^2$/day

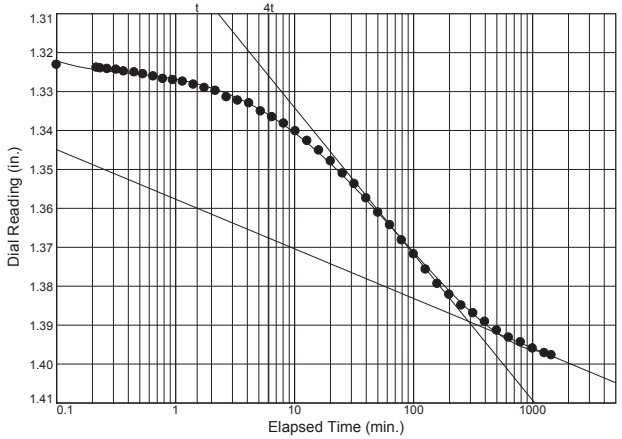
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

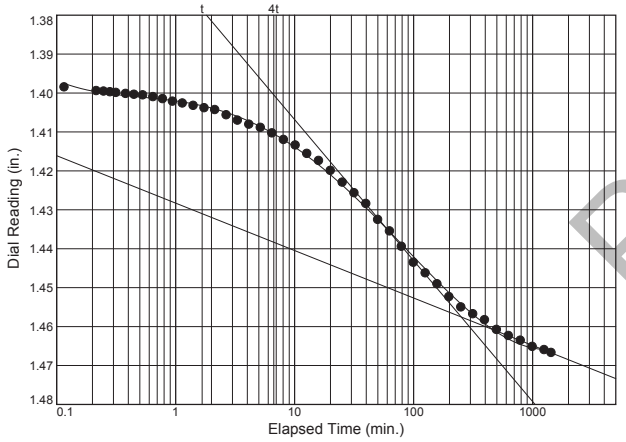
Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 13
Load= 2.00 tsf
D_0 = 1.3200
D_{50} = 1.3545
D_{100} = 1.3890
T_{50} = 31.61 min.

C_v @ T_{50}
0.003 ft.^{2}/day

C_α = 0.081



Load No.= 14
Load= 4.00 tsf
D_0 = 1.3961
D_{50} = 1.4268
D_{100} = 1.4575
T_{50} = 32.33 min.

C_v @ T_{50}
0.002 ft.^{2}/day

C_α = 0.077

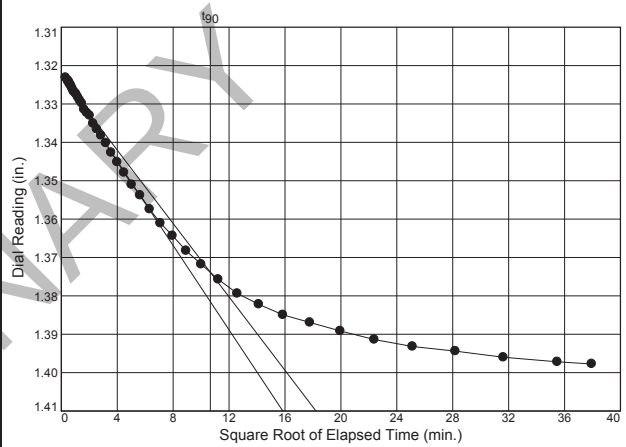
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

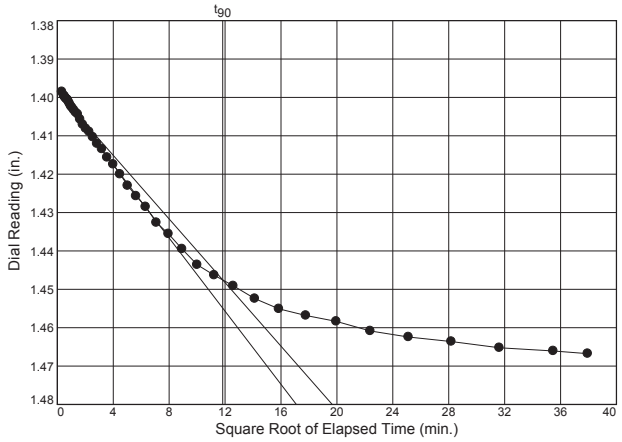
Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 13
Load= 2.00 tsf
D_0 = 1.3229
D_{90} = 1.3739
D_{100} = 1.3795
T_{90} = 113.67 min.

C_v @ T_{90}
0.004 ft.^{2}/day



Load No.= 14
Load= 4.00 tsf
D_0 = 1.3985
D_{90} = 1.4476
D_{100} = 1.4530
T_{90} = 139.99 min.

C_v @ T_{90}
0.002 ft.^{2}/day

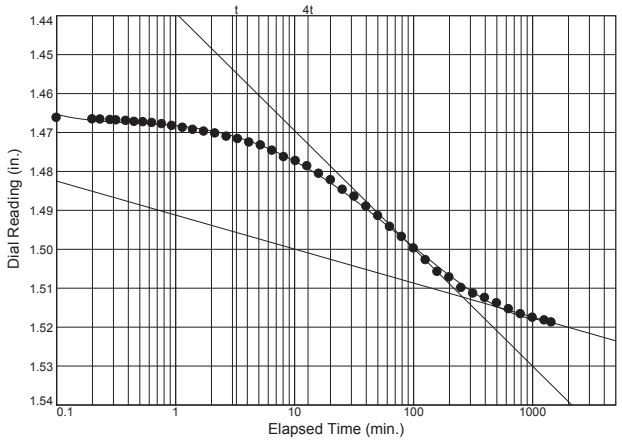
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 15
Load= 8.00 tsf
D_0 = 1.4630
D_{50} = 1.4876
D_{100} = 1.5123
T_{50} = 32.86 min.

C_v @ T_{50}
0.002 $ft.^2$/day

C_α = 0.055

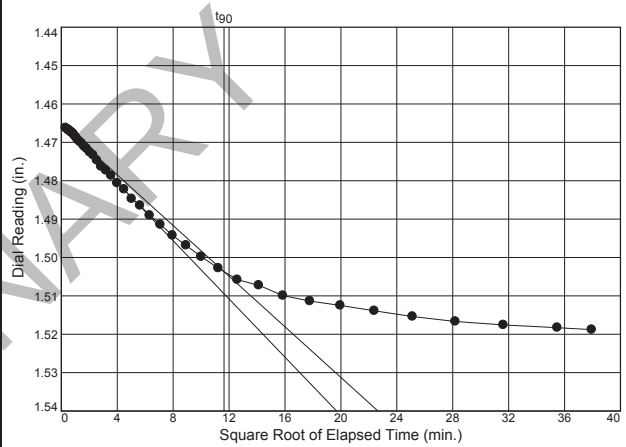
Figure

GeoEngineers, Inc.

Dial Reading vs. Time

Project No.: 10883-020-02
Project: BS-24 Terrace and Marsh Creation

Source of Sample: BHT-14-30 Depth: 7.0' - 9.0'



Load No.= 15
Load= 8.00 tsf
D_0 = 1.4653
D_{90} = 1.5037
D_{100} = 1.5080
T_{90} = 135.53 min.

C_v @ T_{90}
0.002 $ft.^2$/day

Figure

GeoEngineers, Inc.

MINIATURE VANE TEST

Date: 12-22-15	Project Name:		BS24 Terrace & Marsh Creation			10883-020-02	
Boring No.	BHT 13-30	BHT 13-30	BHT 13-30	BHT 13-30	BHT 13-30	BHT 13-30	BHT 13-30
Sample No.							
Penetration, ft	3-5	5-7	7-9	9-11	11-13	13-15	15-17
Test Type: U/R	U	U	U	U	U	U	U
Material Description							
Pen. (P) /Torvane (T) (tsf)							
Spring No.	1	1	1	1	1	1	1
Vane Diameter, (in)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vane Height, (in)	1	1	1	1	1	1	1
Start Point (deg)	0	0	0	0	0	0	0
Stop Point (deg)	74	53	81	84	79	0	0
Spring Rotation, deg.	74	53	81	84	79	0	0
Spring Constant	0.0085756	0.0085756	0.0085756	0.0085756	0.0085756	0.0085756	0.0085756
Tare No.							
Wet Soil + Tare							
Dry Soil + Tare							
Tare							
Mass of Dry Soil							
Mass of Water							
Water Content							
Cohesive Strength, (ksf)	**0.173**	**0.124**	**0.189**	**0.197**	**0.185**	**0.000**	**0.000**

Remarks:		
Tested By:	Computed By:	Checked By:
Date:	Date:	Date:

ASTM D 4648-00

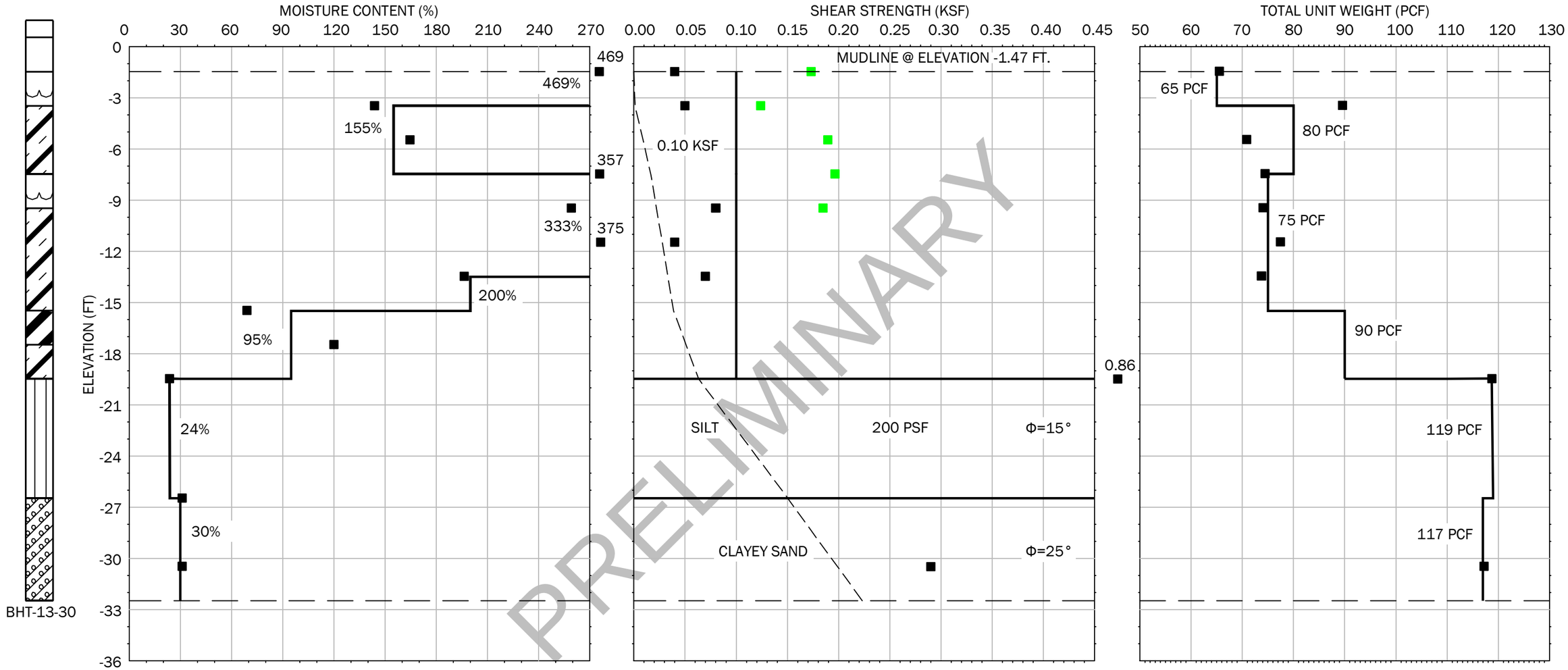
MINIATURE VANE TEST

Date: 12-22-15	Project Name:		BS24 Terrace & Marsh Creation			10883-020-02	
Boring No.	BHT 14-30	BHT 14-30	BHT 14-30	BHT 14-30	BHT 14-30	BHT 14-30	BHT 14-30
Sample No.							
Penetration, ft	3-5	5-7	7-9	9-11	11-13	13-15	15-17
Test Type: U/R	U	U	U	U	U	U	U
Material Description							
Pen. (P) /Torvane (T) (tsf)							
Spring No.	1	1	1	1	1	1	1
Vane Diameter, (in)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vane Height, (in)	1	1	1	1	1	1	1
Start Point (deg)	0	0	0	0	0	0	0
Stop Point (deg)	119	27	44	68	63	55	0
Spring Rotation, deg.	119	27	44	68	63	55	0
Spring Constant	0.0085756	0.0085756	0.0085756	0.0085756	0.0085756	0.0085756	0.0085756
Tare No.							
Wet Soil + Tare							
Dry Soil + Tare							
Tare							
Mass of Dry Soil							
Mass of Water							
Water Content							
Cohesive Strength, (ksf)	**0.278**	**0.063**	**0.103**	**0.159**	**0.147**	**0.129**	**0.000**

Remarks:		
Tested By:	Computed By:	Checked By:
Date:	Date:	Date:

ASTM D 4648-00

APPENDIX C
Design Profiles



SOIL BORING LEGEND

CH CLAY
SC CLAYEY SAND
OH ORGANIC CLAY
PT PEAT
ML SILT

LEGEND

- BHT-13 (COMPRESSIVE TEST)
- BHT-13 (MINIVANE TEST)
- DESIGN PROFILE
- C/P=0.22

DESIGN PROFILE - BHT-13-30

USDA NRCS - BS-24 Terracing and Marsh Creation
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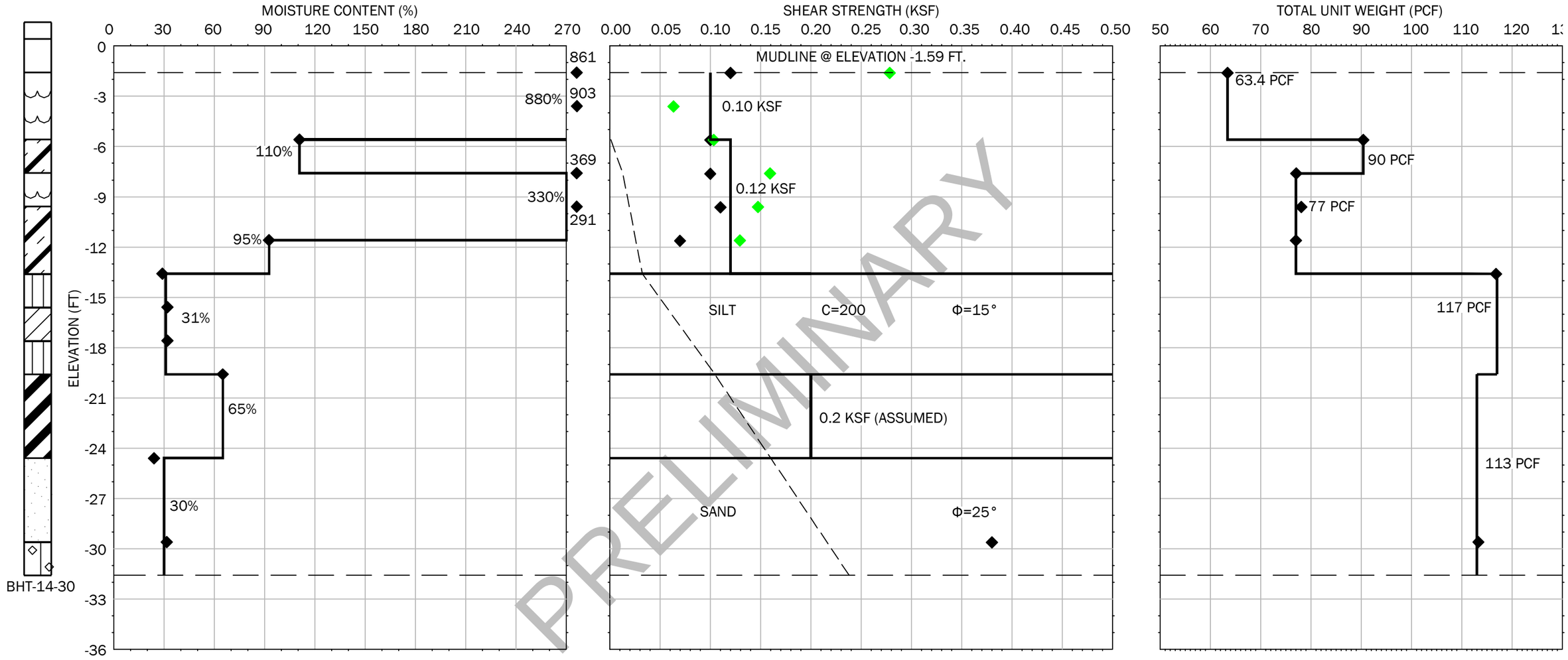
Figure C-16



SOIL BORING LEGEND

- CH CLAY
- SP SAND
- OH ORGANIC CLAY
- SM SILTY SAND
- CL SILTY CLAY
- ML SILT
- PT PEAT

LEGEND

- BHT-14 (COMPRESSIVE STRENGTHS)
- BHT-14 (MINIVANE STRENGTHS)
- DESIGN PROFILE
- C/P=0.22

DESIGN PROFILE - BHT-14-30

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

GeoEngineers

Figure C-17

IAH : KMC

P:\101088302\02\CAD\Lab Graphs.dwg\TAB:Chart A-1 (8) modified on Feb 11, 2016 - 7:46am

APPENDIX D
Slope Stability and Bearing Capacity

Calculation Checksheet

Project No. 10883-020-02 **Project Title:** BS-24 Terracing and Marsh Creation South of Big Mar Project

Deliverable Title: Slope Stability analysis at BHT-13-30 and BHT-14-30

Calculations Description: Slope stability was analyzed using GeoStudio 2012 Slope/W. The terrace was analyzed for slope stability using the soil properties obtained by soil borings BHT-13-30 and BHT-14-30. The selected fill for the terrace and chosen properties consist of a unit weight of 75 pcf and a cohesion of 60 psf. The terrace is set at a 5:1 slope with a top width of 15 feet. The terrace was modeled for elevations of +2, +3, +4, and +5. The elevation +5 evaluation resulted in a stable embankment, as a result lower elevations are not regarded. Stability was analyzed for three different failure cases: "marsh to excavation", "terrace to excavation", and "terrace to marsh". A 25-foot wide construction/stability bench was modeled. The failure case of marsh to excavation included a surcharge of 260 psf on the marsh to model the marsh buggy long reach excavator that is likely to be used. The water elevation was modeled at 0.0 ft. The mudline elevation was modeled at an elevation of -2 feet.

Originator: CAH **Checked by:** JMP **Date:** 2/8/16

Checking method (describe): Verified and corrected soil parameters, where needed. Checked geometry of terrace and subsurface layers. Checked search parameters and project settings. Checked results and assumptions for reasonableness

Comments:

Slope Stability Calculation Approach for the Earthen Terraces
BS-24 Terracing and Marsh Creation South of Big Mar Project

1. 2 new soil borings were evaluated in addition to the 12 soil borings previously analyzed for the project.
2. Subsurface profiles for each soil boring were developed by shear strength, unit weight, and moisture content as provided in Appendix C.
3. Based on the BS-16 project and the information provided in the Geotechnical Scope of Services document,
    - Used design water elevation of 0.0 feet, NAVD 88 Geoid 12A for all analyses.
    - Constructed crown elevations of +2.0, 3.0, 4.0, and 5.0 feet, NAVD88 Geoid 12A.
    - Terrace crown width of 15 feet.
    - Elevation of the bottom of the excavation access channel of El.-10.0 feet NAVD88 Geoid 12A.
    - Used surveyed mudline elevation at each soil boring for bottom elevation of the fill.
4. Factor of safety for earthen terrace stability of 1.3 was considered with 1.2 as absolute minimum.
5. Performed stability analyses for the earthen embankment/containment dike using the computer program SLOPE/W (2012 version), developed by GEO-SLOPE International Ltd. SLOPE/W is a software product that computes factors of safety against potential failure based on limit equilibrium theory to evaluate the stability of earth slopes. The factor of safety for the containment dike and earthen embankment for various slopes was analyzed using the Spencer method. The Spencer method considers both shear and normal interslice forces. The method involves a circular search and takes into account both moment and force equilibrium. The critical failure surface obtained from using Spencer method is then optimized in Slope/W where the program uses statistical random walk procedure based on the Monte Carlo method.
6. The stability for the earthen terraces were evaluated for three conditions (see Figure 4); Condition 1- failure surface from marsh to excavation; Condition 2- failure surface from terrace to excavation; Condition 3- failure surface from terrace to marsh.
7. The stability runs were performed with and without a marsh buggy excavator for construction of the dikes for the three conditions mentioned above as follows:
    - Condition 1 – Includes an excavator load at all times
    - Condition 2 – Does not include an excavator load.
    - Condition 3 – Does not include an excavator load.

Given the distance between the soil borings performed for the projects, variation of soil profile between the soil borings must be expected. The values for unit weight and shear strength for the earthen terraces are dependent on the installation methods and can vary significantly depending on the amount of disturbance the soil undergoes during construction. In general, the average unit weight of soil in the upper profile of the subsurface soil across the site is approximately 75 pcf. Stability evaluations were completed using a shear strength of 60 psf and unit weight of 75 pcf.

Evaluation/Results

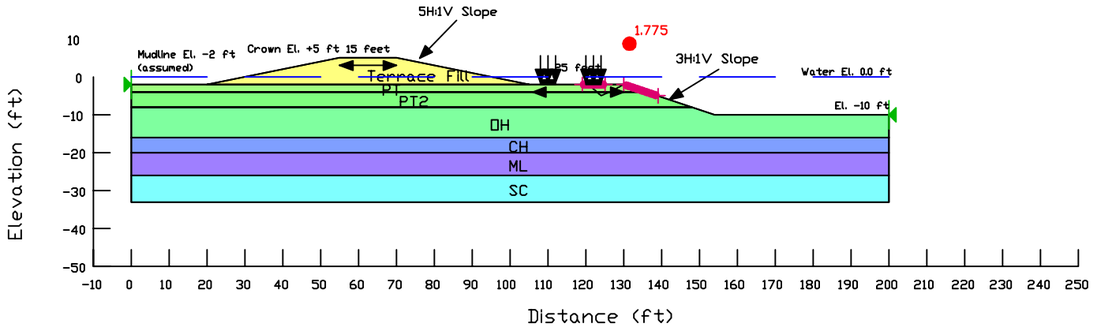
In general, the stability analyses for terraces at the two new boring locations were initially performed for crown elevation of +5 feet and side slopes of 5H:1V. Both evaluations for the new soil boring locations resulted in satisfactory stability at a crown elevation of +5 feet without consideration of multiple-lift construction.

Title: Earthen Terrace Stability at BHT-13-30

Name: Terrace Fill	Model: Mohr-Coulomb	Unit Weight: 75 pcf	Cohesion': 60 psf	Phi': 0 °
Name: PT	Model: Mohr-Coulomb	Unit Weight: 65 pcf	Cohesion': 100 psf	Phi': 0 °
Name: PT2	Model: Mohr-Coulomb	Unit Weight: 80 pcf	Cohesion': 100 psf	Phi': 0 °
Name: OH	Model: Mohr-Coulomb	Unit Weight: 75 pcf	Cohesion': 100 psf	Phi': 0 °
Name: SC	Model: Mohr-Coulomb	Unit Weight: 117 pcf	Cohesion': 0 psf	Phi': 25 °
Name: CH	Model: Mohr-Coulomb	Unit Weight: 90 pcf	Cohesion': 100 psf	Phi': 0 °
Name: ML	Model: Mohr-Coulomb	Unit Weight: 119 pcf	Cohesion': 200 psf	Phi': 15 °

F of S: 1.775

MARSH TO EXCAVATION

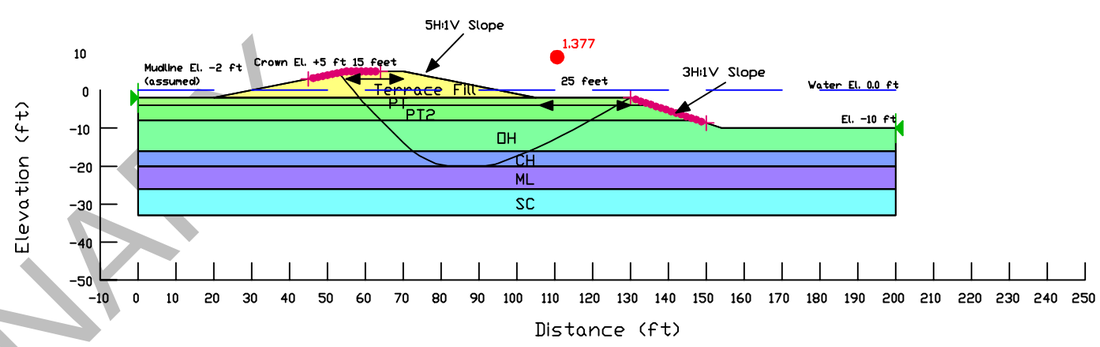


Title: Earthen Terrace Stability at BHT-13-30

Name: Terrace Fill	Model: Mohr-Coulomb	Unit Weight: 75 pcf	Cohesion': 60 psf	Phi': 0 °
Name: PT	Model: Mohr-Coulomb	Unit Weight: 65 pcf	Cohesion': 100 psf	Phi': 0 °
Name: PT2	Model: Mohr-Coulomb	Unit Weight: 80 pcf	Cohesion': 100 psf	Phi': 0 °
Name: OH	Model: Mohr-Coulomb	Unit Weight: 75 pcf	Cohesion': 100 psf	Phi': 0 °
Name: SC	Model: Mohr-Coulomb	Unit Weight: 117 pcf	Cohesion': 0 psf	Phi': 25 °
Name: CH	Model: Mohr-Coulomb	Unit Weight: 90 pcf	Cohesion': 100 psf	Phi': 0 °
Name: ML	Model: Mohr-Coulomb	Unit Weight: 119 pcf	Cohesion': 200 psf	Phi': 15 °

F of S: 1.377

TERRACE TO EXCAVATION

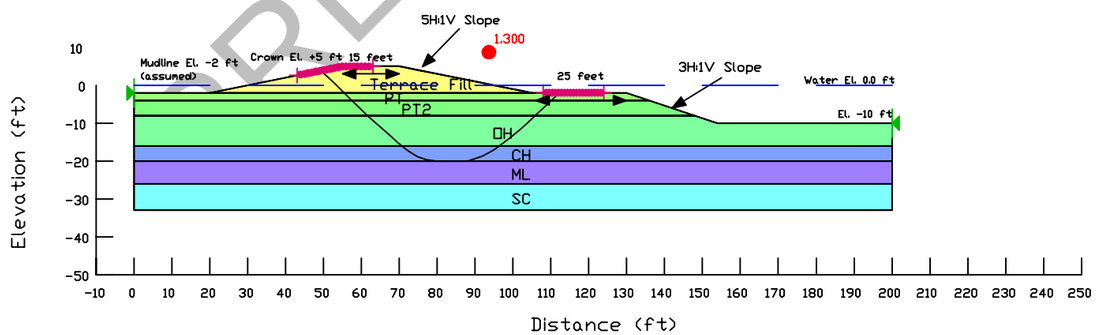


Title: Earthen Terrace Stability at BHT-13-30

Name: Terrace Fill	Model: Mohr-Coulomb	Unit Weight: 75 pcf	Cohesion': 60 psf	Phi': 0 °
Name: PT	Model: Mohr-Coulomb	Unit Weight: 65 pcf	Cohesion': 100 psf	Phi': 0 °
Name: PT2	Model: Mohr-Coulomb	Unit Weight: 80 pcf	Cohesion': 100 psf	Phi': 0 °
Name: OH	Model: Mohr-Coulomb	Unit Weight: 75 pcf	Cohesion': 100 psf	Phi': 0 °
Name: SC	Model: Mohr-Coulomb	Unit Weight: 117 pcf	Cohesion': 0 psf	Phi': 25 °
Name: CH	Model: Mohr-Coulomb	Unit Weight: 90 pcf	Cohesion': 100 psf	Phi': 0 °
Name: ML	Model: Mohr-Coulomb	Unit Weight: 119 pcf	Cohesion': 200 psf	Phi': 15 °

F of S: 1.300

TERRACE TO MARSH



SLOPE STABILITY - BHT-13-30

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Additional Geotechnical Services
Plaquemines Parish, Louisiana

GeoEngineers

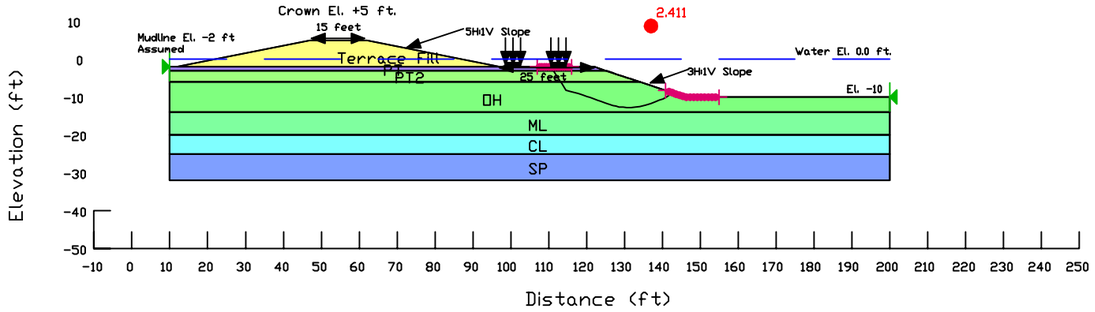
Figure D-26

Title: Earthen Terrace Stability at BHT-14-30

Name: Terrace Fill Model: Mohr-Coulomb Unit Weight: 75 pcf Cohesion': 60 psf Phi': 0 °
Name: PT2 Model: Mohr-Coulomb Unit Weight: 94 pcf Cohesion': 100 psf Phi': 0 °
Name: OH Model: Mohr-Coulomb Unit Weight: 77 pcf Cohesion': 120 psf Phi': 0 °
Name: ML Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 200 psf Phi': 15 °
Name: CL Model: Mohr-Coulomb Unit Weight: 113 pcf Cohesion': 200 psf Phi': 0 °
Name: SP Model: Mohr-Coulomb Unit Weight: 113 pcf Cohesion': 0 psf Phi': 25 °
Name: PT Model: Mohr-Coulomb Unit Weight: 63.4 pcf Cohesion': 100 psf Phi': 0 °

F of S: 2.411

MARSH TO EXCAVATION

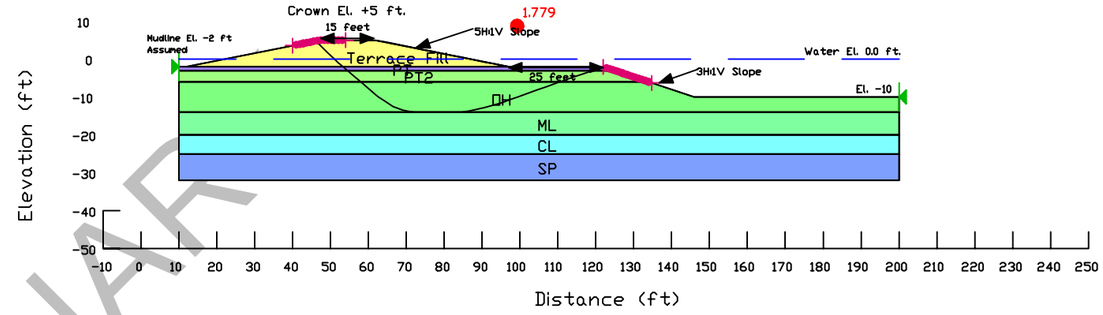


Title: Earthen Terrace Stability at BHT-14-30

Name: Terrace Fill Model: Mohr-Coulomb Unit Weight: 75 pcf Cohesion': 60 psf Phi': 0 °
Name: PT2 Model: Mohr-Coulomb Unit Weight: 94 pcf Cohesion': 100 psf Phi': 0 °
Name: OH Model: Mohr-Coulomb Unit Weight: 77 pcf Cohesion': 120 psf Phi': 0 °
Name: ML Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 200 psf Phi': 15 °
Name: CL Model: Mohr-Coulomb Unit Weight: 113 pcf Cohesion': 200 psf Phi': 0 °
Name: SP Model: Mohr-Coulomb Unit Weight: 113 pcf Cohesion': 0 psf Phi': 25 °
Name: PT Model: Mohr-Coulomb Unit Weight: 63.4 pcf Cohesion': 100 psf Phi': 0 °

F of S: 1.779

TERRACE TO EXCAVATION

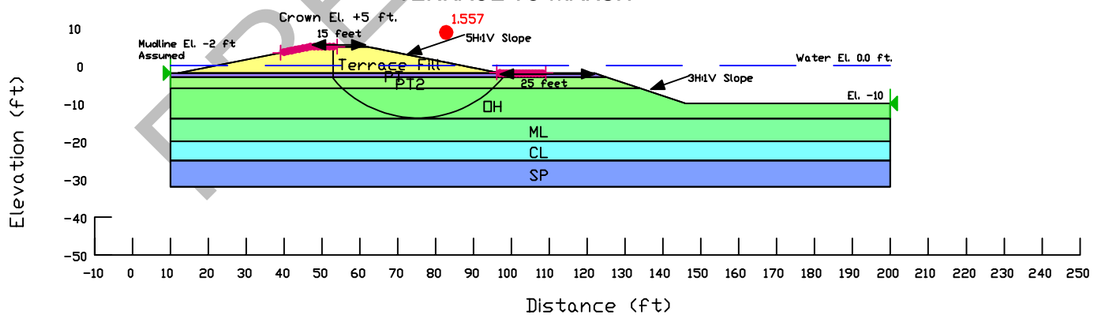


Title: Earthen Terrace Stability at BHT-14-30

Name: Terrace Fill Model: Mohr-Coulomb Unit Weight: 75 pcf Cohesion': 60 psf Phi': 0 °
Name: PT2 Model: Mohr-Coulomb Unit Weight: 94 pcf Cohesion': 100 psf Phi': 0 °
Name: OH Model: Mohr-Coulomb Unit Weight: 77 pcf Cohesion': 120 psf Phi': 0 °
Name: ML Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 200 psf Phi': 15 °
Name: CL Model: Mohr-Coulomb Unit Weight: 113 pcf Cohesion': 200 psf Phi': 0 °
Name: SP Model: Mohr-Coulomb Unit Weight: 113 pcf Cohesion': 0 psf Phi': 25 °
Name: PT Model: Mohr-Coulomb Unit Weight: 63.4 pcf Cohesion': 100 psf Phi': 0 °

F of S: 1.557

TERRACE TO MARSH



SLOPE STABILITY - BHT-14-30

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Additional Geotechnical Services
Plaquemines Parish, Louisiana

GeoEngineers

Figure D-27

Calculation Checksheet

Project No. 10883-020-02 **Project Title:** BS-24 Terracing and Marsh Creation South of Big Mar Project

Deliverable Title: Bearing Capacity analysis at BHT-13-30 and BHT-14-30

Calculations Description: The bearing capacity was analyzed and computed by using an assembled spreadsheet within GeoEngineers' system. The bearing capacity for the proposed terrace was analyzed with the soil boring BHT-13-30 and again using soil boring BHT-14-30. The bearing capacity analysis for the terrace using soil boring BHT-13-30 included the following inputs for both borings:

- Bottom of terrace elevation (mudline): -2 feet (assumed)
- Top elevation of terrace: +5 feet
- Slope of terrace: 5:1
- Unit weight of terrace fill: 75 pcf

The remaining inputs included the defined layers and their respective shear strengths, which were obtained from the soil profile for BHT-13-30. The bearing capacity results indicated a factor of safety greater than 1.3 for both bearing capacity and lateral squeeze.

Originator: CAH **Checked by:** JMP **Date:** 2/8/16

Checking method (describe): Verified results by confirming soil properties in foundation, checking calculations for geometry and applied load, and checking references and assumptions for proper use and reasonableness.

Comments:

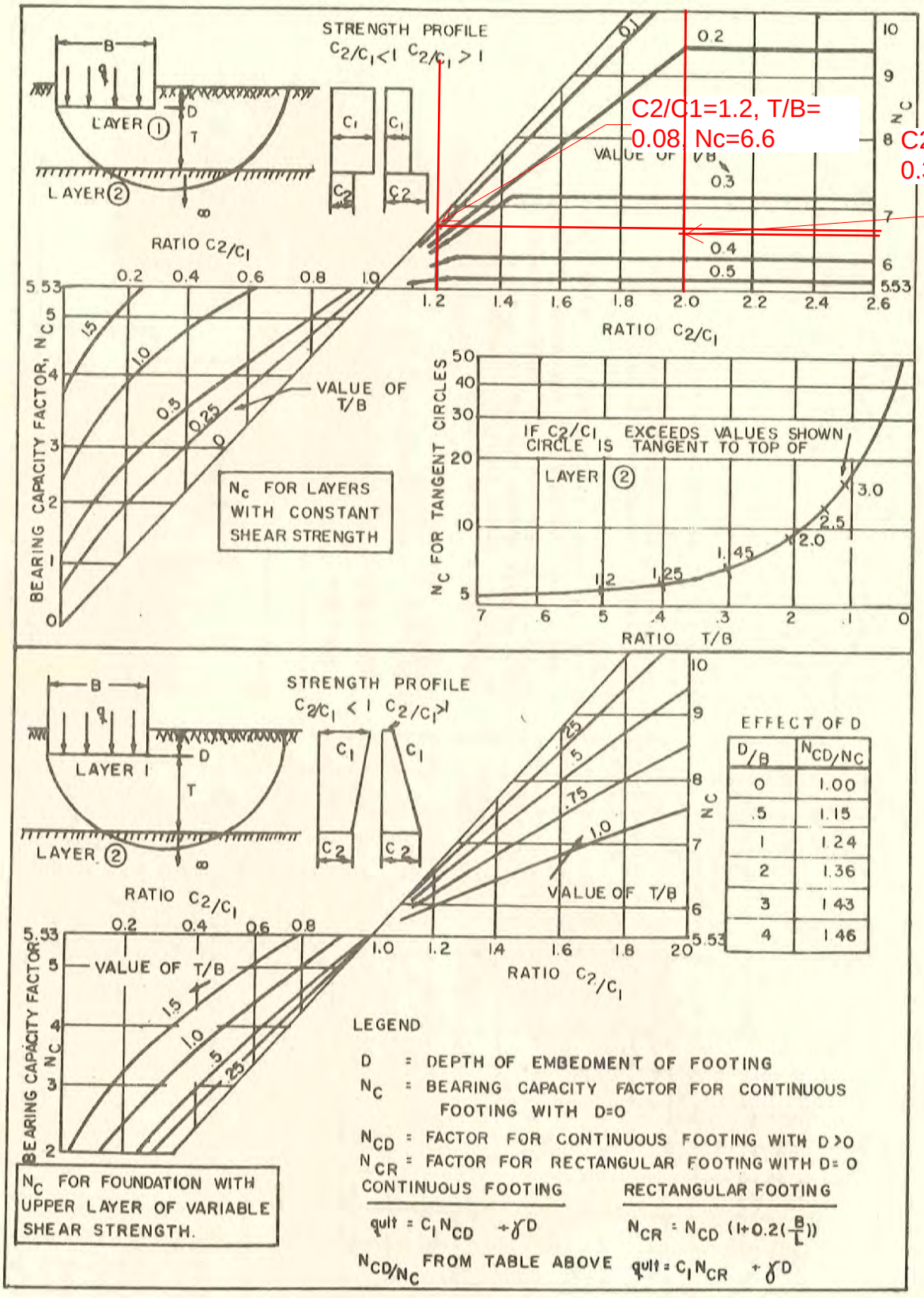
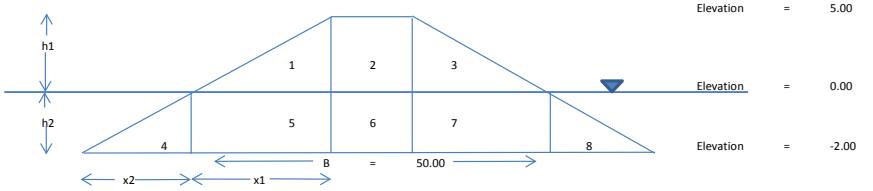


FIGURE 11-5
Ultimate Bearing Capacity on Two Layer Cohesive Soil ($\phi = 0$)

FACTOR OF SAFETY AGAINST BEARING CAPACITY AND LATERAL SQUEEZE FOR UNREINFORCED DIKES USING NAVFAC DM 7; FIGURE 11-5, PAGE 7-11-6

GEOMETRY-BHT-13-30

Elevation at Bottom of Dike (ft.)	Elevation at Top of Dike (ft.)	Height of Dike (ft.)	Slope Inclination (H:V)		Width at Top of Dike (ft.)	Elevation of Water (ft.)	Full Width at Bottom of Dike (ft.)	h1 (ft.)	h2 (ft.)	x1 (ft.)	x2 (ft.)
-2.00	5.00	7.00	5.00	1.00	15.00	0.00	85.00	5.00	2.00	25.00	10.00



Assumptions:
1. Unit weight of dike = 75 pcf
2. Water at EL. 0.0 feet
3. Mud line at EL. -2 feet
4. No reinforcement is used between the dike and the subsurface.
5. The effective width of the dike is equal to the width of the crown plus the width of one sloped side.
6. The factor of safety for bearing capacity must be greater or equal to 1.3. The factor of safety for lateral squeeze must be greater or equal to 1.3.

APPLIED STRESS

Total Unit Weight of Dike (pcf)	Buoyant Unit Weight of Dike (pcf)	Effective Width of Dike (B) (ft.)	Applied Stress (psf)
75.00	12.60	50.00	338

Zone	1	2	3	4	5	6	7	8	Total
Area (ft^2)	63	75	63	10	50	30	50	10	350
Applied Load (lb./ft.)	4688	5625	4688	126	630	378	630	126	16890

SUBSURFACE CONDITIONS

Soil Description		Elevation (ft.)				Cohesion (ksf)	Cohesion (psf)	Thickness (ft.)
PT/OH		-2.00	-	-20.00		0.10	100.00	18.00
ML		-20.00	-	-26.00		0.20	200.00	6.00
SC		-26.00	-	-33.00		0.00	0.00	7.00

T	B	T/B	C1	C2	C2/C1
18.00	50.00	0.36	100.00	200.00	2.00

BEARING CAPACITY RESULTS

Depth of Soft Soil (ft.)	Effective Width of Dike (B) (ft.)	Nc Factor From NAVFAC DM-7 Figure 11-5	C1	Ultimate Bearing Capacity (psf)	Applied Stress (psf)	Factor of Safety
18.00	50.00	6.50	100	650	338	1.92

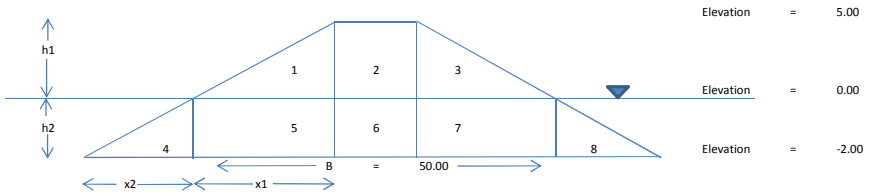
LATERAL SQUEEZE RESULTS

C (psf)	Applied Stress (psf)	a (ft.)	C-req (psf)	Factor of Safety
100	338	9	61	1.64

FACTOR OF SAFETY AGAINST BEARING CAPACITY AND LATERAL SQUEEZE FOR UNREINFORCED DIKES USING NAVFAC DM 7; FIGURE 11-5, PAGE 7-11-6

GEOMETRY-BHT-14-30

Elevation at Bottom of Dike (ft.)	Elevation at Top of Dike (ft.)	Height of Dike (ft.)	Slope Inclination (H:V)		Width at Top of Dike (ft.)	Elevation of Water (ft.)	Full Width at Bottom of Dike (ft.)	h1 (ft.)	h2 (ft.)	x1 (ft.)	x2 (ft.)
-2.00	5.00	7.00	5.00	1.00	15.00	0.00	85.00	5.00	2.00	25.00	10.00



Assumptions:
1. Unit weight of dike = 75 pcf
2. Water at EL. 0.0 feet
3. Mud line at EL. -1.52 feet
4. No reinforcement is used between the dike and the subsurface.
5. The effective width of the dike is equal to the width of the crown plus the width of one sloped side.
6. The factor of safety for bearing capacity must be greater or equal to 1.3. The factor of safety for lateral squeeze must be greater or equal to 1.3.

APPLIED STRESS

Total Unit Weight of Dike (pcf)	Buoyant Unit Weight of Dike (pcf)	Effective Width of Dike (B) (ft.)	Applied Stress (psf)
75.00	12.60	50.00	338

Zone	1	2	3	4	5	6	7	8	Total
Area (ft^2)	63	75	63	10	50	30	50	10	350
Applied Load (lb./ft.)	4688	5625	4688	126	630	378	630	126	16890

SUBSURFACE CONDITIONS

Soil Description		Elevation (ft.)				Cohesion (ksf)	Cohesion (psf)	Thickness (ft.)
PT		-2.00	-	-6.00		0.10	100.00	4.00
OH		-6.00	-	-13.00		0.12	120.00	7.00
ML		-13.00	-	-20.00		0.12	120.00	7.00
CL		-20.00	-	-25.00		0.12	120.00	5.00
SP		-25.00	-	-32.00		0.12	120.00	7.00

T	B	T/B	C1	C2	C2/C1
4.00	50.00	0.08	100.00	120.00	1.2

BEARING CAPACITY RESULTS

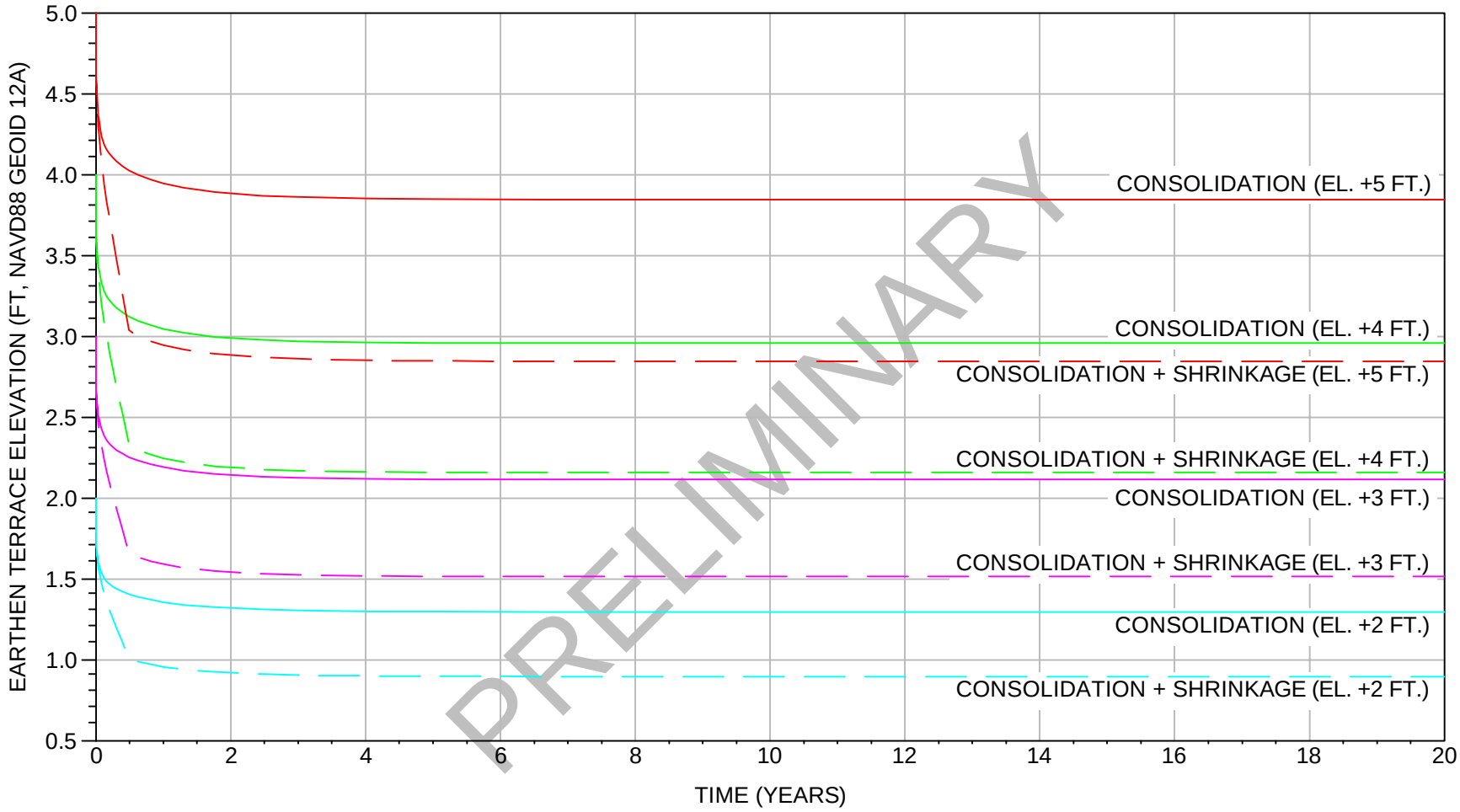
Depth of Soft Soil (ft.)	Effective Width of Dike (B) (ft.)	Nc Factor From NAVFAC DM-7 Figure 11-5	C1	Ultimate Bearing Capacity (psf)	Applied Stress (psf)	Factor of Safety
22.00	50.00	6.60	100	660	338	1.95

LATERAL SQUEEZE RESULTS

C (psf)	Applied Stress (psf)	a (ft.)	C-req (psf)	Factor of Safety
100	338	11	74	1.35

APPENDIX E
Settlement Analyses Earth Terraces

P:\10\10883020\02\CAD\SETTLEMENT.dwg\TAB:E-4 modified on Feb 11, 2016 - 2:14pm VT：KMC



EARTHEN TERRACE ELEVATION (FEET NAVD88) CONSOLIDATION (CONSOLIDATION + SHRINKAGE)						
0 DAYS	6 MONTHS	1 YEAR	3 YEAR	5 YEAR	10 YEAR	LONG TERM
2.0	1.4 (1.0)	1.4 (1.0)	1.3 (0.9)	1.3 (0.9)	1.3 (0.9)	1.3 (0.9)
3.0	2.3 (1.7)	2.2 (1.6)	2.2 (1.6)	2.1 (1.5)	2.1 (1.5)	2.1 (1.5)
4.0	3.1 (2.3)	3.1 (2.3)	3.0 (2.2)	3.0 (2.2)	3.0 (2.2)	3.0 (2.2)
5.0	4.0 (3.0)	4.0 (3.0)	3.9 (2.9)	3.9 (2.9)	3.9 (2.9)	3.9 (2.9)

CONSTRUCTION SETTLEMENT (FEET)
0.1
0.2
0.2
0.2

Notes: 1. Construction settlement must be added for quantity estimates.

EARTHEN TERRACE ELEVATION VS. TIME
BHT-13-30

USDA NRCS - BS-24 Terracing and Marsh Creation
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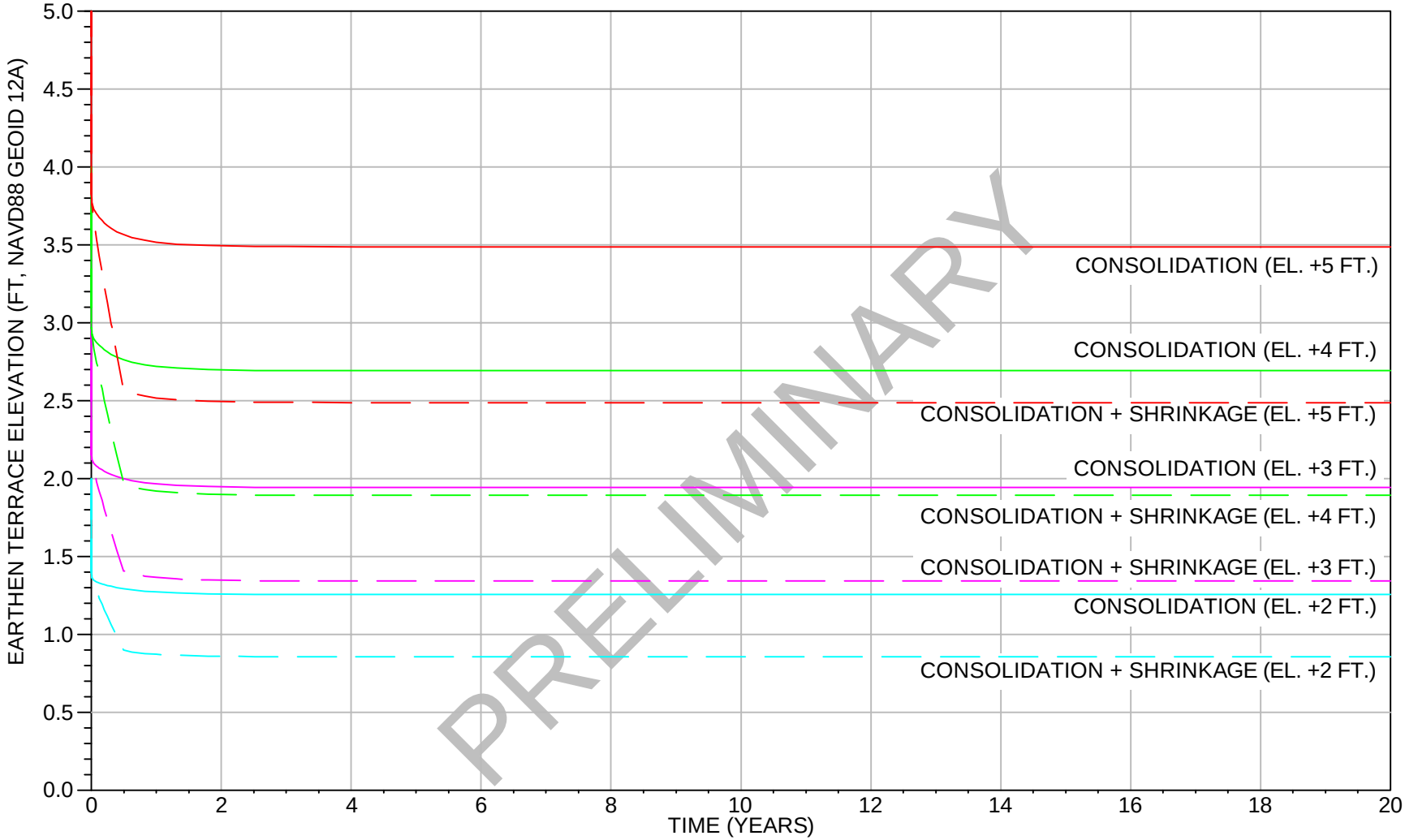
Figure E-18

P:\10\10883020\02\CAD\SETTLEMENT.dwg\TAB:E-4 (2) modified on Feb 11, 2016 - 2:29pm VT：KMC



EARTHEN TERRACE ELEVATION (FEET NAVD88) CONSOLIDATION (CONSOLIDATION + SHRINKAGE)						
0 DAYS	6 MONTHS	1 YEAR	3 YEAR	5 YEAR	10 YEAR	LONG TERM
2.0	1.3 (0.9)	1.3 (0.9)	1.3 (0.9)	1.3 (0.9)	1.3 (0.9)	1.3 (0.9)
3.0	2.0 (1.4)	2.0 (1.4)	1.9 (1.3)	1.9 (1.3)	1.9 (1.3)	1.9 (1.3)
4.0	2.8 (2.0)	2.7 (1.9)	2.7 (1.9)	2.7 (1.9)	2.7 (1.9)	2.7 (1.9)
5.0	3.6 (2.6)	3.5 (2.5)	3.5 (2.5)	3.5 (2.5)	3.5 (2.5)	3.5 (2.5)

CONSTRUCTION SETTLEMENT (FEET)
0.2
0.2
0.3
0.3

Notes: 1. Construction settlement must be added for quantity estimates.

EARTHEN TERRACE ELEVATION VS. TIME
BHT-14-30

USDA NRCS - BS-24 Terracing and Marsh Creation
Additional Geotechnical Services
Plaquemines Parish, Louisiana

GeoEngineers

Figure E-19

NRCS- BS-24 TERRACING AND MARSH CREATION SOUTH OF BIG MAR PROJECT
PLAQUEMINES PARISH, LOUISIANA
SETTLEMENT PARAMETERS FOR BHT-13-30

DESIGN PARAMETERS

ELEV						UNIT WEIGHT		EQ. 1		EQ. 2		EQ. 3							Pc						
			COHESION	M.C		WET	DRY		Consol.	Use MC	Consol.		Adopted	Adopted	Adopted	Adopted	C_v[1]	C_v	Consol	P_{avg}	P_t	Po	OCR[2]	OCR	Adopted[3]
FEET			KSF	%	S.G	PCF	PCF	e_o	C_c	C_c	C_r	C_r	C_c	$C_{c\varepsilon}$	Cr	Cr_ε	ft^2/day	$\times10^{-5}in^2$/sec	tsf	tsf	tsf	tsf		Consol	OCR
-1.5	-	-3.5	0.100	469	1.94	65	11	9.104		4.727		0.709	4.727	0.468	0.709	0.070	0.100	16.7		0.0013	0	0.0013	635.7		100.0
-3.5	-	-7.5	0.100	155	2.51	80	31	3.892		1.913		0.287	1.913	0.391	0.287	0.059	0.100	16.7		0.0176	0.0026	0.0202	20.6		20.6
-7.5	-	-13.5	0.100	333	2.06	75	17	6.847		3.508		0.526	3.508	0.447	0.526	0.067	0.050	8.3		0.0189	0.0378	0.0567	5.7		5.7
-13.5	-	-15.5	0.100	200	2.32	75	25	4.639		2.316		0.347	2.316	0.411	0.347	0.062	0.040	6.7		0.0063	0.0756	0.0819	3.6		3.6
-15.5	-	-19.5	0.100	95	2.68	90	46	2.542		1.184		0.178	1.184	0.334	0.178	0.050	0.040	6.7		0.0276	0.0882	0.1158	2.3		2.3
-19.5	-	-26.5	silt	24.0	2.65	119	96	0.349		0.154		0.023	0.154	0.115	0.023	0.017	5.000	833.3		0.09905	0.1434	0.24245	#VALUE!		#VALUE!
-26.5	-	-32.5	sand	30.0	2.65	117	90	0.534		0.240		0.036	0.240	0.157	0.036	0.023	2.000	333.3		0.0819	0.3415	0.4234	#VALUE!		#VALUE!

Equations:

EQ. 1 e0 = 0.0309*M.C. -0.3931 (for low moisture soils)
e0 = 0.0166*M.C. +1.3187 (for high moisture soils)

EQ. 2 C_c = 0.0054*((S.G.*M.C.)-35) (NAVFAC)

EQ. 3 Cr= 0.15Cc

EQ. 4 S.G. = e0/M.C. (assumes 100% saturation)

Note:

1 Cv values for materials were determined using the Cv vs MC curve developed by GeoEngineers based on data from coastal projects

2 OCR = (c/(p' * 0.22))^(1/0.8) (Recommended practice for soft ground site characterization: Aruthur Casagrande Lecture Figure 7.1)

3 From Note 2, reviewing c/p line and consolidation test result; Assumed OCR =1 if OCR<1 from calculations

4

References:

"Foundation Design: Principles and Practices" Donald Coduto 1994
"NAVFAC DM-7.1 Soil Mechanics" 1982
"GeoEngineers" based on our experience with coastal soils
"Soil Mechanics" Lambe and Whitman 1969

NRCS- BS-24 TERRACING AND MARSH CREATION SOUTH OF BIG MAR PROJECT
PLAQUEMINES PARISH, LOUISIANA
SETTLEMENT PARAMETERS FOR BHT-14-30

ELEV			COHESION	M.C		UNIT WEIGHT WET	UNIT WEIGHT DRY	EQ. 1		EQ. 2		EQ. 3	DESIGN PARAMETERS						Pc						
									Consol.	Use MC	Consol.		Adopted	Adopted	Adopted	Adopted	C_v[1]	C_v	Consol	P_{avg}	P_t	Po	OCR[2]	OCR	Adopted[3]
FEET			KSF	%	S.G	PCF	PCF	e_o	C_c	C_c	C_r	C_r	C_c	$C_c\varepsilon$	Cr	$Cr\varepsilon$	ft^2/day	$\times 10^{-5} in^2$/sec	tsf	tsf	tsf	tsf		Consol	OCR
-1.6	-	-5.6	0.100	880	1.81	63	6	15.927		8.411		1.262	8.411	0.497	1.262	0.075	5.000	833.3		0.001	0	0.001	882.4		100.0
-5.6	-	-7.6	0.120	110	2.86	90	43	3.145		1.509		0.226	1.509	0.364	0.226	0.055	0.020	3.3		0.0138	0.002	0.0158	35.2		35.2
-7.6	-	-11.6	0.120	330	2.06	77	18	6.797	2.600	3.481	0.400	0.522	3.481	0.446	0.522	0.067	0.100	16.7	0.080	0.0146	0.0296	0.0442	9.7	2.2	9.7
-11.6	-	-13.6	0.120	95	2.68	77	39	2.542		1.184		0.178	1.184	0.334	0.178	0.050	0.020	3.3		0.0073	0.0588	0.0661	5.9		5.9
-13.6	-	-19.6	silt	31	2.65	117	89	0.565		0.255		0.038	0.255	0.163	0.038	0.024	0.500	83.3		0.0819	0.0588	0.1407	#VALUE!		#VALUE!
-19.6	-	-24.9	0.200	65	2.70	113	68	1.615		0.759		0.114	0.759	0.290	0.114	0.044	0.033	5.5		0.0671715	0.2226	0.2897715	1.8		1.8
-24.9	-	-31.6	sand	30	2.65	113	87	0.534		0.240		0.036	0.240	0.157	0.036	0.023	5.000	833.3		0.0846285	0.356943	0.4415715	#VALUE!		#VALUE!

Equations:

EQ. 1 e0 = 0.0309*M.C. -0.3931 (for low moisture soils)
e0 = 0.0166*M.C. +1.3187 (for high moisture soils)

EQ. 2 C_c = 0.0054*((S.G.*M.C.)-35) (NAVFAC)

EQ. 3 Cr= 0.15Cc

EQ. 4 S.G. = e0/M.C. (assumes 100% saturation)

Note:

1 Cv values for materials were determined using the Cv vs MC curve developed by GeoEngineers based on data from coastal projects

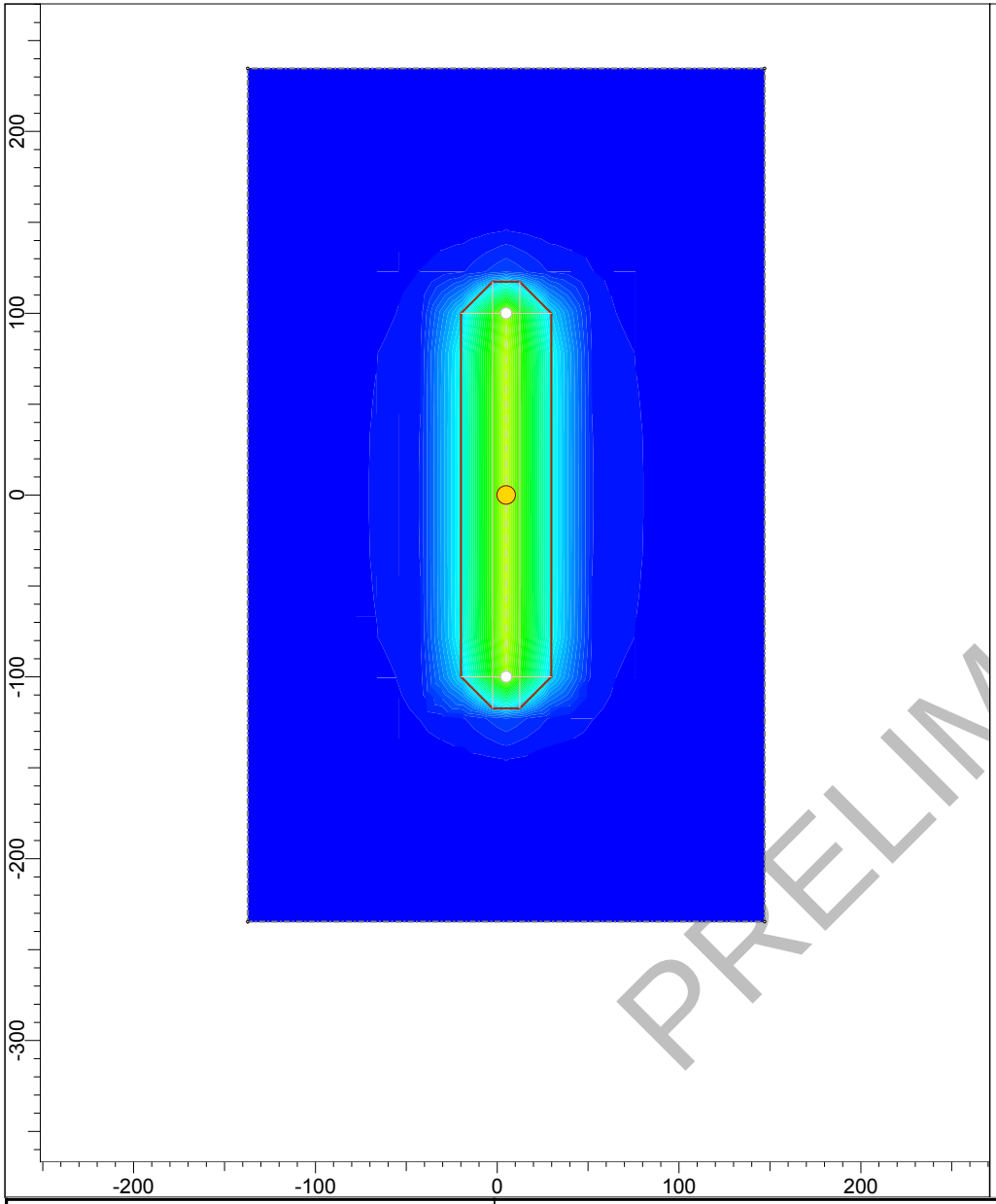
2 OCR = (c/(p' * 0.22))^(1/0.8) (Recommended practice for soft ground site characterization: Aruthur Casagrande Lecture Figure 7.1)

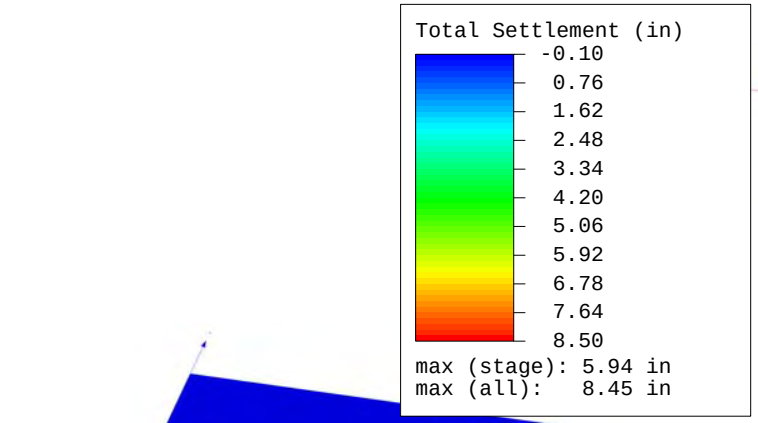
3 From Note 2, reviewing c/p line and consolidation test result; Assumed OCR =1 if OCR<1 from calculations

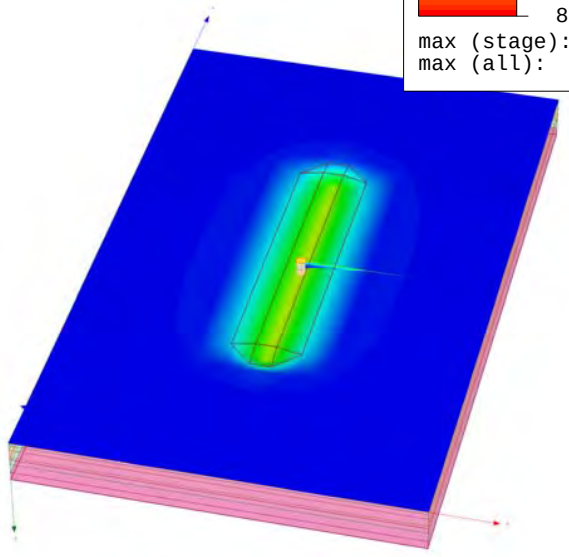
Consldation test results from Boring BHT-14-30

References:

"Foundation Design: Principles and Practices" Donald Coduto 1994
"NAVFAC DM-7.1 Soil Mechanics" 1982
"GeoEngineers" based on our experience with coastal soils
"Soil Mechanics" Lambe and Whitman 1969







rocscience	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 13-30 Settlement - Crown El. +2 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/6/2016	*File Name* BHT-13-30 (EL +2) (75 pcf).s3z

SETTLE3D 3.015

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-13-30 (EL +2) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 13-30 Settlement - Crown El. +2 ft
Author	CAH
Company	GeoEngineers
Date Created	2/6/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-13-30	0
2	BHT-13-30	0.041
3	BHT-13-30	0.082
4	BHT-13-30	0.123
5	BHT-13-30	0.164
6	BHT-13-30	0.247
7	BHT-13-30	0.493
8	BHT-13-30	1
9	BHT-13-30	3
10	BHT-13-30	5
11	BHT-13-30	10
12	BHT-13-30	20

Results

Time taken to compute: 0.111599 seconds

Stage: BHT-13-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0	1.0106
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0
Pore Water Pressure [ksf]	0.168642	1.97732
Excess Pore Water Pressure [ksf]	0.0429228	0.168642
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1.4	100
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0.264552

Stage: BHT-13-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	4.88664
Consolidation Settlement [in]	0	4.88664
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.0503315	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	-0.00120897	0.519553
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.134025
Degree of Consolidation [%]	0	97.0543
Pre-consolidation Stress [ksf]	0.13975	1.52473
Over-consolidation Ratio	1	21.5295
Void Ratio	0	8.18748
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	87.5838
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	5.5208
Consolidation Settlement [in]	0	5.5208
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.0778303	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	-0.000461864	0.51961
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.12431
Degree of Consolidation [%]	0	97.8625
Pre-consolidation Stress [ksf]	0.140913	1.52473
Over-consolidation Ratio	1	19.1991
Void Ratio	0	8.08017
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	94.5703
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	5.92433
Consolidation Settlement [in]	0	5.92433
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.0910747	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	-0.000491624	0.519633
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.115358
Degree of Consolidation [%]	0	98.1457
Pre-consolidation Stress [ksf]	0.149962	1.52473
Over-consolidation Ratio	1	15.798
Void Ratio	0	8.04554
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	97.3614
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	6.19895
Consolidation Settlement [in]	0	6.19895
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.103998	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	-0.000589724	0.519642
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.111556
Degree of Consolidation [%]	0	98.311
Pre-consolidation Stress [ksf]	0.153974	1.52473
Over-consolidation Ratio	1	13.3747
Void Ratio	0	8.03145
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	98.5814
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	6.5654
Consolidation Settlement [in]	0	6.5654
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.117062	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	-0.000600063	0.519649
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.104525
Degree of Consolidation [%]	0	98.5059
Pre-consolidation Stress [ksf]	0.156901	1.52473
Over-consolidation Ratio	1	10.8218
Void Ratio	0	8.02164
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.4552
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	7.14068
Consolidation Settlement [in]	0	7.14068
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.145313	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0.519652
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.0885972
Degree of Consolidation [%]	0	98.7322
Pre-consolidation Stress [ksf]	0.159258	1.52473
Over-consolidation Ratio	1	8.78873
Void Ratio	0	8.01709
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.861
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	7.71031
Consolidation Settlement [in]	0	7.71031
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.158971	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0.519653
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.058016
Degree of Consolidation [%]	0	99.0412
Pre-consolidation Stress [ksf]	0.159903	1.52473
Over-consolidation Ratio	1	8.06614
Void Ratio	0	8.01609
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9485
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.33591
Consolidation Settlement [in]	0	8.33591
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.159302	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0.519653
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.00878374
Degree of Consolidation [%]	0	99.8457
Pre-consolidation Stress [ksf]	0.160241	1.52473
Over-consolidation Ratio	1	7.62737
Void Ratio	0	8.01557
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9933
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.41925
Consolidation Settlement [in]	0	8.41925
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.159344	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0.519653
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.00129625
Degree of Consolidation [%]	0	99.9772
Pre-consolidation Stress [ksf]	0.160284	1.52473
Over-consolidation Ratio	1	7.57262
Void Ratio	0	8.01551
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.999
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.43336
Consolidation Settlement [in]	0	8.43336
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.159351	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0.519653
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	1.07946e-005
Degree of Consolidation [%]	0	99.9998
Pre-consolidation Stress [ksf]	0.160292	1.52473
Over-consolidation Ratio	1	7.5633
Void Ratio	0	8.01549
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.266762

Stage: BHT-13-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.43348
Consolidation Settlement [in]	0	8.43348
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0.0429228	0.168642
Effective Stress [ksf]	0.159351	1.05352
Total Stress [ksf]	0.168642	2.98792
Total Strain	0	0.519653
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	7.19241e-010
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.160292	1.52473
Over-consolidation Ratio	1	7.56323
Void Ratio	0	8.01549
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.266762

Embankments

1. Embankment

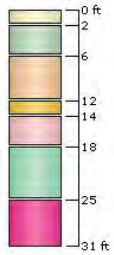
Center Line	(4.914, -100) to (4.914, 100)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	49.7

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-13-30 = 0 y	0	11.31	3.47	0.0486	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.47-3.47)	2	0	No
2	OH (3.47-7.47)	4	2	No
3	PT (7.47-13.47)	6	6	No
4	OH (13.47-15.47)	2	12	No
5	CH (15.47-19.47)	4	14	Yes
6	ML (19.47-26.47)	7	18	Yes
7	SC (26.47-32.47)	6	25	Yes



Soil Properties

Property	PT (1.47-3.47)	OH (3.47-7.47)	PT (7.47-13.47)	OH (13.47-15.47)	CH (15.47-19.47)	ML (19.47-26.47)	SC (26.47-32.47)
Color							
Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Saturated Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Enabled	Disabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear	Non-Linear		
Cc	4.727	1.913	3.508	2.316	1.184		
Cr	0.709	0.287	0.526	0.347	0.178		
e0	9.104	3.892	6.847	4.639	2.542		
OCR	100	20.6	5.7	3.6	2.3	2	1.4
Cv [ft^2/d]	0.1	0.1	0.05	0.04	0.04		
B-bar	1	1	1	1	1		
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

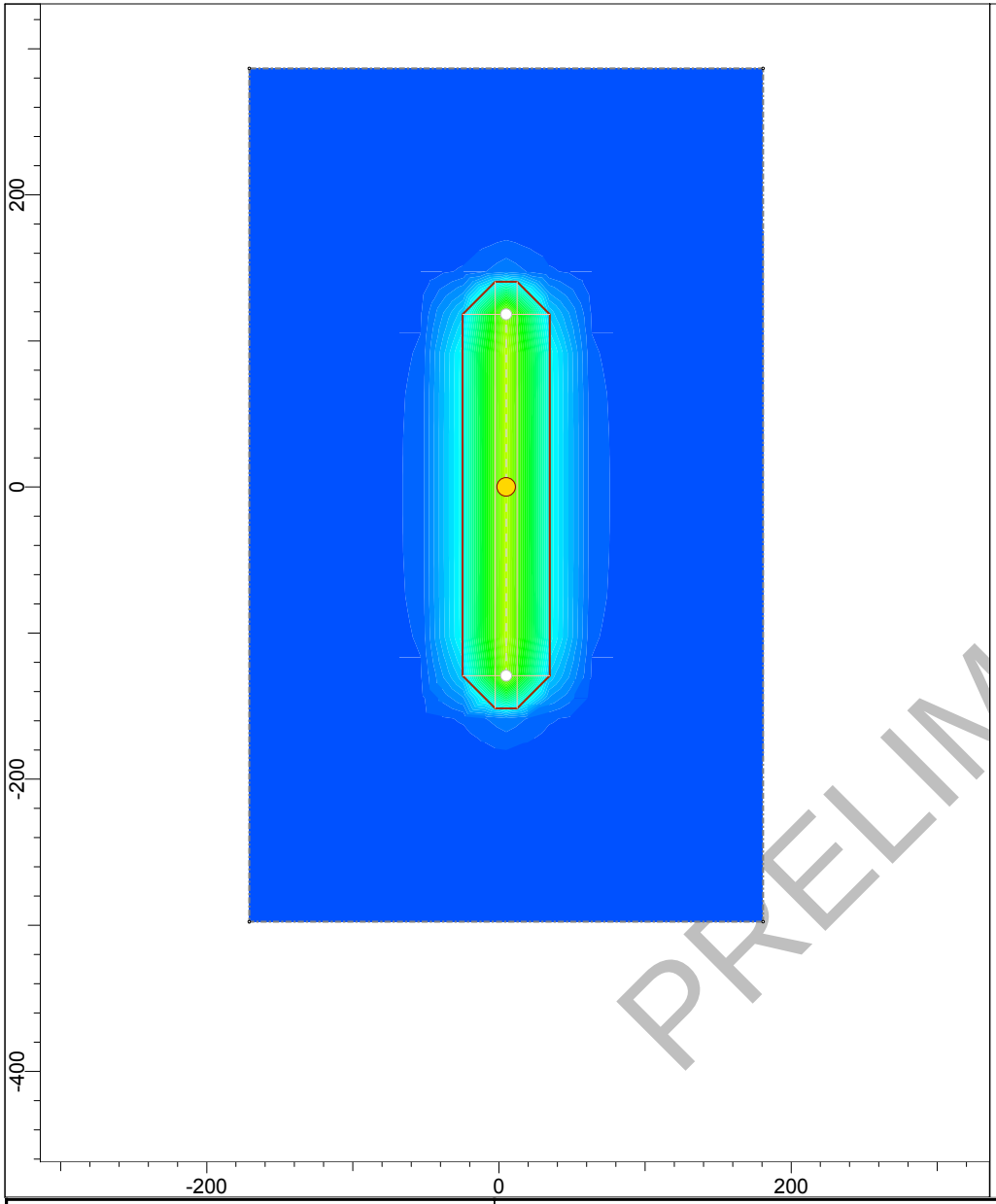
Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

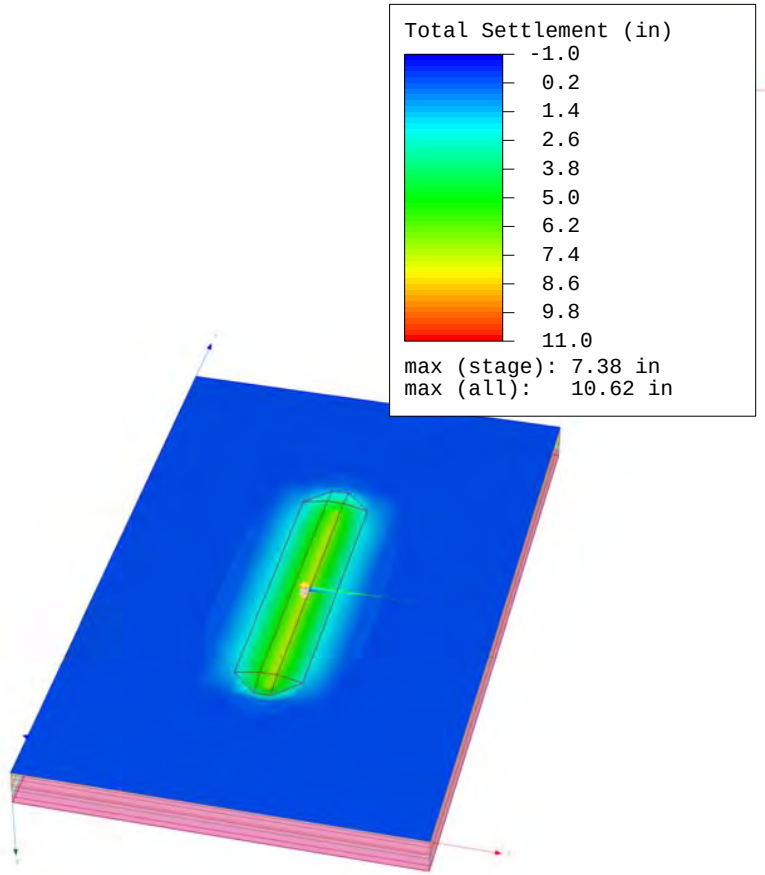
Piezometric Line Entities

ID	Depth (ft)
1	0 ft

Query Points

Point #	(X,Y) Location	Number of Divisions
1	4.914, 0	Auto: 71





rocscience	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 13-30 Settlement - Crown El. +3 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/6/2016	*File Name* BHT-13-30 (EL +3) (75 pcf).s3z

SETTLE3D 3.015

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-13-30 (EL +3) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 13-30 Settlement - Crown El. +3 ft
Author	CAH
Company	GeoEngineers
Date Created	2/6/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-13-30	0
2	BHT-13-30	0.041
3	BHT-13-30	0.082
4	BHT-13-30	0.123
5	BHT-13-30	0.164
6	BHT-13-30	0.247
7	BHT-13-30	0.493
8	BHT-13-30	1
9	BHT-13-30	3
10	BHT-13-30	5
11	BHT-13-30	10
12	BHT-13-30	20

Results

Time taken to compute: 5.17054 seconds

Stage: BHT-13-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.0106
Total Stress [ksf]	0	3.01681
Total Strain	0	0
Pore Water Pressure [ksf]	0	2.00621
Excess Pore Water Pressure [ksf]	0	0.243619
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1.4	100
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	10
Undrained Shear Strength	0	0.264552

Stage: BHT-13-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.00746595	6.02782
Consolidation Settlement [in]	-0.00746595	6.02782
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	-0.00225373	0.594243
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.197206
Degree of Consolidation [%]	0	97.2243
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.6474
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	92.923
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	6.86169
Consolidation Settlement [in]	0	6.86169
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	-0.00091648	0.594328
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.184989
Degree of Consolidation [%]	0	98.0485
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.5483
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	97.5888
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	7.3766
Consolidation Settlement [in]	0	7.3766
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	-0.000830277	0.594356
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.173185
Degree of Consolidation [%]	0	98.3529
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.5147
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	98.9858
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	7.7293
Consolidation Settlement [in]	0	7.7293
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	-0.000936687	0.594368
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.167272
Degree of Consolidation [%]	0	98.5367
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4999
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.4827
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.2067
Consolidation Settlement [in]	0	8.2067
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	-0.00105482	0.594376
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.158415
Degree of Consolidation [%]	0	98.7657
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4871
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.7894
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.95637
Consolidation Settlement [in]	0	8.95637
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	0	0.594379
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.134673
Degree of Consolidation [%]	0	99.0786
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4761
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9358
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.70547
Consolidation Settlement [in]	0	9.70547
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	0	0.59438
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.0878586
Degree of Consolidation [%]	0	99.4015
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.47
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9752
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.5007
Consolidation Settlement [in]	0	10.5007
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	0	0.59438
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.0131932
Degree of Consolidation [%]	0	99.9085
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4632
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9968
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.6032
Consolidation Settlement [in]	0	10.6032
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	0	0.59438
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.00193371
Degree of Consolidation [%]	0	99.9865
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4622
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9995
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.6204
Consolidation Settlement [in]	0	10.6204
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	0	0.59438
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	1.58302e-005
Degree of Consolidation [%]	0	99.9999
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.462
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.268209

Stage: BHT-13-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.6206
Consolidation Settlement [in]	0	10.6206
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.243619
Effective Stress [ksf]	0	1.08241
Total Stress [ksf]	0	3.01681
Total Strain	0	0.59438
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	1.01887e-009
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.462
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.268209

Embankments

1. Embankment

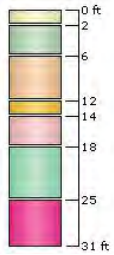
Center Line	(4.914, -129.206) to (4.914, 118.13)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	59.7

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-13-30 = 0 y	0	11.31	4.47	0.0545	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.47-3.47)	2	0	No
2	OH (3.47-7.47)	4	2	No
3	PT (7.47-13.47)	6	6	No
4	OH (13.47-15.47)	2	12	No
5	CH (15.47-19.47)	4	14	Yes
6	ML (19.47-26.47)	7	18	Yes
7	SC (26.47-32.47)	6	25	Yes



Soil Properties

Property	PT (1.47-3.47)	OH (3.47-7.47)	PT (7.47-13.47)	OH (13.47-15.47)	CH (15.47-19.47)	ML (19.47-26.47)	SC (26.47-32.47)
Color							
Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Saturated Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Enabled	Disabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear	Non-Linear		
Cc	4.727	1.913	3.508	2.316	1.184		
Cr	0.709	0.287	0.526	0.347	0.178		
e0	9.104	3.892	6.847	4.639	2.542		
OCR	100	20.6	5.7	3.6	2.3	2	1.4
Cv [ft^2/d]	0.1	0.1	0.05	0.04	0.04		
B-bar	1	1	1	1	1		
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	0 ft

Query Points

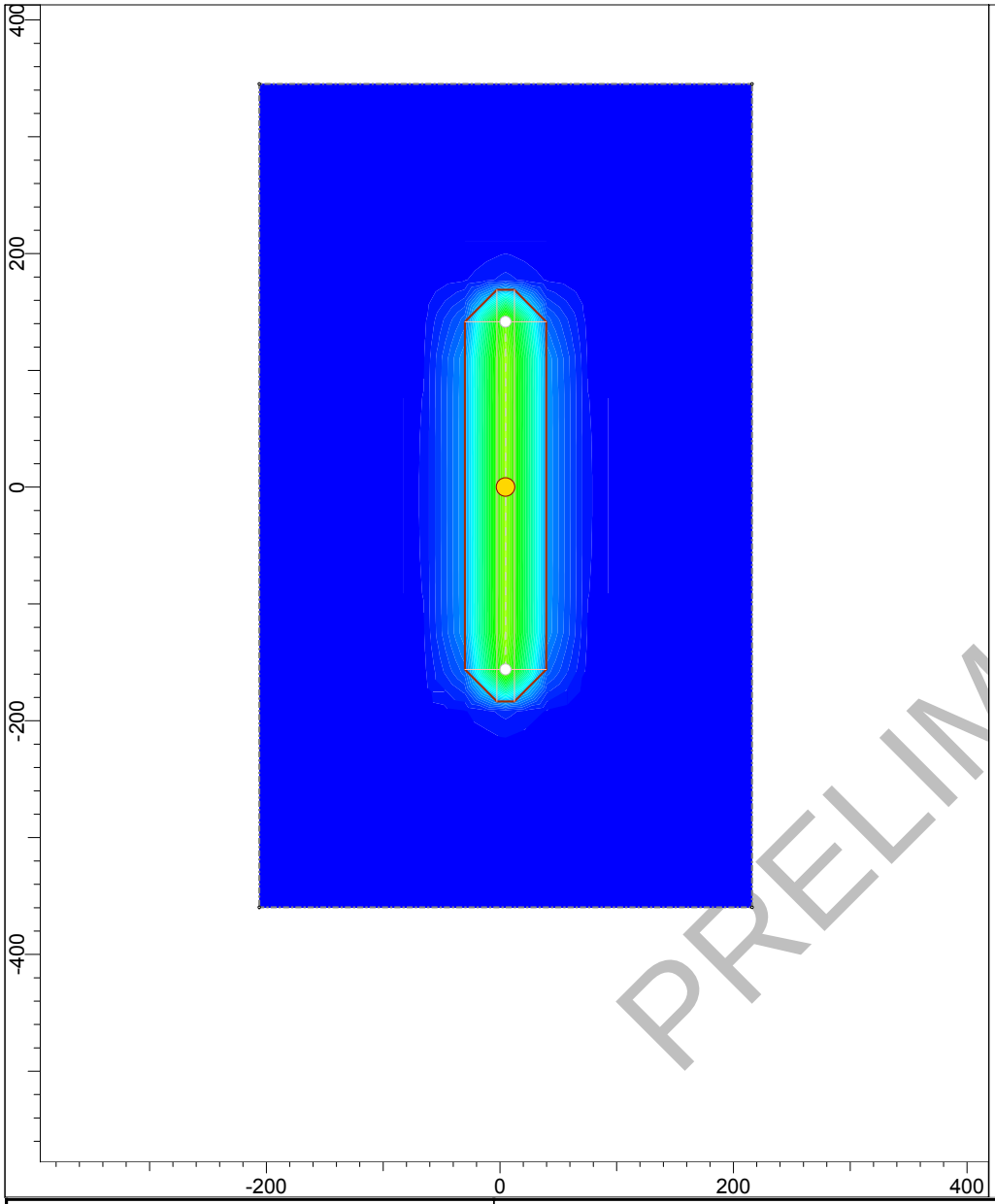
Point #	(X,Y) Location	Number of Divisions
1	4.914, 0	Auto: 71

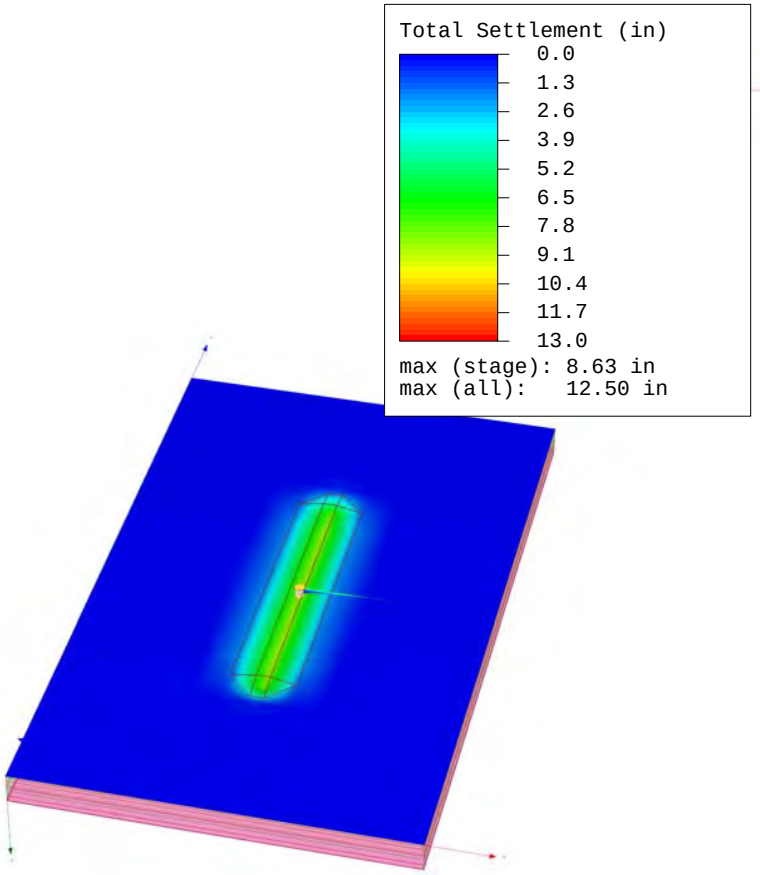
Field Point Grid

Number of points 286
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
180.782	286.498
180.782	-297.574
-170.954	-297.574
-170.954	286.498





rocscience	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 13-30 Settlement - Crown El. +4 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/6/2016	*File Name* BHT-13-30 (EL +4) (75 pcf).s3z

SETTLE3D 3.015

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-13-30 (EL +4) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 13-30 Settlement - Crown El. +4 ft
Author	CAH
Company	GeoEngineers
Date Created	2/6/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-13-30	0
2	BHT-13-30	0.041
3	BHT-13-30	0.082
4	BHT-13-30	0.123
5	BHT-13-30	0.164
6	BHT-13-30	0.247
7	BHT-13-30	0.493
8	BHT-13-30	1
9	BHT-13-30	3
10	BHT-13-30	5
11	BHT-13-30	10
12	BHT-13-30	20

Results

Time taken to compute: 5.31934 seconds

Stage: BHT-13-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.0106
Total Stress [ksf]	0	3.05051
Total Strain	0	0
Pore Water Pressure [ksf]	0	2.03991
Excess Pore Water Pressure [ksf]	0	0.318359
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1.4	100
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	10
Undrained Shear Strength	0	0.264552

Stage: BHT-13-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	6.97404
Consolidation Settlement [in]	0	6.97404
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	-0.00267449	0.648628
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.261797
Degree of Consolidation [%]	0	97.3765
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.6408
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	91.7261
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	7.9991
Consolidation Settlement [in]	0	7.9991
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	-0.00108249	0.648714
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.247613
Degree of Consolidation [%]	0	98.11
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.5399
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	96.5156
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.63478
Consolidation Settlement [in]	0	8.63478
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	-0.000987881	0.648742
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.233555
Degree of Consolidation [%]	0	98.4086
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.5056
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	98.3704
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.05668
Consolidation Settlement [in]	0	9.05668
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	-0.00113272	0.648754
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.225619
Degree of Consolidation [%]	0	98.5907
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4906
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.1607
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.61777
Consolidation Settlement [in]	0	9.61777
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	-0.00123822	0.648762
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.215131
Degree of Consolidation [%]	0	98.8184
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4775
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.7012
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.5253
Consolidation Settlement [in]	0	10.5253
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	0	0.648765
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.183659
Degree of Consolidation [%]	0	99.131
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4664
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9281
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	11.4317
Consolidation Settlement [in]	0	11.4317
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	0	0.648766
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.119739
Degree of Consolidation [%]	0	99.4447
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4602
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9733
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.3635
Consolidation Settlement [in]	0	12.3635
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	0	0.648766
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.0179705
Degree of Consolidation [%]	0	99.9156
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4532
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9965
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.4812
Consolidation Settlement [in]	0	12.4812
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	0	0.648766
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.00263391
Degree of Consolidation [%]	0	99.9875
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4522
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9995
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.5009
Consolidation Settlement [in]	0	12.5009
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	0	0.648766
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	2.15623e-005
Degree of Consolidation [%]	0	99.9999
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.452
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.269859

Stage: BHT-13-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.501
Consolidation Settlement [in]	0	12.501
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.318359
Effective Stress [ksf]	0	1.11611
Total Stress [ksf]	0	3.05051
Total Strain	0	0.648766
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	1.38781e-009
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.452
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.269859

Embankments

1. Embankment

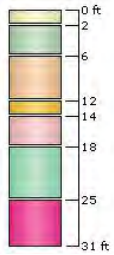
Center Line	(4.914, -156.145) to (4.914, 141.611)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	69.7

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-13-30 = 0 y	0	11.31	5.47	0.0582	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.47-3.47)	2	0	No
2	OH (3.47-7.47)	4	2	No
3	PT (7.47-13.47)	6	6	No
4	OH (13.47-15.47)	2	12	No
5	CH (15.47-19.47)	4	14	Yes
6	ML (19.47-26.47)	7	18	Yes
7	SC (26.47-32.47)	6	25	Yes



Soil Properties

Property	PT (1.47-3.47)	OH (3.47-7.47)	PT (7.47-13.47)	OH (13.47-15.47)	CH (15.47-19.47)	ML (19.47-26.47)	SC (26.47-32.47)
Color							
Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Saturated Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Enabled	Disabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear	Non-Linear		
Cc	4.727	1.913	3.508	2.316	1.184		
Cr	0.709	0.287	0.526	0.347	0.178		
e0	9.104	3.892	6.847	4.639	2.542		
OCR	100	20.6	5.7	3.6	2.3	2	1.4
Cv [ft^2/d]	0.1	0.1	0.05	0.04	0.04		
B-bar	1	1	1	1	1		
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	0 ft

Query Points

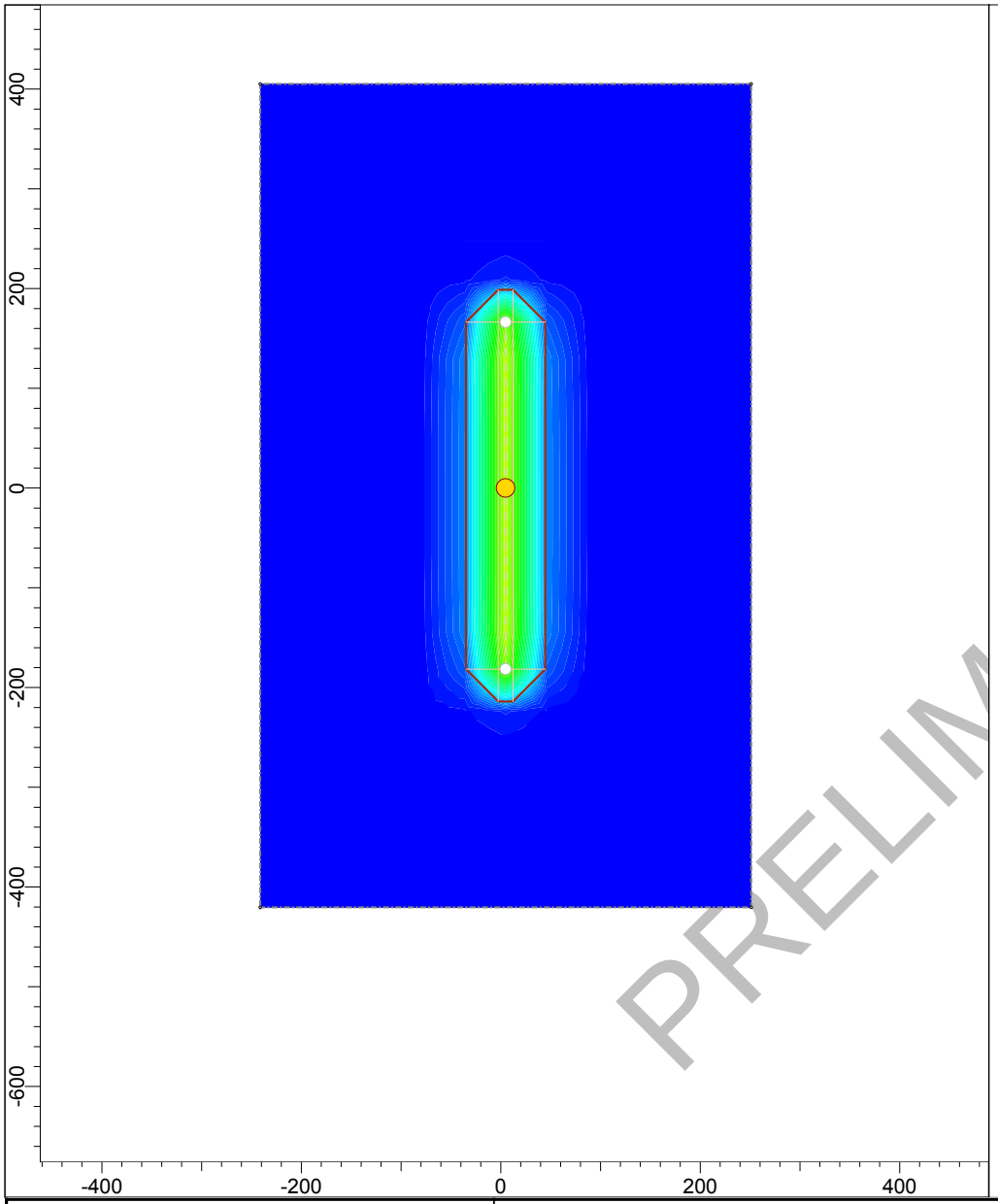
Point #	(X,Y) Location	Number of Divisions
1	4.914, 0	Auto: 71

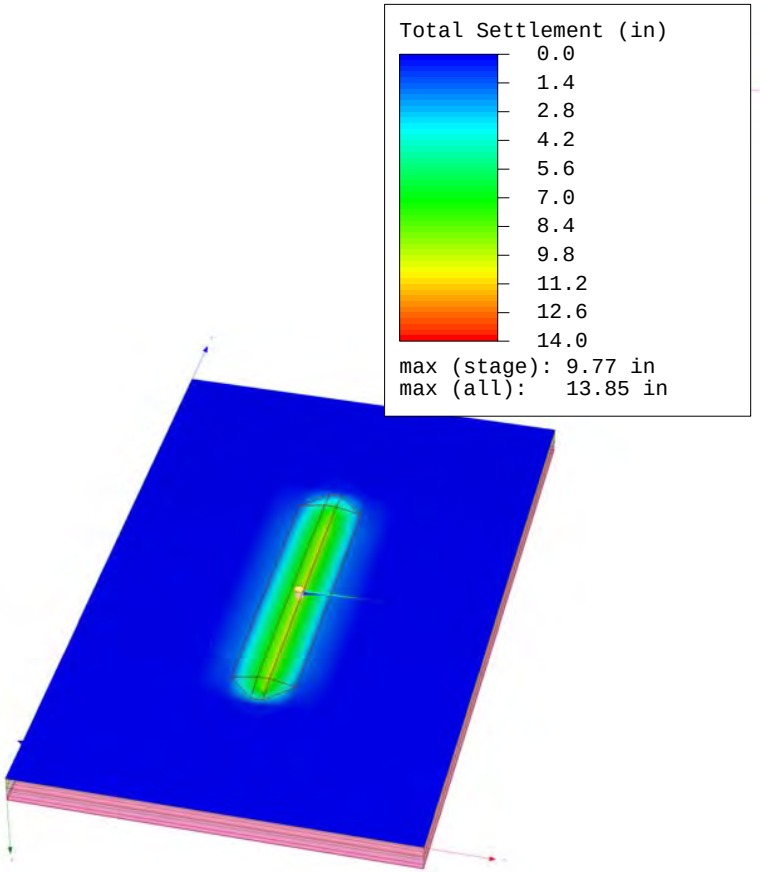
Field Point Grid

Number of points 286
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
215.992	345.189
215.992	-359.723
-206.164	-359.723
-206.164	345.189





SETTLE3D 3.015	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 13-30 Settlement - Crown El. +5 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/6/2016	*File Name* BHT-13-30 (EL +5) (75 pcf).s3z

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-13-30 (EL +5) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 13-30 Settlement - Crown El. +5 ft
Author	CAH
Company	GeoEngineers
Date Created	2/6/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-13-30	0
2	BHT-13-30	0.041
3	BHT-13-30	0.082
4	BHT-13-30	0.123
5	BHT-13-30	0.164
6	BHT-13-30	0.247
7	BHT-13-30	0.493
8	BHT-13-30	1
9	BHT-13-30	3
10	BHT-13-30	5
11	BHT-13-30	10
12	BHT-13-30	20

Results

Time taken to compute: 5.52378 seconds

Stage: BHT-13-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.0106
Total Stress [ksf]	0	3.0823
Total Strain	0	0
Pore Water Pressure [ksf]	0	2.0717
Excess Pore Water Pressure [ksf]	0	0.376556
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1.4	100
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	10
Undrained Shear Strength	0	0.264552

Stage: BHT-13-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	7.77531
Consolidation Settlement [in]	0	7.77531
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	-0.0027955	0.682538
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.313043
Degree of Consolidation [%]	0	97.4905
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.6534
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	92.4338
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.1146
Consolidation Settlement [in]	0	9.1146
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	-0.00106958	0.682837
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.296752
Degree of Consolidation [%]	0	98.1964
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.556
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	98.2664
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	9.76559
Consolidation Settlement [in]	0	9.76559
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	-0.0010584	0.68289
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.281902
Degree of Consolidation [%]	0	98.4453
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.5229
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.4588
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.1807
Consolidation Settlement [in]	0	10.1807
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	-0.00123507	0.682903
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.273147
Degree of Consolidation [%]	0	98.6252
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.5084
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.7692
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	10.7417
Consolidation Settlement [in]	0	10.7417
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	-0.00128503	0.682909
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.2605
Degree of Consolidation [%]	0	98.8526
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4958
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9118
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	11.7027
Consolidation Settlement [in]	0	11.7027
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	0	0.682911
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.223787
Degree of Consolidation [%]	0	99.1659
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.485
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9698
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.6789
Consolidation Settlement [in]	0	12.6789
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	0	0.682911
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.151801
Degree of Consolidation [%]	0	99.4737
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.479
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9872
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.6881
Consolidation Settlement [in]	0	13.6881
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	0	0.682912
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.0277252
Degree of Consolidation [%]	0	99.9204
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4723
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9982
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.8234
Consolidation Settlement [in]	0	13.8234
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	0	0.682912
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	0.00490677
Degree of Consolidation [%]	0	99.9882
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4713
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9997
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.8492
Consolidation Settlement [in]	0	13.8492
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	0	0.682912
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	6.43996e-005
Degree of Consolidation [%]	0	99.9999
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4711
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.271379

Stage: BHT-13-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.8497
Consolidation Settlement [in]	0	13.8497
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.376556
Effective Stress [ksf]	0	1.1479
Total Stress [ksf]	0	3.0823
Total Strain	0	0.682912
Pore Water Pressure [ksf]	0	1.9344
Excess Pore Water Pressure [ksf]	0	1.07698e-008
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.026	1.52473
Over-consolidation Ratio	1	99.4711
Void Ratio	0	9.104
Permeability [ft/d]	0	4.88175
Coefficient of Consolidation [ft^2/d]	0	0.1
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.271379

Embankments

1. Embankment

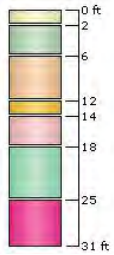
Center Line	(4.914, -181.704) to (4.914, 166.344)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	79.7

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-13-30 = 0 y	0	11.31	6.47	0.0582	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.47-3.47)	2	0	No
2	OH (3.47-7.47)	4	2	No
3	PT (7.47-13.47)	6	6	No
4	OH (13.47-15.47)	2	12	No
5	CH (15.47-19.47)	4	14	Yes
6	ML (19.47-26.47)	7	18	Yes
7	SC (26.47-32.47)	6	25	Yes



Soil Properties

Property	PT (1.47-3.47)	OH (3.47-7.47)	PT (7.47-13.47)	OH (13.47-15.47)	CH (15.47-19.47)	ML (19.47-26.47)	SC (26.47-32.47)
Color							
Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Saturated Unit Weight [kips/ft^3]	0.065	0.08	0.075	0.075	0.09	0.119	0.117
Primary Consolidation Material Type	Enabled Non-Linear	Enabled Non-Linear	Enabled Non-Linear	Enabled Non-Linear	Enabled Non-Linear	Disabled	Disabled
Cc	4.727	1.913	3.508	2.316	1.184		
Cr	0.709	0.287	0.526	0.347	0.178		
e0	9.104	3.892	6.847	4.639	2.542		
OCR	100	20.6	5.7	3.6	2.3	2	1.4
Cv [ft^2/d]	0.1	0.1	0.05	0.04	0.04		
B-bar	1	1	1	1	1		
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	0 ft

Query Points

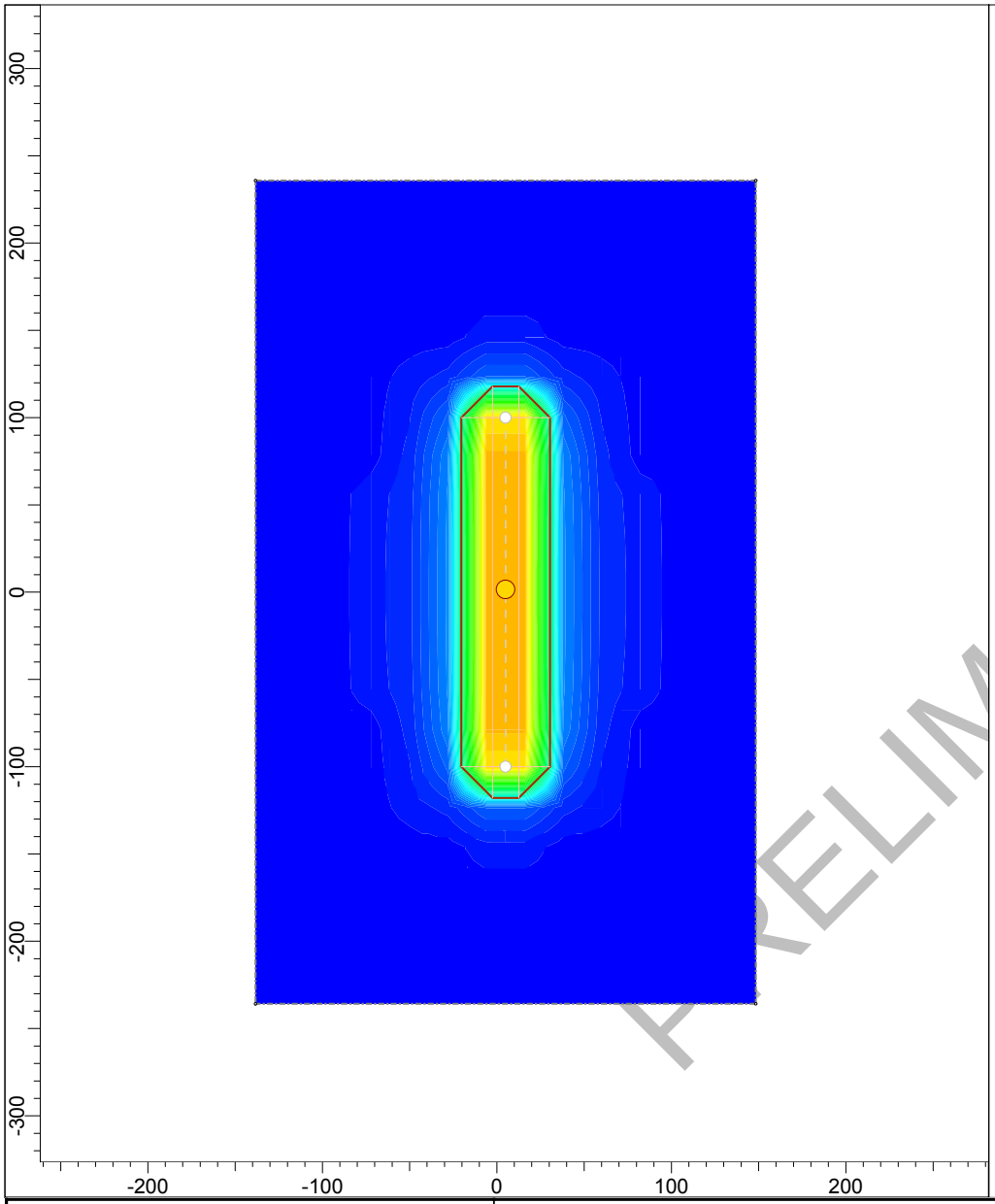
Point #	(X,Y) Location	Number of Divisions
1	4.914, 0	Auto: 71

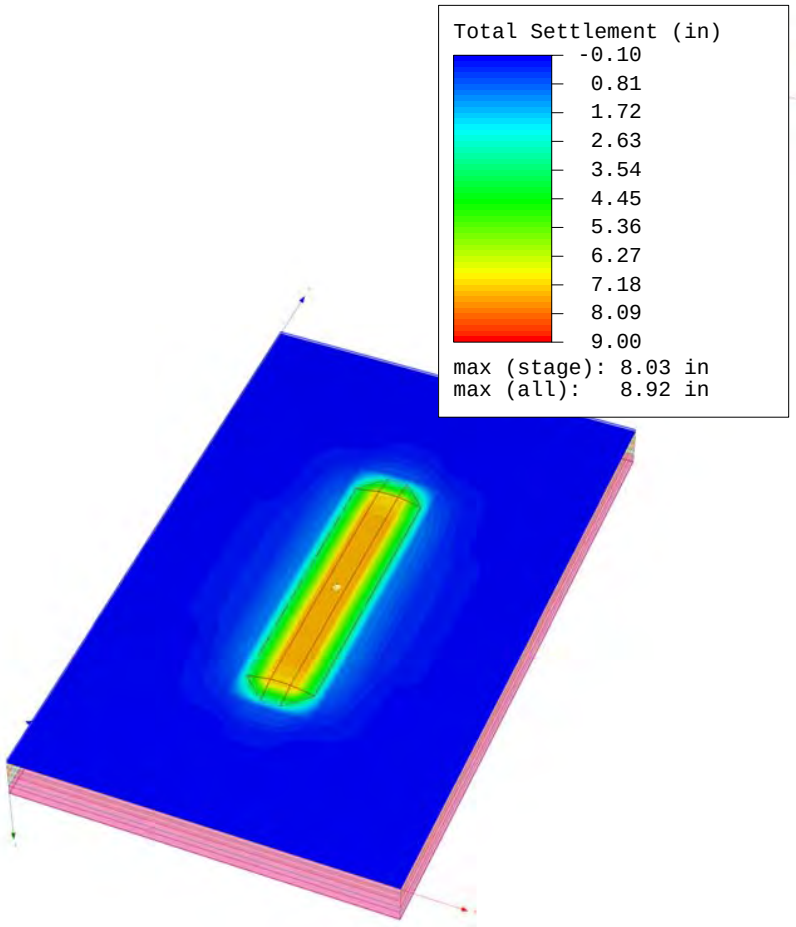
Field Point Grid

Number of points 286
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
251.138	405.068
251.138	-420.428
-241.31	-420.428
-241.31	405.068





SETTLE3D 3.015	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 14-30 Settlement - Crown El. +2 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/4/2016	*File Name* BHT-14-30 (EL +2) (75 pcf).s3z

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-14-30 (EL +2) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 14-30 Settlement - Crown El. +2 ft
Author	CAH
Company	GeoEngineers
Date Created	2/4/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-14-30	0
2	BHT-14-30	0.041
3	BHT-14-30	0.082
4	BHT-14-30	0.123
5	BHT-14-30	0.164
6	BHT-14-30	0.247
7	BHT-14-30	0.493
8	BHT-14-30	1
9	BHT-14-30	3
10	BHT-14-30	5
11	BHT-14-30	10
12	BHT-14-30	20

Results

Time taken to compute: 5.88781 seconds

Stage: BHT-14-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.0816
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0
Pore Water Pressure [ksf]	0.094848	1.98707
Excess Pore Water Pressure [ksf]	0	0.075318
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1.6	100
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	2
Undrained Shear Strength	0	0.316529

Stage: BHT-14-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.00105565	7.8291
Consolidation Settlement [in]	-0.00105565	7.8291
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	-0.000573195	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0543721
Degree of Consolidation [%]	0	99.836
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4198
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9542
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.000309033	7.94676
Consolidation Settlement [in]	-0.000309033	7.94676
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	-0.000582849	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0518222
Degree of Consolidation [%]	0	99.9038
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4194
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9778
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.03223
Consolidation Settlement [in]	0	8.03223
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	-0.000358674	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0497609
Degree of Consolidation [%]	0	99.9239
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4193
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9848
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.10417
Consolidation Settlement [in]	0	8.10417
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	-9.7828e-005	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0475633
Degree of Consolidation [%]	0	99.9335
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4193
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9881
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.22614
Consolidation Settlement [in]	0	8.22614
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.042317
Degree of Consolidation [%]	0	99.9438
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4192
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9911
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.47881
Consolidation Settlement [in]	0	8.47881
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0287052
Degree of Consolidation [%]	0	99.9623
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4191
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9944
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.73609
Consolidation Settlement [in]	0	8.73609
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0126167
Degree of Consolidation [%]	0	99.9834
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.419
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9976
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.9118
Consolidation Settlement [in]	0	8.9118
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.000490489
Degree of Consolidation [%]	0	99.9994
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4189
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9999
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.91836
Consolidation Settlement [in]	0	8.91836
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	1.90212e-005
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4189
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.91862
Consolidation Settlement [in]	0	8.91862
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-8.38473e-024	5.51056e-009
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4189
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.317677

Stage: BHT-14-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	8.91862
Consolidation Settlement [in]	0	8.91862
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.170166
Effective Stress [ksf]	0	1.10182
Total Stress [ksf]	0.094848	3.06867
Total Strain	0	0.782323
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-5.61629e-024	3.73323e-016
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.4189
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.317677

Embankments

1. Embankment

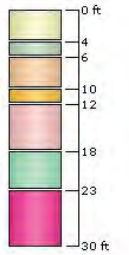
Center Line	(5.002, -100.012) to (5.002, 99.951)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	50.9

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-14-30 = 0 y	0	11.31	3.59	0.0474	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.59-5.59)	4	0	No
2	OH (5.59-7.59)	2	4	No
3	PT (7.59-11.59)	4	6	No
4	OH (11.59-13.59)	2	10	Yes
5	ML (13.59-19.59)	6	12	Yes
6	CH (19.59-24.59)	5	18	Yes
7	SP (24.59-31.59)	7	23	Yes



Soil Properties

Property	PT (1.59-5.59)	OH (5.59-7.59)	PT (7.59-11.59)	OH (11.59-13.59)	ML (13.59-19.59)	CH (19.59-24.59)	SP (24.59-31.59)
Color							
Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Saturated Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Disabled	Enabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear		Non-Linear	
Cc	8.411	1.509	3.831	1.184		0.759	
Cr	1.262	0.226	0.575	0.178		0.114	
e0	15.927	3.145	6.797	2.542		1.615	
OCR	100	35.2	8.7	5.5	2	1.7	1.6
Cv [ft^2/d]	5	0.02	0.1	0.02		0.033	
B-bar	1	1	1	1		1	
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	-1.52 ft

Query Points

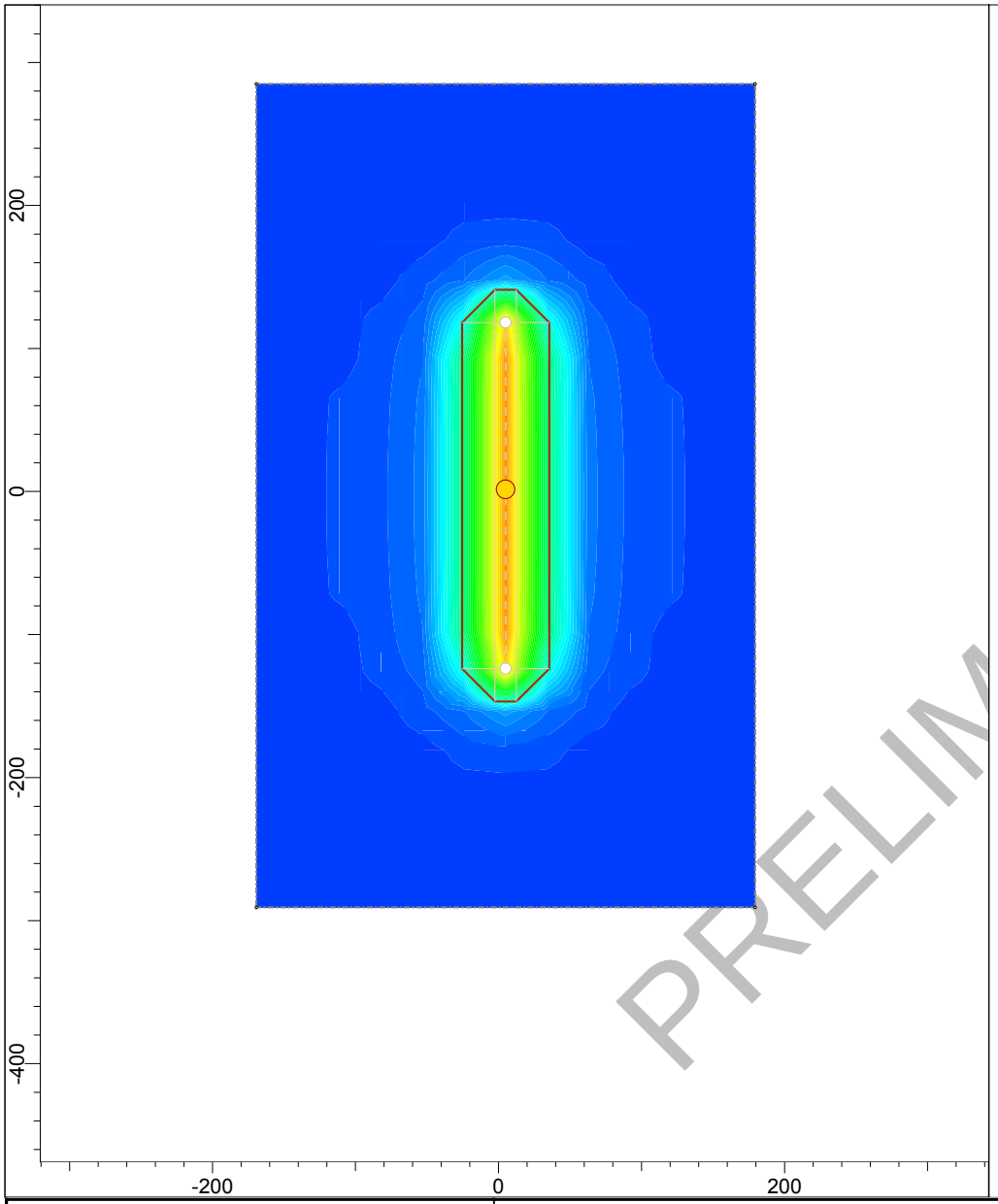
Point #	(X,Y) Location	Number of Divisions
1	5.002, 1.49339	Auto: 71

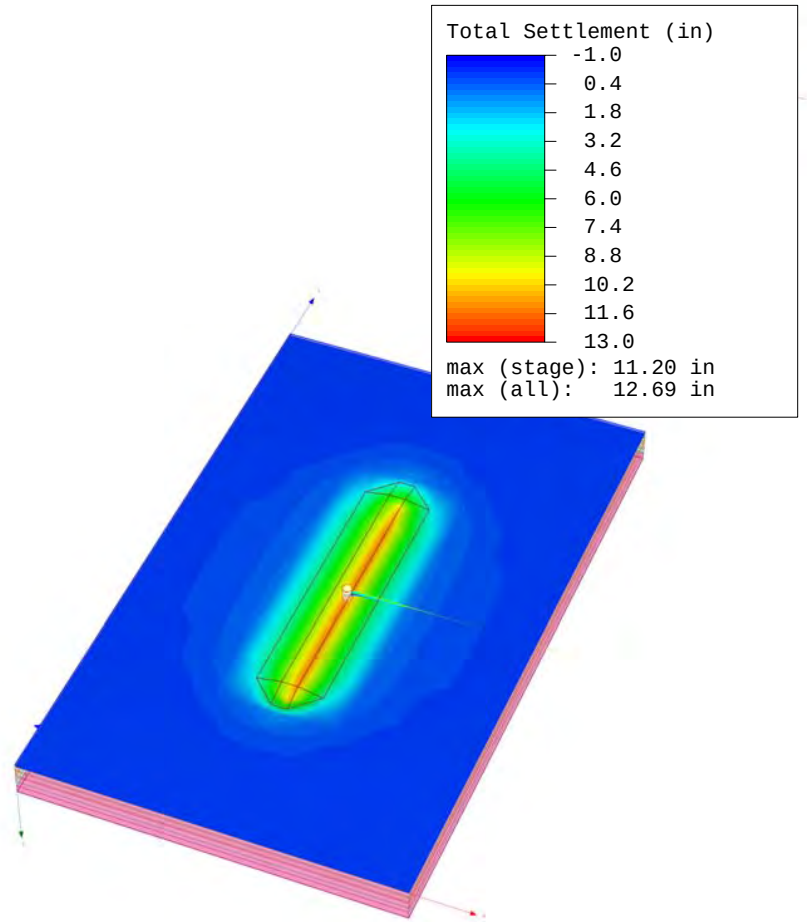
Field Point Grid

Number of points 308
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
148.383	235.832
148.383	-235.893
-138.379	-235.893
-138.379	235.832





rocscience	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 14-30 Settlement - Crown El. +3 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/4/2016	*File Name* BHT-14-30 (EL +3) (75 pcf).s3z

SETTLE3D 3.015

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-14-30 (EL +3) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 14-30 Settlement - Crown El. +3 ft
Author	CAH
Company	GeoEngineers
Date Created	2/4/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-14-30	0
2	BHT-14-30	0.041
3	BHT-14-30	0.082
4	BHT-14-30	0.123
5	BHT-14-30	0.164
6	BHT-14-30	0.247
7	BHT-14-30	0.493
8	BHT-14-30	1
9	BHT-14-30	3
10	BHT-14-30	5
11	BHT-14-30	10
12	BHT-14-30	20

Results

Time taken to compute: 5.70231 seconds

Stage: BHT-14-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.0816
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0
Pore Water Pressure [ksf]	0.094848	2.01324
Excess Pore Water Pressure [ksf]	0	0.150259
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1.6	100
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	2
Undrained Shear Strength	0	0.316748

Stage: BHT-14-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.00103398	10.8436
Consolidation Settlement [in]	-0.00103398	10.8436
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	-0.00118403	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.112309
Degree of Consolidation [%]	0	99.8352
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1115
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9632
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	11.0461
Consolidation Settlement [in]	0	11.0461
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	-0.00136933	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.107452
Degree of Consolidation [%]	0	99.9031
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1109
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9818
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	11.2026
Consolidation Settlement [in]	0	11.2026
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	-0.00101849	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.103396
Degree of Consolidation [%]	0	99.9232
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1108
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9875
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	11.3373
Consolidation Settlement [in]	0	11.3373
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	-0.000313361	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.098781
Degree of Consolidation [%]	0	99.9328
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1107
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9902
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	11.5642
Consolidation Settlement [in]	0	11.5642
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0878319
Degree of Consolidation [%]	0	99.9432
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1106
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9926
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.0078
Consolidation Settlement [in]	0	12.0078
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0595625
Degree of Consolidation [%]	0	99.9618
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1104
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9954
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.4205
Consolidation Settlement [in]	0	12.4205
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0261774
Degree of Consolidation [%]	0	99.9832
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1103
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.998
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.6844
Consolidation Settlement [in]	0	12.6844
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.00101757
Degree of Consolidation [%]	0	99.9999
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1101
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9999
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.694
Consolidation Settlement [in]	0	12.694
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	3.94576e-005
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1101
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.6944
Consolidation Settlement [in]	0	12.6944
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-9.08194e-024	1.14281e-008
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1101
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.31935

Stage: BHT-14-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	12.6944
Consolidation Settlement [in]	0	12.6944
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.245108
Effective Stress [ksf]	0	1.128
Total Stress [ksf]	0.094848	3.09484
Total Strain	0	0.931343
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-2.81891e-023	7.73789e-016
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	99.1101
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.31935

Embankments

1. Embankment

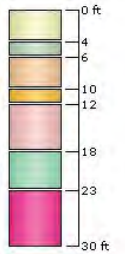
Center Line	(5.002, -123.86) to (5.002, 118.085)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	60.9

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-14-30 = 0 y	0	11.31	4.59	0.0534	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.59-5.59)	4	0	No
2	OH (5.59-7.59)	2	4	No
3	PT (7.59-11.59)	4	6	No
4	OH (11.59-13.59)	2	10	Yes
5	ML (13.59-19.59)	6	12	Yes
6	CH (19.59-24.59)	5	18	Yes
7	SP (24.59-31.59)	7	23	Yes



Soil Properties

Property	PT (1.59-5.59)	OH (5.59-7.59)	PT (7.59-11.59)	OH (11.59-13.59)	ML (13.59-19.59)	CH (19.59-24.59)	SP (24.59-31.59)
Color							
Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Saturated Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Disabled	Enabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear		Non-Linear	
Cc	8.411	1.509	3.831	1.184		0.759	
Cr	1.262	0.226	0.575	0.178		0.114	
e0	15.927	3.145	6.797	2.542		1.615	
OCR	100	35.2	8.7	5.5	2	1.7	1.6
Cv [ft^2/d]	5	0.02	0.1	0.02		0.033	
B-bar	1	1	1	1		1	
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	-1.52 ft

Query Points

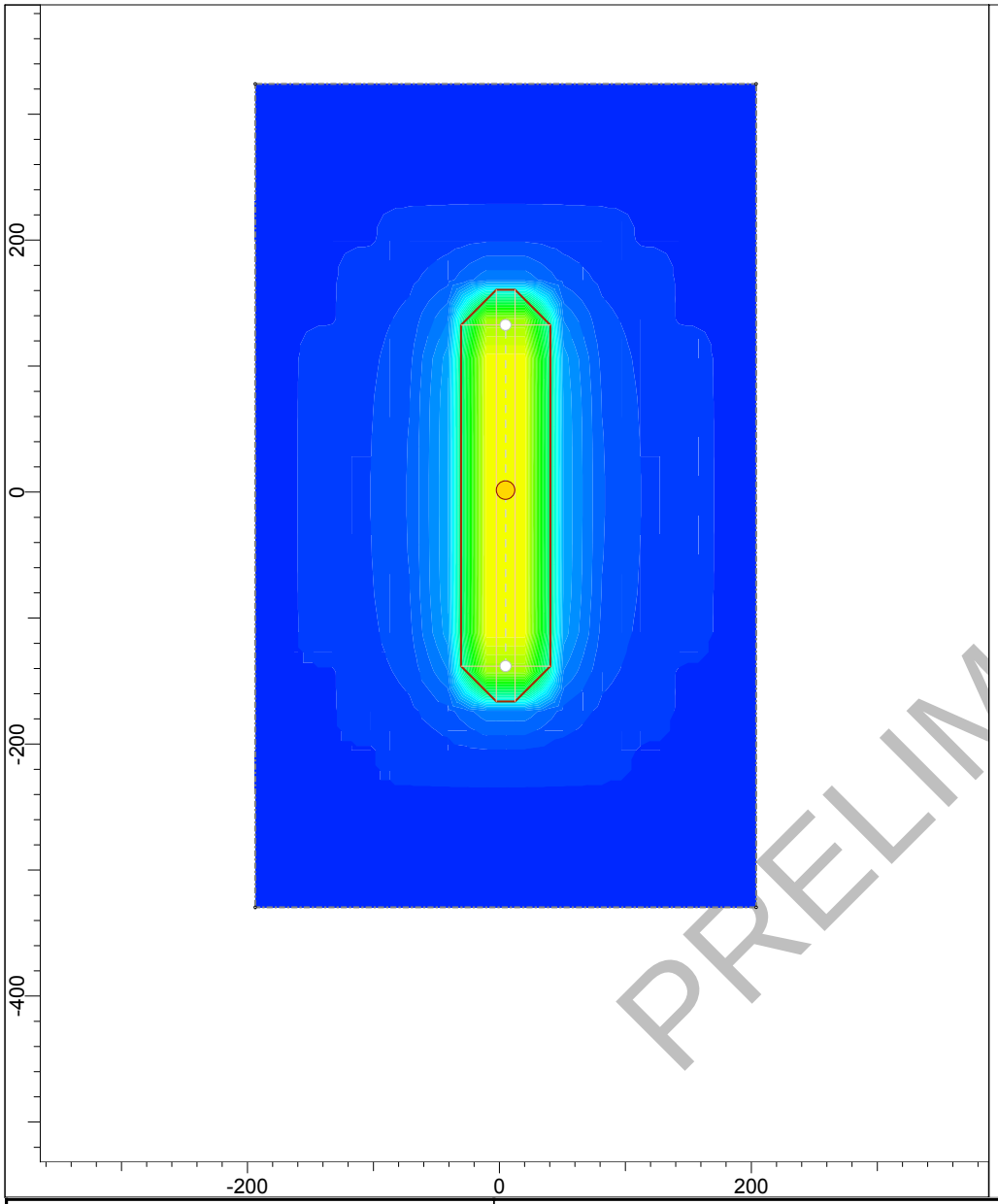
Point #	(X,Y) Location	Number of Divisions
1	5.002, 1.49339	Auto: 71

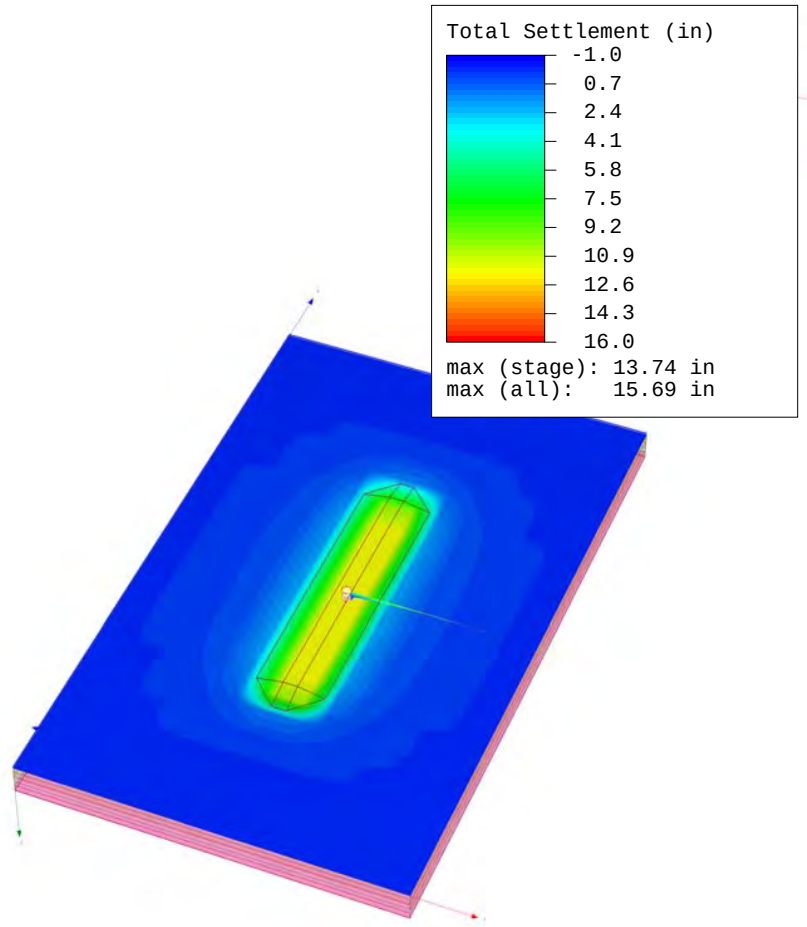
Field Point Grid

Number of points 286
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
179.374	284.957
179.374	-290.732
-169.37	-290.732
-169.37	284.957





SETTLE3D 3.015	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 14-30 Settlement - Crown El. +4 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/4/2016	*File Name* BHT-14-30 (EL +4) (75 pcf).s3z

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-14-30 (EL +4) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 14-30 Settlement - Crown El. +4 ft
Author	CAH
Company	GeoEngineers
Date Created	2/4/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-14-30	0
2	BHT-14-30	0.041
3	BHT-14-30	0.082
4	BHT-14-30	0.123
5	BHT-14-30	0.164
6	BHT-14-30	0.247
7	BHT-14-30	0.493
8	BHT-14-30	1
9	BHT-14-30	3
10	BHT-14-30	5
11	BHT-14-30	10
12	BHT-14-30	20

Results

Time taken to compute: 5.94586 seconds

Stage: BHT-14-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.0816
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	0
Pore Water Pressure [ksf]	0.094848	2.04465
Excess Pore Water Pressure [ksf]	0	0.225459
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1.6	100
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	2
Undrained Shear Strength	0	0.316944

Stage: BHT-14-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.00157878	13.2439
Consolidation Settlement [in]	-0.00157878	13.2439
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	-0.00143982	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.173165
Degree of Consolidation [%]	0	99.8342
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.849
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9706
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.521
Consolidation Settlement [in]	0	13.521
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	-0.00122424	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.1661
Degree of Consolidation [%]	0	99.9025
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8483
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9851
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.7417
Consolidation Settlement [in]	0	13.7417
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	-0.000187701	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.160107
Degree of Consolidation [%]	0	99.9228
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8481
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9896
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	13.9328
Consolidation Settlement [in]	0	13.9328
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.152891
Degree of Consolidation [%]	0	99.9324
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.848
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9917
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	14.2505
Consolidation Settlement [in]	0	14.2505
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.135886
Degree of Consolidation [%]	0	99.9428
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8479
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9937
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	14.8433
Consolidation Settlement [in]	0	14.8433
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0921313
Degree of Consolidation [%]	0	99.9615
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8477
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.996
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.361
Consolidation Settlement [in]	0	15.361
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0404886
Degree of Consolidation [%]	0	99.9831
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8475
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9982
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.6783
Consolidation Settlement [in]	0	15.6783
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0015737
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8473
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9999
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.6897
Consolidation Settlement [in]	0	15.6897
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	6.10149e-005
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8473
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.6902
Consolidation Settlement [in]	0	15.6902
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-3.39792e-023	1.76667e-008
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8473
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.321251

Stage: BHT-14-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.6902
Consolidation Settlement [in]	0	15.6902
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.320307
Effective Stress [ksf]	0	1.1594
Total Stress [ksf]	0.094848	3.12625
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-3.60226e-023	1.19539e-015
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8473
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.321251

Embankments

1. Embankment

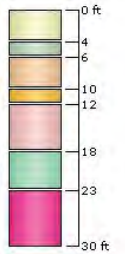
Center Line	(5.002, -138.261) to (5.002, 132.599)
Number of Layers	1
Near End Angle	11.31 degrees
Far End Angle	11.31 degrees
Base Width	70.9

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-14-30 = 0 y	0	11.31	5.59	0.0573	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.59-5.59)	4	0	No
2	OH (5.59-7.59)	2	4	No
3	PT (7.59-11.59)	4	6	No
4	OH (11.59-13.59)	2	10	Yes
5	ML (13.59-19.59)	6	12	Yes
6	CH (19.59-24.59)	5	18	Yes
7	SP (24.59-31.59)	7	23	Yes



Soil Properties

Property	PT (1.59-5.59)	OH (5.59-7.59)	PT (7.59-11.59)	OH (11.59-13.59)	ML (13.59-19.59)	CH (19.59-24.59)	SP (24.59-31.59)
Color							
Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Saturated Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Disabled	Enabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear		Non-Linear	
Cc	8.411	1.509	3.831	1.184		0.759	
Cr	1.262	0.226	0.575	0.178		0.114	
e0	15.927	3.145	6.797	2.542		1.615	
OCR	100	35.2	8.7	5.5	2	1.7	1.6
Cv [ft^2/d]	5	0.02	0.1	0.02		0.033	
B-bar	1	1	1	1		1	
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	-1.52 ft

Query Points

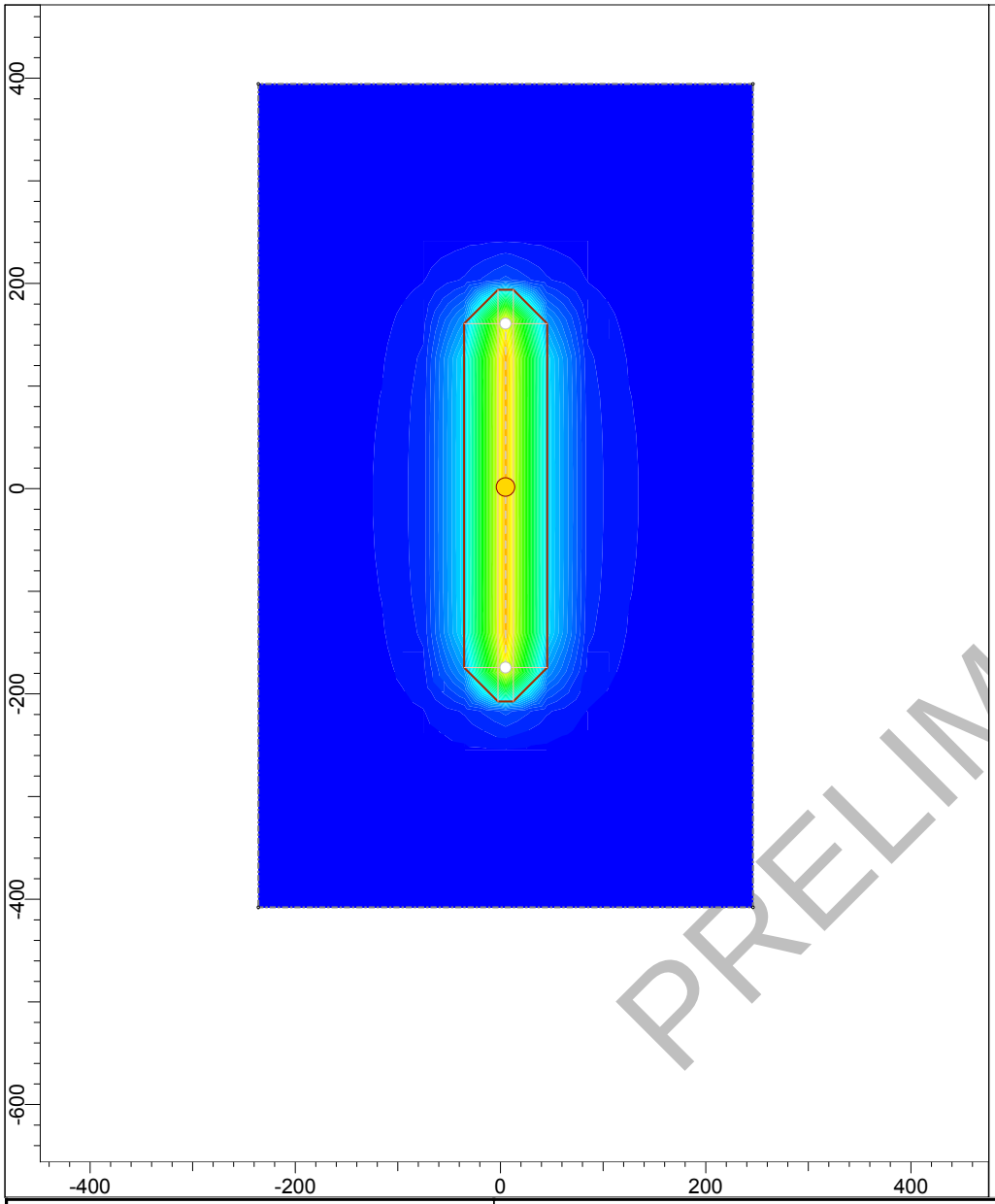
Point #	(X,Y) Location	Number of Divisions
1	5.002, 1.49339	Auto: 71

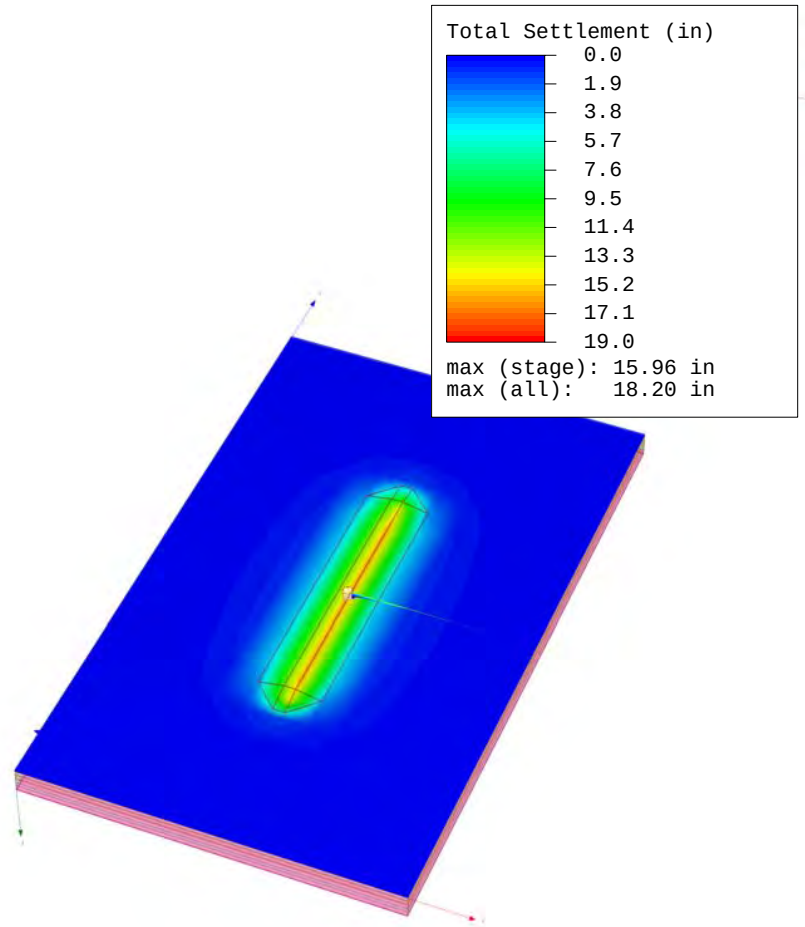
Field Point Grid

Number of points 308
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
203.832	323.929
203.832	-329.591
-193.828	-329.591
-193.828	323.929





rocscience	*Project*	LGH BS-24 Terracing and Marsh Creation	
	Analysis Description	BHT 14-30 Settlement - Crown El. +5 ft	
	Drawn By	CAH	*Company* GeoEngineers
	Date	2/4/2016	*File Name* BHT-14-30 (EL +5) (75 pcf).s3z

SETTLE3D 3.015

Settle3D Analysis Information
LGH BS-24 Terracing and Marsh Creation

Project Settings

Document Name	BHT-14-30 (EL +5) (75 pcf).s3z
Project Title	LGH BS-24 Terracing and Marsh Creation
Analysis	BHT 14-30 Settlement - Crown El. +5 ft
Author	CAH
Company	GeoEngineers
Date Created	2/4/2016
Comments	
10883-020-02	
Stress Computation Method	Westergaard
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Use settlement cutoff	
Load/Insitu vertical stress ratio	0.1
Use average properties to calculate layered stresses	

Stage Settings

Stage #	Name	Time [years]
1	BHT-14-30	0
2	BHT-14-30	0.041
3	BHT-14-30	0.082
4	BHT-14-30	0.123
5	BHT-14-30	0.164
6	BHT-14-30	0.247
7	BHT-14-30	0.493
8	BHT-14-30	1
9	BHT-14-30	3
10	BHT-14-30	5
11	BHT-14-30	10
12	BHT-14-30	20

Results

Time taken to compute: 5.44763 seconds

Stage: BHT-14-30 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.0816
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	0
Pore Water Pressure [ksf]	0.094848	2.08033
Excess Pore Water Pressure [ksf]	0	0.299893
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1.6	100
Void Ratio	0	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	2
Undrained Shear Strength	0	0.317123

Stage: BHT-14-30 = 0.041 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.3487
Consolidation Settlement [in]	0	15.3487
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	-0.00207424	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.234894
Degree of Consolidation [%]	0	99.9953
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8488
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9825
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 0.082 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.6821
Consolidation Settlement [in]	0	15.6821
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	-0.00216555	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.225812
Degree of Consolidation [%]	0	99.9973
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8481
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9906
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 0.123 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	15.9566
Consolidation Settlement [in]	0	15.9566
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	-0.0011827	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.217534
Degree of Consolidation [%]	0	99.9978
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8479
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9933
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 0.164 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	16.1941
Consolidation Settlement [in]	0	16.1941
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.207121
Degree of Consolidation [%]	0	99.9981
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8478
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9946
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 0.247 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	16.5817
Consolidation Settlement [in]	0	16.5817
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.183285
Degree of Consolidation [%]	0	99.9984
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8477
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9959
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 0.493 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	17.2756
Consolidation Settlement [in]	0	17.2756
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.123436
Degree of Consolidation [%]	0	99.9989
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8475
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9974
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	17.8531
Consolidation Settlement [in]	0	17.8531
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.0535225
Degree of Consolidation [%]	0	99.9995
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8473
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.9989
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 3 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	18.192
Consolidation Settlement [in]	0	18.192
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	0.00197424
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8471
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 5 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	18.2035
Consolidation Settlement [in]	0	18.2035
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	0	7.26336e-005
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8471
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 10 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	18.2039
Consolidation Settlement [in]	0	18.2039
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-2.60937e-023	1.85275e-008
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8471
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.323317

Stage: BHT-14-30 = 20 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	18.2039
Consolidation Settlement [in]	0	18.2039
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress [ksf]	0	0.394741
Effective Stress [ksf]	0	1.19508
Total Stress [ksf]	0.094848	3.16193
Total Strain	0	1
Pore Water Pressure [ksf]	0.094848	1.96685
Excess Pore Water Pressure [ksf]	-9.7903e-023	1.25271e-015
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.004	1.88954
Over-consolidation Ratio	1	98.8471
Void Ratio	-1	15.927
Permeability [ft/d]	0	1685.13
Coefficient of Consolidation [ft^2/d]	0	5
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0.323317

Embankments

1. Embankment

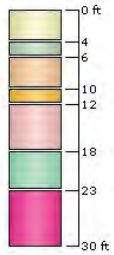
Center Line (5.002, -174.382) to (5.002, 160.804)
Number of Layers 1
Near End Angle 11.31 degrees
Far End Angle 11.31 degrees
Base Width 80.9

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	BHT-14-30 = 0 y	0	11.31	6.59	0.0599	11.3	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	PT (1.59-5.59)	4	0	No
2	OH (5.59-7.59)	2	4	No
3	PT (7.59-11.59)	4	6	No
4	OH (11.59-13.59)	2	10	Yes
5	ML (13.59-19.59)	6	12	Yes
6	CH (19.59-24.59)	5	18	Yes
7	SP (24.59-31.59)	7	23	Yes



Soil Properties

Property	PT (1.59-5.59)	OH (5.59-7.59)	PT (7.59-11.59)	OH (11.59-13.59)	ML (13.59-19.59)	CH (19.59-24.59)	SP (24.59-31.59)
Color							
Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Saturated Unit Weight [kips/ft^3]	0.0634	0.09	0.077	0.077	0.117	0.113	0.113
Primary Consolidation	Enabled	Enabled	Enabled	Enabled	Disabled	Enabled	Disabled
Material Type	Non-Linear	Non-Linear	Non-Linear	Non-Linear		Non-Linear	
Cc	8.411	1.509	3.831	1.184		0.759	
Cr	1.262	0.226	0.575	0.178		0.114	
e0	15.927	3.145	6.797	2.542		1.615	
OCR	100	35.2	8.7	5.5	2	1.7	1.6
Cv [ft^2/d]	5	0.02	0.1	0.02		0.033	
B-bar	1	1	1	1		1	
Undrained Su A [kips/ft2]	0	0	0	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1	1	1	1

Groundwater

Groundwater method Piezometric Lines
Water Unit Weight 0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	-1.52 ft

Query Points

Point #	(X,Y) Location	Number of Divisions
1	5.002, 1.49339	Auto: 71

Field Point Grid

Number of points 286
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
245.995	394.297
245.995	-407.875
-235.991	-407.875
-235.991	394.297

APPENDIX F
Report Limitations and Guidelines for Use

APPENDIX F
REPORT LIMITATIONS AND GUIDELINES FOR USE

This appendix provides information to help you manage your risks with respect to the use of this report.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for US Department of Agriculture/Natural Resources Conservation Service and their authorized agents and regulatory agencies. The information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. No party other than US Department of Agriculture/Natural Resources Conservation Service may rely on the product of our services unless we agree to such reliance in advance and in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. Use of this report is not recommended for any purpose or project except the one originally contemplated.

A Geotechnical Engineering or Geologic Report Is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the BS-24 Terracing and Marsh Creation South of Big Mar project in Plaquemines Parish, Louisiana. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, we recommend that GeoEngineers be given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Most Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an informed opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

The construction recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers is unable to assume responsibility for the recommendations in this report without performing construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help prevent costly problems associated with unanticipated subsurface conditions, we recommend giving contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report's accuracy is limited. In addition, encourage them to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) are less exact than other engineering and natural science disciplines. Without this understanding, there may be expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

Have we delivered World Class Client Service?

Please let us know by visiting **www.geoengineers.com/feedback**.

GeoEngineers

APPENDIX E

Proposal for Additional Services

PROPOSAL FOR ADDITIONAL SERVICES

Terracing and Marsh Creation South of Big Mar (BS-24)
Plaquemines Parish, Louisiana

May 2015

Prepared for:

Natural Resources Conservation Service
3737 Government Street
Alexandria, La 71302

Attention: Ms. Vicki Supler, Contracting Officer

Prepared by:

Lonnie G. Harper & Associates, Inc.
2746 Hwy 384
Bell City, La 70630
337.905.1079

Prepared By: Chris Wheat, PE
Project Engineer

Lonnie G. Harper & Associates, Inc.
CIVIL ENGINEERING AND LAND SURVEYING CONSULTANTS

Table of Contents

(BS-24) TERRACING AND MARSH CREATION PROJECT
SCOPE OF ADDITIONAL SERVICES

NEED FOR ADDITIONAL SERVICES

Due to the location of existing pipelines and site access restrictions, it has been determined by the NRCS and the USFWS that the construction of earthen terraces in the original terrace cells "1" and "2" may not be feasible. As a result, USFWS has requested that terraces be constructed in the open water area adjacent to "Cell 2", east of the existing pipelines and west of the proposed marsh creation area. This area (referred to "Cell 2B" herein) was not included in the original topographic/bathymetric survey; therefore no data exists in which to determine the terrace and borrow area cross-sections for the construction drawings. An additional magnetometer survey is also needed to insure no underground utilities are located within Cell 2B. Lonnie G. Harper & Associates, Inc (LGH) possesses the necessary equipment, knowledge, and expertise to collect all additional data required for this project and has included an estimated cost to perform these additional services.

In addition to the additional surveying services, it was discovered that no geotechnical soil borings were obtained from Cell 2B during the original geotechnical investigation. The design requirements of the BS-24 project requires that LGH design the terraces such that the projected finished grade elevation is approximately one foot above marsh elevation at year 20. This requires thorough knowledge of the soil strata in the project area, which can only be obtained by obtaining soil samples and performing settlement and consolidation testing. As a result, LGH has requested that GeoEngineers, Inc. prepare a scope of work and budget to obtain the additional soil samples and perform the necessary tests to determine the settlement potential of the native soils.

In addition to soil borings and testing, LGH has requested that GeoEngineers incorporate the following tasks to their proposal.

- Original settlement and consolidation calculations were based on an assumed average water elevation of 0.0 feet NAVD 88, Geoid 12A. CPRA is currently in the process of updating their water stage data from the area to Geoid 12A, and LGH is confident that the average water surface elevation will be above 0.0 feet. A higher average water surface elevation will reduce the settlement/consolidation potential of the soil mass, and LGH has requested that GeoEngineers provide means of estimating this reduction based on the new stage data once it is provided. (i.e. an increase of 0.4 feet will provide approximately 10% reduction in settlement)
- Due to site access restrictions, it is evident that all terrace construction will be performed using a barge mounted dragline. The existing pipelines will prevent barge access from the north and west; therefore LGH is proposing to access the sites from the east, through the newly constructed lake rim (BS-16). This will require the contractor to cut a flotation channel through the lake rim to gain access the terrace and marsh creation areas, and GeoEngineers is being asked to evaluate this process and make recommendations on the geometry of the floatation channel, limits of spoil placement, etc.

GeoEngineers proposal is attached hereto for reference.

DELIVERABLES

Surveying:

1. All data collected will be provided on a disc in comma delimited, ASCII format to the NRCS;
2. Contour map of Cell 2B with 0.5 feet contours;
3. Map showing all magnetic anomalies encountered;
4. Copy all field notes, and
5. A survey report describing all equipment, methods, and procedures used to complete the work.

Geotechnical:

Refer to the geotechnical proposal attached hereto.

SITE ACCESS AND PERMITS

LGH will contact the landowners and obtain the necessary permission to access the property in order to complete the said work. LGH does not foresee the need for any special permits to complete the surveying work; however, a coastal use/Corp permit may be required for the geotechnical investigation. It is our understanding that USFWS acquired the environmental permits for the original geotechnical investigation, and we assume they can provide any additional permits required for this work.

ESTIMATED COSTS AND COMPLETION TIME

Surveying

A. Topographic/Bathymetric Survey: **$69,645.00** (Estimate is based on 10 days in the field and includes collecting data using RTK surveying methodologies, probing of any existing pipelines, staking geotechnical boring locations, travel expenses and transportation on the site (airboats), consumables, etc.) Topographic/bathymetric survey plan lines follow the same offset and shot spacing as performed by the NRCS during the original data collection process.

B. Magnetometer Survey: **$14,440.00** (Estimate is based on 3 days in the field and includes all surveying equipment, transportation to and on the project site, etc.) 500 feet (maximum) grid spacing is being proposed for the plan lines for the mag survey of Cell 2B and the proposed access routes. Reference the attached survey plan map depicting the proposed magnetometer survey lines.

C. Data Processing and Office Time: **$8,632.00** (Estimate is based on the estimated office time required to process the data and prepare the deliverables.)

Total cost for surveying services: **$92,717.00** An itemized breakdown of all tasks is attached hereto for reference.

Survey Work Plan:

Once authorized by the NRCS, LGH will mobilize to the site and perform the magnetometer survey. Allow 3 days to complete this work. Magnetometer data will be processed in the office and all anomaly locations will be uploaded into a survey data collector. LGH will then re-mobilize to the site for the topographic data collection phase. All magnetic anomalies located during the previous survey will be identified and probed if needed during the data collection phase. Allow 10 days to complete the data

collection phase. Once complete, all data will be processed in the office and the deliverables prepared. Allow 5 business days to process and prepare the deliverables. LGH requests that approximately 45 calendar days from the Notice to Proceed be allowed to complete all surveying work and provide the final deliverables to the NRCS. 45 days allows for: field work and document preparation (30 days), NRCS review period (10 days), revisions and final deliverables (5 days). *Work schedule is subject to change based on site and weather conditions. Estimated completion time is based on "ideal" work conditions. Daily work reports will document work delays and weather conditions at the site.

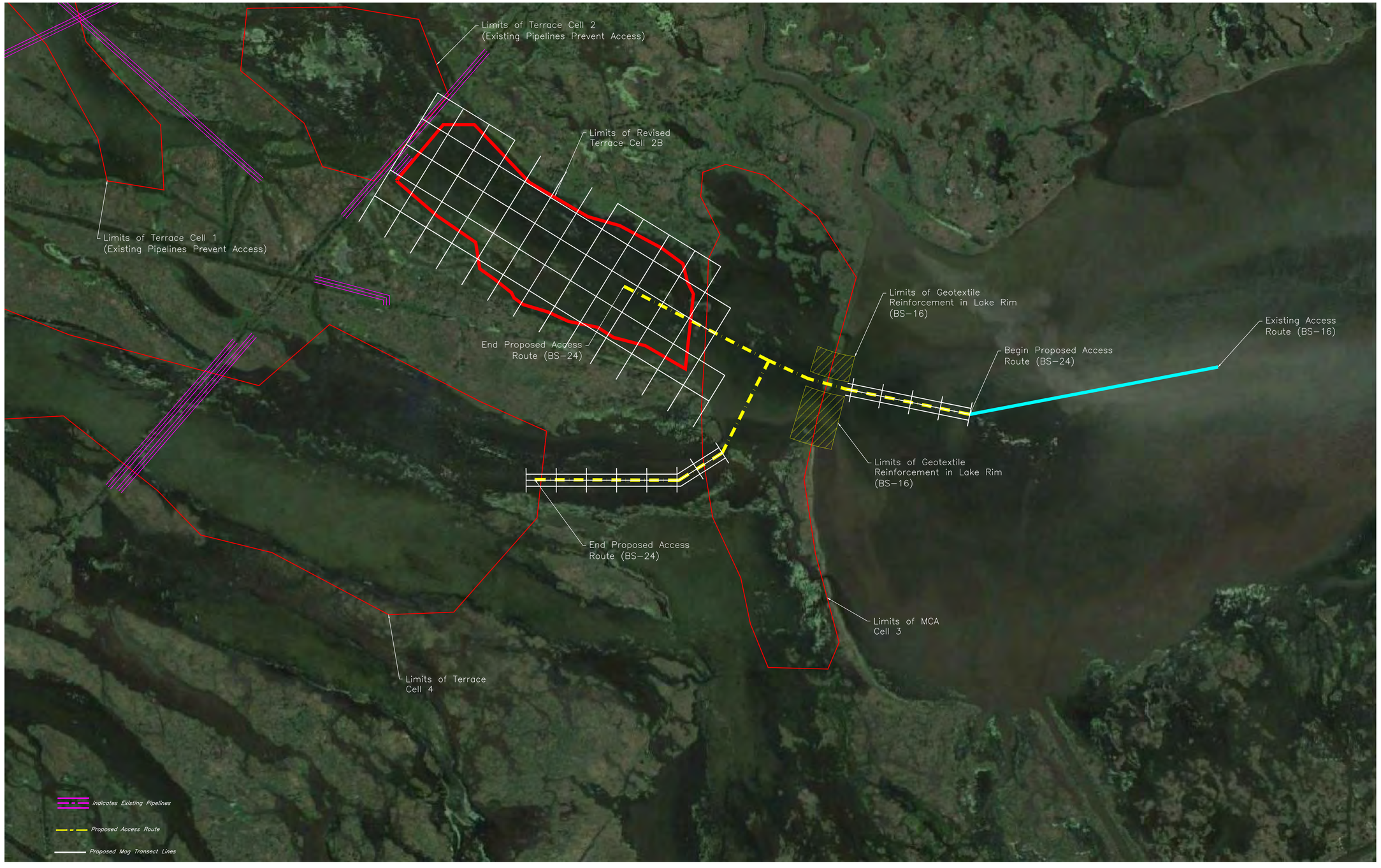
Geotechnical Investigation, Testing, and Reporting

GeoEngineers, Inc. has prepared a scope of services, which is included in Attachment C. The estimated cost of the said geotechnical services is $38,497. Please reference Attachment C for further explanation of the scope of work and associated costs.

Total estimated cost for the additional surveying and geotechnical services is $131,214.

Thank you for the opportunity to submit a proposal for the said work and we look forward to working with the NRCS on this project. Should anyone have any questions or concerns pertaining to the scope of work outlined herein, please do not hesitate to contact our office at your convenience.

ATTACHMENT A
Survey Plan Drawings



Date	
Designed	Chris Wheat 05/08/15
Drawn	Chris Wheat 05/08/15
Checked	Leonard Harper 05/08/15
Approved	Lonnie Harper 05/08/15

PROPOSED MAGNETOMETER SURVEY PLAN LINES
BS-24 TERRACING AND MARSH CREATION SOUTH OF BIG MAR

Page 01 of 01

Plaquemines Parish, Louisiana

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

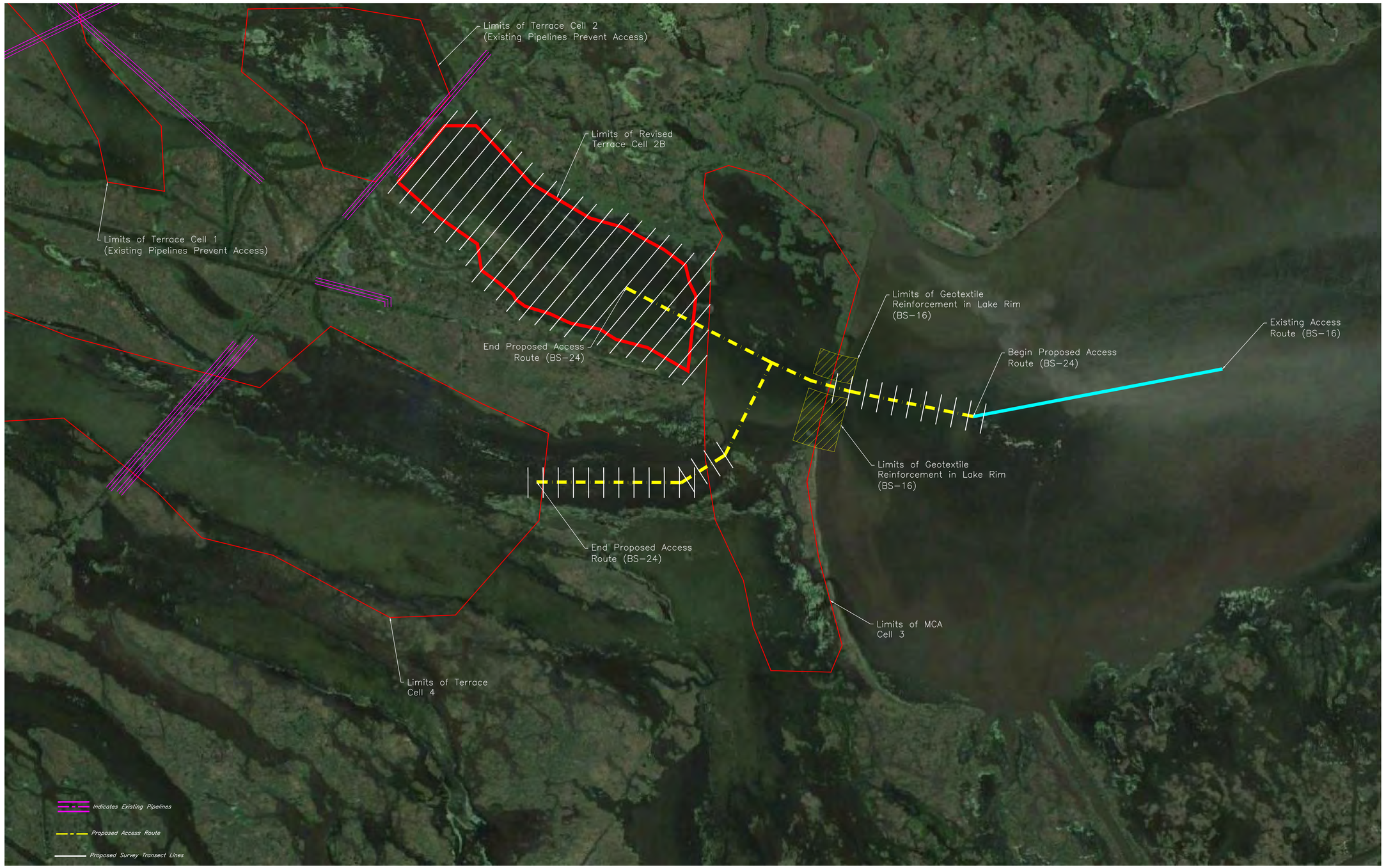
0 800' 1,600' 2,400'
Hor. Scale in Feet

Magnetometer survey transect lines are offset approximately 500 feet in each direction.

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
MAGPLAN.dwg
Drawing No.

5/8/15 11:37 AM
Sheet *01* of *01*



Date	
Designed	Chris Wheat 05/08/15
Drawn	Chris Wheat 05/08/15
Checked	Leonard Harper 05/08/15
Approved	Lonnie Harper 05/08/15

PROPOSED TOPOGRAPHIC/BATHYMETRIC SURVEY PLAN LINES
BS-24 TERRACING AND MARSH CREATION SOUTH OF BIG MAR

Page 01 of 01

Plaquemines Parish, Louisiana

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

0 800' 1,600' 2,400'
Hor. Scale in Feet

Survey transect lines are offset approximately 250 feet. Elevation shot spacing along each transect shall be approximately 30 feet or where significant elevation changes (±0.5 feet) occur.

NRCS Natural Resources Conservation Service, United States Department of Agriculture

File No.
TOPOPLAN.dwg
Drawing No.

5/8/15 11:34 AM
Sheet *01* of *01*

ATTACHMENT B
SURVEYING ESTIMATE

Schedule of Services BS-24 Terracing and Marsh Creation South of Big Mar January 2015 Scope of Services for Design Cost Proposal							
Surveying							
Item No.	Work			Quantity	Unit	Unit Price	Amount
1	**Topographic/Bathymetric Survey**			**1**	**LS**	**$69,645**	**$69,645**
	Personnel	Rate	Hours	Extended Price			
	PLS- Supervision	$176	20	$3,520			
	2-Two Man Survey Crew	$270	120	$32,400			
	2-Airboats	$2,400	10	$24,000			
	RTK Base & Rover	$520	10	$5,200			
	Add'l RTK Rover	$260	10	$2,600			
	Vehicle Mileage	$1.10	1750	$1,925			
			Subtotal	$69,645			
2	**Magnetometer Survey**			**1**	**LS**	**$14,440**	**$14,440**
	Personnel	Rate	Hours	Extended Price			
	PLS- Supervision	$176	10	$1,760			
	Two Man Survey Crew	$135	36	$4,860			
	Airboat	$1,200	3	$3,600			
	RTK Base & Rover	$520	3	$1,560			
	Magnetometer	$520	3	$1,560			
	Vehicle Mileage	$1.10	1,000	$1,100			
			Subtotal	$14,440			
3	**Data Processing & Deliverables**			**1**	**LS**	**$8,632**	**$8,632**
	Personnel	Rate	Hours	Extended Price			
	PLS	$176	16	$2,816			
	CAD Technician	$105	40	$4,200			
	Engineer III/Proj. Mngr	$140	10	$1,400			
	Admin/Clerical II	$54	4	$216			
			Subtotal	$8,632			
					Surveying Total		**$92,717**

ATTACHMENT C
GEOTECHNICAL INVESTIGATION PROPOSAL

GeoEngineers
11955 Lakeland Park Boulevard, Suite 100
Baton Rouge, Louisiana 70809
225.293.2460

August 19, 2015

Lonnie G. Harper & Associates, Inc.
2746 Hwy 384
Bell City, Louisiana 70630

Attention: Chris Wheat, PE

Subject: Proposal for Additional Geotechnical Services – Rev. 1
BS-24 Terracing and Marsh Creation South of Big Mar Project
Plaquemines Parish, Louisiana
File No. 10883-020-02

INTRODUCTION

As requested by Lonnie G. Harper & Associates (LGH), GeoEngineers, Inc. has prepared a cost estimate for geotechnical services in support of the BS-24 Terracing and Marsh Creation South of Big Mar in Plaquemines Parish, Louisiana. This project is approved for engineering and design by the NRCS, in cooperation with the Coastal Protection and Restoration Authority of Louisiana (CPRA). The funding for this project is through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) on Project Priority List 22. This revision was completed at the August 18, 2015 LGH request to bring our fee estimate into agreement with our cost estimate spreadsheet adjusted for 2015 per diem rates and removal of fiber content testing and sample shipping.

PROJECT UNDERSTANDING

BS-24 Terracing and Marsh Creation South of Big Mar Project is located in Plaquemines Parish, Louisiana. In general, it is west of Lake Lery, as shown on Figure 1. The approximate center of the project area is N 29° 47' 46.11", W 89° 54' 01.39".

GeoEngineers understands that the primary goal of this project is to create terraces in shallow open water areas within the Caernarvon Diversion outfall area. The terraces will reduce wave fetch in open water areas and promote conditions conducive to growth of marsh vegetation and submerged aquatic vegetation. Approximately 334 acres of marsh creation is also proposed to re-establish the western shoreline of Lake Lery in association with the Lake Lery Shoreline Restoration and Marsh Creation project (BS-16).

The terrace component of the project will most likely be constructed with marsh buggy long reach excavators. The marsh creation area will be designed as a traditional marsh creation area utilizing earthen dikes to contain fill material hydraulically dredged and pumped from a borrow area in Lake Lery.

GeoEngineers completed a geotechnical investigation and engineering evaluations for the BS-24 project in 2014. However, as project planning has advanced, LGH and NRCS realized that construction access to Terrace Cells 1 and 2, as they were originally planned, is blocked by a pipeline that cuts through the project area. As a result of LGH and NRCS working to find a way to avoid losing the benefit of terracing in Terrace Cells 1 and 2, Terrace Cell 2 was moved closer to Lake Lery. The new Terrace Cell 2 location does not include any existing geotechnical explorations, so LGH has asked that GeoEngineers provide a scope and cost estimate to collect geotechnical design information.

SCOPE OF SERVICES

GeoEngineers will perform the following services in support of the BS-24 Terracing and Marsh Creation South of Big Mar Project:

1. Coordinate access to the site with LGH at least one week prior to accessing the site. Additionally, we will notify LGH and NRCS at least 48 hours before we access the site for our field exploration.

2. Sign access agreements with the land owner and provide appropriate certificates of insurance prior to beginning field work.

3. Notify Louisiana One Call of our intent to drill soil borings in the project area to clear boring locations of potential subsurface utilities.

4. Drill and sample a total of 2 soil borings to a depth of 30 feet each within the revised Terrace Cell 2 limits.

   Two field vane tests will be conducted at each soil boring location.

   Due to access restrictions from the landowners, an airboat-mounted drill rig will be used to drill all soil borings for the project.

   Cohesive and semi-cohesive samples will be collected using 3-inch diameter steel Shelby tubes. Cohesionless samples will be collected using the standard penetration test (SPT) method. Sampling will occur continuously (i.e., at 2-foot intervals) in the top 20 feet of the borings and then on 5-foot centers to the completion depth of the boring. Shelby tube samples will be examined at the end of the tube and classified by our representative in the field, sealed with caps and tape, labeled, and stored upright for transport to a laboratory. Split-spoon samples from the SPT test will be classified, placed in plastic bags for moisture preservation, and labeled in preparation for transport to a laboratory. On completion of sampling, soil borings will be backfilled with cement-bentonite grout in accordance with Louisiana requirements.

   GeoEngineers will record sample descriptions on a hand-written exploration log, along with borehole identification, water depth, borehole ground surface or mudline elevation (provided by LGH), and geodetic coordinates. GeoEngineers will be on the alert for cultural resource deposits as requested for our previous exploration activities.

5. After transport to the soils laboratory, samples will be tested for shear strength using a table-mounted miniature vane shear device and all samples will be extruded and preserved for further testing. Any cultural resource deposits discovered during sample extrusion shall be documented, preserved, and labeled as requested for our previous exploration activities.

   Selected soil samples will be used to conduct a laboratory testing program that may include testing as described below:

   - Unconfined compression and unconsolidated-undrained triaxial compression testing;
   - Moisture content testing;
   - Atterberg limit determination;
   - Grain size distribution testing, including mechanical sieve testing and wet sieve testing (where sand is present);
   - Incremental consolidation with rebound testing;
   - Specific gravity testing; and
   - Organic content testing (where organic materials are present).

   We will provide a copy of the field logs and a list of proposed samples to receive consolidation testing to LGH/NRCS prior to consolidation testing. All material classifications will be reported using the Unified Soil Classification System (USCS).

6. Use field exploration observations and laboratory testing results along with LGH-supplied survey data to develop and provide engineering recommendations for project design and construction. Engineering and construction recommendations will be provided for the following project features:

   a. Earthen Terraces, including

      i. Stability of terraces with a 15-foot top width and a lower borrow area excavation limit of elevation -10 feet (EL -10 FT) adjacent to the terraces;

      ii. Acceptable side slopes. If stable side slopes are steeper than 5H:1V, a 5H:1V slope will also be analyzed;

      iii. Evaluate constructed terrace top elevations of +2 feet, +3 feet, +4 feet and +5 feet. Note that after determining a stable elevation, GeoEngineers has not included budget to run lower elevations, since they will be more stable;

      iv. Settlement analyses performed for stable slopes determined in the slope stability analyses. Initial settlement at construction and settlement at 6 months, 1, 5, 10 and 20 years after construction will be estimated;

      v. Bearing capacity analyses completed for all elevations and stable terrace configurations determined from the slope stability and settlement analyses. Note that once a stable bearing capacity has been determined at some elevation, GeoEngineers has not included budget to run bearing capacity for lower elevation terraces;

      vi. Cut to fill ratio; and

      vii. Construction maintenance recommendations;

7. Submit a list of equipment used and names of personnel involved in drilling activities and a package including all field soil boring logs and notes (including pictures);

8. Present a preliminary geotechnical investigation report that includes a minimum of the following:

    a. Site vicinity and updated boring location maps;
    b. Project narrative;
    c. Description of sampling methods;
    d. Description of site and subsurface conditions;
    e. Borehole logs including mudline elevations and water depths;
    f. Drilling, sampling, and laboratory testing descriptions;
    g. Field vane test results;
    h. Consolidation test results;
    i. Laboratory test results;
    j. Graphical boring profiles;
    k. Grain size distributions (sieve analysis results);
    l. Bearing capacity analyses;
    m. Dike sliding calculations;
    n. Slope stability analyses;
    o. Foundation analyses;
    p. Settlement analyses, including tables and graphs;
    q. Construction recommendations;
    r. Calculations completed for all elements of sampling, testing and analyses;
    s. A list of collected material with potential cultural significance (if applicable);
    t. A discussion of results; and
    u. Any other information necessary to convey the testing and analysis requirements for the project.

9. Present a final geotechnical report that addresses comments from a multi-agency review of the preliminary report. The preliminary report will be submitted electronically for review. Final reports will be printed on loose-leaf paper, punched with a large-hole three-ring (3-ring) punch, and assembled in 3-ring binders. Bound reports will be clearly labeled on the spine of each binder. A minimum of 6 bound copies of the final report will be submitted to LGH for distribution to the NRCS.

10. Submit an electronic copy of the report in compact disc (CD) format along with the bound report copies. Borehole logs in .dxf format will be included on the CD.

There are a few qualifications and assumptions associated with this proposal. These include:

- We have assumed the land owner access agreement we will be required to sign will not contain unreasonable terms, and we will be able to reach a timely agreement with the owner.

- The U.S. Fish and Wildlife Service (USFWS) secured Coastal Zone Consistency determination number C20130221 and U.S. Army Corps of Engineers authorization number MVN 2013-2682 EOO under Category II of the Programmatic General Permit prior to initial geotechnical exploration for the BS-24 project. For the additional geotechnical exploration proposed in this document, we have assumed the USFWS will secure any required permit modifications or extensions at no additional cost or delay to GeoEngineers. GeoEngineers can arrange for permitting, at additional cost.
- We assume the soil borings will be staked by others and a magnetometer survey will be performed at each location to clear a radius of at least 25 feet.
- The mudline elevation and staked soil boring location coordinates will be provided to GeoEngineers by LGH prior to performing our analyses.
- We will not encounter contamination in the soil or water at the site.
- We will be allowed to spread soil cuttings at the site.

SCHEDULE

We expect to be able to mobilize within 2 weeks of surveying being completed, and/or permits received. Field investigation is only expected to require one day. Laboratory testing is expected to take 2 weeks, and engineering/reporting, 3 weeks from completion of laboratory testing. From mobilization to draft report issue we expect approximately 7 weeks.

TERMS AND FEE ESTIMATE

Our services will be completed in accordance with our existing agreement with LGH for NRCS projects.

The estimated fee for our services will be a lump sum of $38,497 as detailed below.

Item	Estimated Cost
Project Coordination	$ 1,860
Field Investigation	$ 14,357
Laboratory Testing	$ 6,255
Engineering	$ 8,554
Reporting, including preliminary report, review meeting, and final report.	$ 7,471
Estimated Lump Sum Total	**$ 38,497**

There are no intended third party beneficiaries arising from the services described in this proposal and no party other than the party executing this proposal shall have the right to legally rely on the product of our services without prior written permission of GeoEngineers.

This proposal is valid for a period of 60 days commencing from the first date listed above and subject to renegotiation by GeoEngineers, Inc., after the expiration date.

GeoEngineers appreciates the opportunity to be of continued service to Lonnie G. Harper & Associates and the NRCS. If you have any questions concerning this proposal, please contact us at 225.293.2460.

Sincerely,
GeoEngineers, Inc.

Joshua M. Pruett, PE
Geotechnical Engineer

David S. Eley, PE
Principal

JMP:DSE:lb